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The effect of the carbohydrate intake on the glycaemic control of people with insulin dependent diabetes mellitus

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THE EFFECT OF THE CARBOHYDRATE INTAKE ON THE GLYCAEMIC CONTROL OF PEOPLE WITH INSULIN DEPENDENT DIABETES MELLITUS.

A thesis submitted in partial fulfilment of the requirements for the award of the degree of

MASTER OF SCIENCE (NUTRITION AND DIETETICS).

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BY KATHY HODSON.

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1. INTRODUCTION

"Of any nutrient in the nutritional management of diabetes, carbohydrate evokes the most debate. It is the nutrient that has played a role in the management of diabetes, possibly from the time that diabetes was first described and certainly from the turn of the century". (Frost. 1995. (p160).

The effect of a high carbohydrate diet on the diabetes control in people with Insulin Dependent Diabetes Mellitus (IDDM) has been a major area of research for many years. Studies such as that conducted by the Diabetes Control and Complications Trial (DCCT) have identified that the main goal of IDDM management is glycaemic control. Carbohydrates are found to play an important role in influencing the glycaemic control. (DCCT research group. 1993).

1.1 AIM

The aim of the project is to determine the importance of the currently recommended high complex carbohydrate, high dietary fibre dietary regime, by the American Diabetes Association, in the control of Insulin Dependent Diabetes Mellitus.

For instance, are there some people with IDDM who consume the recommended high complex carbohydrate, high dietary fibre and low simple carbohydrate diet who nevertheless find great difficulty in managing their diabetes control, while other people with IDDM consume a low complex carbohydrate and low fibre diet and manage to maintain diabetes control?

Does the carbohydrate intake have an effect on the glycaemic control of the people with IDDM?
1.2 OBJECTIVES

1.2.1. To assess the intake of carbohydrate of people with IDDM and compare these to the nutritional recommendations for carbohydrate intake (fifty to sixty percent of total energy from carbohydrate) as outlined by the American Diabetes Association.

1.2.2. To assess the simple carbohydrate intake of people with IDDM and compare these with the nutritional recommendations for simple carbohydrate (less than ten percent of total energy and/or less than thirty percent total carbohydrate intake) as outlined by the American Diabetes Association.

1.2.3. To assess the dietary fibre intake of people with IDDM and compare these with the nutritional recommendations for the dietary fibre content (twenty five to thirty five grams per day) as outlined by the American Diabetes Association.

1.2.4. To determine the HbA1c as a measure of glycaemic control.

1.2.5. To investigate the relationship between the carbohydrate intake with the people with insulin dependent diabetes control.

1.2.6. To determine if people with IDDM adjust their meal patterns and/or insulin routine when they exercise.
2. LITERATURE REVIEW

2.1. INSULIN DEPENDENT DIABETES MELLITUS.

Diabetes Mellitus is a disease affecting the endocrine system with the pancreas's secretion of insulin reduced and / or absent due to the inactivation of the beta cells of the islets of Langerhans. (Guyton. 1989).

Two major categories exist in diabetes mellitus. These are;
* Insulin dependent diabetes mellitus (IDDM).
* Non insulin dependent diabetes mellitus (NIDDM).

NIDDM accounts for ninety percent of all the diabetes diseases cases. NIDDM patients are usually middle to elderly aged at the onset of the disease. The ability to produce insulin in people with NIDDM is delayed or reduced however, is NOT absent. It is believed to be associated with the reduced sensitivity of the cell receptors to the insulin. This is known as insulin resistance. The ability to transport glucose across the cell membrane is hence, delayed even though insulin is available. (Brown. 1990).

Only ten percent of all diabetes mellitus cases are due to insulin deficiency. IDDM patients are typically less than thirty years of age prior to diagnosis. They usually have a reduction or absence in insulin production and are prone to the development of ketosis.
(Brown. 1990).

IDDM was, in the past, believed to be caused by a viral infection. Currently it is accepted to be a disease associated with the autoimmune destruction of the pancreatic
beta cells. The disease usually exists in the "preclinical phase" for some years. As the diabetes becomes more severe, with the majority of the beta cells destroyed, causing lack of insulin production, the classic symptoms of hyperglycaemia and ketosis become evident. (Atkinson et al. 1994 (p1428).

Due to the insufficient insulin production by the pancreas, people with IDDM must be provided with insulin daily. The two methods of insulin administration currently utilised in Australia are via the insulin injection and the insulin pump. (D.A.A. 1990).

The patient's blood glucose concentration must be monitored throughout the day. This enables people with IDDM to determine their diabetes control. Great variations exist in people with IDDMs ability to control their diabetes. Some patients are able to control their blood glucose levels within the recommended range (4 - 8mmol/L), by daily insulin injections and adherence to a prescribed diet. This is not the case for all people with IDDM. Other people with IDDM have great difficulty controlling their diabetes with dangerous blood glucose variations. This may cause complications associated with diabetes in the future such as; retinopathy, nephropathy, neuropathy and cardiovascular complications. (Sherman et al. 1990).

The incidence of IDDM are greatest in the zero to fifteen years age group. (Karvonen et al. 1993). Only twenty to fifty percent of IDDM patients are however, identified by the age of fifteen. IDDM usually develops up until the age of thirty. It may however, occur at any age. (Karvonen et al. 1993).

Wide variations exist across continents in the incidence and prevalence of IDDM in the world. A significant difference exists in the incidence of IDDM between the northern and southern hemispheres. Below the equator, the incidence of IDDM are < 15.0 / 100, 000. Within the northern hemisphere alone there are variations in the incidence of IDDM. The greatest incidence of childhood IDDM worldwide is found in
Finland, with 35.0 /100,000. The rates of incidence of IDDM in Australia are similar to those found in other Anglo- Saxon populations in the world. For example Australia (Western) 13.2 /100 000 (1985-1989); United Kingdom 13.5 /100 000 (1988); New Zealand (Canterbury) 11.6 /100 000 (1981-1986). (Karvonen et al. 1993).

In Australia the prevalence of IDDM varies within regions. In the five to nine years age group the incidence of IDDM in N.S.W. and Western Australia were found to be similar. For the ten to fourteen years age group the incidence were similar in both N.S.W. and Western Australia. The prevalence, however in N.S.W. was thirty percent less than in Western Australia. (Glatthaar et al. 1988).

Studies in Australia have identified that the incidence of IDDM has increased in recent years. (Moses et al. 1986; Glatthaar et al. 1988; Sutton et al. 1989). For example, Sutton et al. (1989), found an increase in the zero to nineteen years age group to rise from 10.3 / 100,000 in 1984 to 14.8 / 100,000 in 1987. Similar findings have been found in the U.S.A. and Europe. (Karvonen et al. 1993).

2.2. DIETARY ADVISE FOR IDDM MANAGEMENT.

The overall primary goal of dietary management of IDDM includes: attaining and maintaining euglycaemia with minimal episodes of hyperglycaemia and / or hypoglycaemia, with the desired outcome to reduce the incidence of the long term microvascular, neurologic and macrovascular complications. (Garnett et al.1995).

There are however, additional nutritional management goals for IDDM. These are as follows:
* Attain and maintain as near possible euglycaemia and minimising the episodes of hyperglycaemia and/or hypoglycaemia. This may be achieved by compliance with the prescribed regime for diabetes.

* Accomplishment of optimal serum lipid levels thus, minimising the possibility of occurrence of cardiovascular disease.

* Consumption of adequate kilojoules for attaining and maintaining normal body weight in adults and normal growth in children. In addition, providing adequate nutrition for pregnant and lactating women.

* Prevention and treatment of both short term, such as hypoglycaemia, hyperglycaemia, diabetes related illnesses, sick days, exercise related illnesses and long term, such as microvascular, macrovascular, neurologic complications associated with diabetes.

* The progression of the overall health status of the IDDM person.

* The identification of an appropriate dietary regime compatible with the patient's current lifestyle. This is based on information obtained via a thorough diet history, daily blood glucose monitoring and the patient's insulin therapy. (Diab. Care. 1994a).

These nutritional management aims may be achieved by adherence to the recommended dietary guidelines outlined by the American Diabetes Association. (Coulston 1994b).
2.3. NUTRITIONAL MANAGEMENT RECOMMENDATIONS
FOR IDDM.

Dietary advice for the nutritional management for people with diabetes has been encouraged since the diagnosis of the disease. There has, over the years, been some disagreement relating to what constitutes the most beneficial dietary regime for people with IDDM. There has been wide variation in the dietary advice prescribed to people with IDDM. In particular, this has been with respect to the proportion of kilojoules which should be obtained from carbohydrates. (Abraira et al. 1980).

Prior to the discovery of insulin, the diabetes dietary regimes were aimed at decreasing the carbohydrate content in the diet. The prescribed diets were high in fat and protein and low in carbohydrate. The major dietary advise being avoiding simple carbohydrates. It was hypothesised that carbohydrate foods had a damaging effect on the blood glucose metabolism. For this reason it was believed that carbohydrates should be consumed in small amounts. Simple carbohydrates were thought to have the greatest effect on the blood glucose concentration as they would cause faster rises in the blood glucose concentration.
(Coulston. 1994b).

These extreme carbohydrate restrictions no longer exist due to the availability of insulin and the growing research on carbohydrate intake recommended for diabetes. It was not however, until the 1930's that the trend towards high complex carbohydrate diets began. From the 1930's onwards, research on the percentage of energy from carbohydrate has continued. With more investigations, new conclusions are drawn. These results have demonstrated a vast increase in the percentage of energy from carbohydrate in the nutritional management of diabetes. (Coulston. 1994b).
See Table 1 for the Historical Perspective of the carbohydrate recommendations for diabetes.

**TABLE 1- THE HISTORICAL PERSPECTIVE OF THE CARBOHYDRATE RECOMMENDATIONS FOR DIABETES.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage of Carbohydrate</th>
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<tbody>
<tr>
<td>1921</td>
<td>20%</td>
</tr>
<tr>
<td>1950</td>
<td>40%</td>
</tr>
<tr>
<td>1971</td>
<td>45%</td>
</tr>
<tr>
<td>1986</td>
<td>up to 60%</td>
</tr>
<tr>
<td>1994</td>
<td>60%</td>
</tr>
</tbody>
</table>

(Coulston. 1994b;10).

The current "Nutritional Recommendations for People with Diabetes" which have been published by the American Diabetes Association suggest the IDDM patients should proceed with a high complex carbohydrate, high fibre, low fat diet.

The recommendations are as follows:

* The percentage of energy from complex carbohydrate should be individually based depending on the patients blood glucose concentrations, lipid levels, exercise and eating habits. The general recommendation is fifty to sixty percent of total energy should be provided from carbohydrate. (Coulston. 1994a).

* The same recommendations for dietary fibre apply to IDDM persons as do to the general population. There is currently no scientific evidence to suggest that people with IDDM require more or less fibre than their non-diabetic counterparts. The recommendation for dietary fibre is twenty five to thirty five grams dietary fibre per day. (Coulston. 1994a).
It has been suggested by the American Diabetes Association that up to ten percent of total energy and/or less than thirty percent of the carbohydrate content may be in the form of simple carbohydrate. This quantity has not been found to impair the blood glucose control or the plasma triglyceride and cholesterol concentrations in IDDM patients. The amount of simple carbohydrate consumed however, should be influenced by the patient's metabolic control and body weight. (Coulston. 1994a).

The recommended percentage of energy from fat is dependent on the blood glucose concentrations, lipid levels and body weight. The total fat intake should be restricted to less than thirty percent of total energy. Less than ten percent from saturated fat and less than three hundred milligrams per day from dietary cholesterol. (Coulston. 1994a).

There is insufficient scientific evidence to suggest that IDDM patients should consume more or less protein than the rest of the population. Approximately ten to fifteen percent of total energy should be from protein. (Coulston. 1994a).

The Dietitians Association of Australia are currently using similar dietary recommendations as those outlined by the American Diabetes Association for people with IDDM. (D.A.A. 1990). These dietary recommendations were also used in many dietary studies on IDDM such as, the DCCT. (DCCT research group. 1993).

2.4 SUBJECTS ADHERENCE TO DIETARY REGIMES.

The patient's adherence to dietary regimes are believed to play an important role in the control of IDDM. Adherence to meal plans for diabetes requires some readjustment to the patient's lifestyle. This may require modifying previous meal patterns and/or implementing new food habits and/or adjustments to previous exercise regimes. This
requires motivation. Dietary adherence is believed to be one of the most difficult components of the diabetes regime. (Eckerling et al. 1984).

Pate et al. (1986), identified predictors of compliance of IDDM patients with a low fat diet. The predictors of compliance identified were; duration of the disease, severity of the disease and illnesses influenced by the disease. Similar predictors were identified by Kouris et al. (1988). They found that IDDM subjects who did not adhere to the dietary regimes did not feel that nutrition was of great importance in their diabetes management. They were not generally concerned about reaching their ideal body weight, they did not perceive diabetes as a threat to their health, did not adhere to other aspects of diabetes management, felt that their nutritional status was adequate and believed that food likes and dislikes were the most important factors in influencing dietary changes.

How important is adherence to a prescribed diet in the management of diabetes?
Numerous studies investigating the importance of compliance to dietary regimes in the control of IDDM, suggest that patients who adhere to diabetes regimes exhibit better control of their diabetes. (McCulloch et al, 1983; Ney et al, 1983; Kouris et al, 1988; Schmidt et al, 1994).

According to the DCCT study the better the diabetes control the fewer the long term complications associated with IDDM. (Schmidt et al. 1994). It was found in the DCCT study that the intensively treated patients who adhered to their prescribed meal plan ninety percent of the time had an average HbA1c lower than those who followed their diet forty five percent of the time. The HbA1c was used to measure the long term diabetes control. The study identified that, on average, those subjects with a lower HbA1c had been identified as being more compliant with the prescribed meal plan (fifty to sixty percent carbohydrate, thirty percent fat and ten to fifteen percent protein). They were also noted to have had similar dietary behaviours which assisted them in
achieving this glycaemic control. These behaviours were: dietary adherence to a high complex carbohydrate diet, avoiding additional snack foods throughout the day and not overtreating hypoglycaemia. (Delahanty et al. 1993).

Subject compliance to diabetic dietary regimes has been shown to be an important factor in the blood glucose control and hence, overall diabetes management. The results from the studies examining the patient adherence to dietary regimes have identified however, that patient adherence although advisable, is difficult. This questions the long term IDDM patients adherence with the recommended diabetes dietary regime.

2.5 CARBOHYDRATE RECOMMENDATIONS FOR PEOPLE WITH IDDM.

2.5.1 Carbohydrates
Carbohydrates are the leading source of energy in the diet. Carbohydrates constitute a diverse group, from simple carbohydrates to complex carbohydrates and including dietary fibre.

Complex carbohydrates are also known as polysaccharides and/or starches. They are described as carbohydrate polymers having twenty or more monosaccharide residues. Simple carbohydrates are also known as - mono-, di-, tri- and tetra- saccharides and/or sugars. They are described as having up to nineteen monosaccharide residues. (Brit. Nutr. Found. 1990).

As previously mentioned, complex carbohydrates have been recommended as an important constituent in the nutritional management of IDDM. This is thought to be due to the fact that carbohydrates have a far greater effect on the insulin requirements in diabetes than do lipids and proteins. It has been found in studies such as, that
conducted by Anderson et al. (1979), to be due to the influence carbohydrates have on the postprandial glucose values. It was found that complex carbohydrates in the diet have been shown to reduce fasting glucose concentrations and also reduce insulin and/or oral hypoglycaemic requirements in people with IDDM. On studies such as, that conducted by Anderson et al. (1979), the current recommendations for a high carbohydrate diet have been structured.

Many of these studies such as, that conducted by Anderson et al. (1979), have obtained their results with the use of very high carbohydrate intakes (seventy percent of total energy). Such promising results have not been obtained by diets consisting of forty five percent carbohydrate of total energy, which closer resembles the traditional diets of people with IDDM.

There has been much controversy in the past regarding the effect of simple carbohydrate on the diet of people with IDDM. It had been suggested, for most of this century, that sugars should be avoided in the diet for diabetes. It was assumed that sugars are digested and absorbed faster than complex carbohydrates and therefore would cause hyperglycaemia. This assumption has since been disproven. (Franz et al. 1994).

Franz et al. (1994), have identified five studies which determine that single meals containing twelve to twenty five percent of the total energy as sucrose, found no adverse effects on the overall glycaemic control. These studies have identified that sucrose, sucrose containing foods and other simple carbohydrates such as fructose, may be included in the meal plan.

Ten percent of total energy in the form of simple carbohydrate is the amount which may be added to the diet for people with diabetes, as recommended by the American Diabetes Association. The simple carbohydrate must be substituted for another
Although the American Diabetes Association recommends that less than ten percent of total energy may come from the simple carbohydrate source, there is no scientific evidence to indicate that all people with IDDM may only consume this quantity. In light of the Glycaemic Index theory (shall be discussed in section 2.7), the Glycaemic Index of sucrose is less than some currently recommended high complex carbohydrate foods. When the simple carbohydrate foods are incorporated into the meal plan they have no detrimental effect on the diabetes control. The amount of simple carbohydrate consumed as part of the meal plan should however, be individually based, depending upon the person with IDDMs glycaemic control, lipid values and weight control.

Fructose is a monosaccharide which provides a smaller rise in the plasma glucose concentration than other carbohydrates such as, sucrose. Fructose is often used as an alternative sweetening agent in diabetes. Other sweeteners such as corn syrup, fruit juice, honey, molasses, dextrose produce similar effects on the plasma glucose concentration as sucrose. They therefore, have no desirable advantages or disadvantages to sucrose in the diabetic diet. Like other sugars they must be substituted for a carbohydrate food in the diet. (Franz et al. 1994).

2.5.2 Dietary Fibre.
Dietary fibre is a non digestible polysaccharide component of the plant. Dietary fibre is categorised by it's solubility in water. The two categories are:
1. soluble dietary fibre
2. insoluble dietary fibre.
The sum of the soluble and insoluble fibre constitutes the make up of the dietary fibre. (Nuttal. 1993).
Insoluble fibre consists of cellulose, lignin and hemicellulose. It increases the faecal bulk as it is poorly metabolised. Insoluble fibre is a beneficial factor in the treatment of constipation, diverticular disease and in the prevention of colon cancer. (Franz et al. 1994).

The soluble fibre consists of gums, pectins and mucilages. It is fermented in the colon and has limited contribution to faecal bulk. Soluble fibre prolongs the gastric emptying and intestinal transit time. Diets high in soluble fibre have been found to decrease blood cholesterol and triglycerides. (Franz et al. 1994).

It is the soluble fibre component that is believed to have an influential effect on the plasma glucose concentration in IDDM. This is achieved by reducing the fasting blood glucose concentration, insulin requirements and urinary glucose excretion and hence, improvement in the glycaemic control. Numerous studies have shown that soluble fibre may decrease the postprandial rises in plasma glucose and insulin levels in proportion to the viscosity of the fibre. (Jenkins et al. 1976; Jenkins et al. 1977; Hockaday. 1990).

These studies produced a significant reduction in the postprandial glucose level and a reduction in the glucose excretion in the urine. The effect however, was only evident in the presence of particular types of soluble fibre, such as guar gum. (Jenkins et al. 1976; Jenkins et al. 1977). Nuttal’s (1993), review of the studies conducted on the effect of dietary fibre on the diabetes control has not found these results with less viscous dietary fibres such as pectin. Since these results have only been identified in the presence of more viscous fibres, such as guar gum, it is not possible to conclude, from these studies, that all soluble fibres have a positive effect on the people with IDDM diabetes control.
In addition, as mentioned by Coulston (1994a), the majority of these studies that have found that soluble fibre reduces the postprandial plasma glucose concentration, use a dietary fibre content that is five to seven times the usual recommended quantity. Long term compliance of people with IDDM, to such a dietary regime is hence questionable.

2.5.3 High Complex Carbohydrate, High Dietary Fibre Diets for IDDM.
As previously mentioned, the high complex carbohydrate theory has been advocated since the 1930's, with the percentage of energy from carbohydrate increasing, over the years, to the current recommendation of fifty to sixty percent of the total energy. (Brit. Nutr. Found. 1990). During this time numerous studies have been conducted to determine if it is the complex carbohydrate component and/or the dietary fibre which produces the beneficial effects on the blood glucose concentration. Studies have identified that a high complex carbohydrate diet (from fifty percent carbohydrate of total energy) alone are not effective in treating diabetes. For example a study conducted by Anderson et al. (1979), have found that a high carbohydrate diet alone does not offer any benefits for diabetes management. A high carbohydrate diet increased the plasma insulin and triglyceride levels.

Similarly, Shimakawa et al. (1993), did not find any association between the percentage of energy from carbohydrate and the glycaemic control as measured by the HbA1c level. The average carbohydrate content which had a HbA1c value of less than ten percent, in the subjects diet was 43.3% for men and 43.4% for women. At HbA1c of less than ten percent, the average dietary fibre content of the diet for men was 20.9g and for women was 20.1g. Both the carbohydrate intake and the fibre contents were below the recommended levels. The researchers suggested that if the fibre content were increased then this may have shown a greater association between the total carbohydrate content and the glycaemic control.
Diets containing dietary fibre in addition to a high carbohydrate diet have been associated with beneficial effects of IDDM by improvements in the subjects glycaemic control. (Brunzell et al. 1971; Jenkins et al. 1976; Kiehm et al. 1976; Anderson et al. 1979; Simpson et al. 1979; Jenkins et al. 1980; Rivellese et al. 1980; Simpson et al. 1981; Anderson et al. 1991; Riccardi et al. 1991).

Usually the diets that are high in fibre are also high in complex carbohydrate. This is due to the fact that high fibre foods are predominantly also high in complex carbohydrate. The combination of high complex carbohydrate and high soluble fibre has been demonstrated in many studies to reduce the plasma glucose concentration and reduce the insulin doses. Studies conducted by Brunzell et al. (1971); Anderson et al. (1979); Anderson et al. (1991), observed that a high complex carbohydrate diet (seventy to eighty percent carbohydrate of total energy) combined with high fibre (sixty five grams per day) played an influential role in lowering the plasma glucose concentration and insulin doses in comparison to the control diet (forty five percent carbohydrate of total energy).

Similarly studies such as that conducted by Simpson et al. (1981), have discovered that a diet high in complex carbohydrate (sixty percent carbohydrate of total energy) and high in fibre (96.6 grams per day) produced superior overall diabetes control in people with IDDM. Those on the high carbohydrate diet on average had; lower basal, preprandial, postprandial blood glucose levels (p < 0.05), glucosuria was lower (p > 0.05), total cholesterol concentration was lower (p < 0.05) and their low density lipoprotein values were lower (p < 0.05).

However, the majority of these studies, such as those conducted by Brunzell et al. (1971); Kiehm et al. (1976); Anderson et al. (1979); Anderson et al. (1991), have been carried out in metabolic wards under very strict conditions. The conditions under which these studies were carried out do not represent a normal free living environment.
They also have all used very high quantities of dietary fibre (sixty five to ninety five grams per day) and usually high complex carbohydrate (greater than sixty percent of total energy). Therefore the encouraging results. In addition, the diets are very high in both complex carbohydrate and dietary fibre and may be unpalatable. Compliance by IDDM subjects to such a diet and the ability of free living IDDM persons to achieve such promising results are questionable.

The study conducted by Simpson et al. (1981), was not conducted in a metabolic ward but in the patient's own homes. The study was the first long term study that did not use guar gum as the source of soluble dietary fibre in the diet. A viscous leguminous fibre was used in the study. This was selected as it more closely represents the usual fibre in the diet. The results from this study indicate that the high carbohydrate, high leguminous fibre diet illustrated an improvement in the diabetes control. The improvement was not as grand as that found in previous studies using guar gum. This study, unfortunately used a dietary fibre content, five times greater than the recommendations. Therefore, no strong conclusions may be drawn from this study. With this quantity of leguminous fibre, the people with diabetes long term adherence to the diet is unlikely.

However, do the currently recommended guidelines for complex carbohydrate (fifty to sixty percent of total energy) and dietary fibre (greater than twenty five grams per day) produce beneficial results in diabetes control?

A review of the literature by the British Nutrition Foundation. (1990), have found that using more realistic amounts of complex carbohydrate (forty five to fifty five percent of total energy) and dietary fibre (thirty five to forty five grams of fibre per day) have demonstrated minor improvements in the mean blood glucose concentration and the twenty four hour blood glucose profiles.
Although studies have demonstrated that a diet high in complex carbohydrates and high in dietary fibre have a positive effect on the blood glucose concentration and hence, the glycaemic control, there are conflicting results regarding the effect that this dietary prescription has on the alterations in insulin therapy. Studies such as those conducted by Kiehm et al. (1976), found that with a diet consisting of seventy five percent of total energy as carbohydrate, resulted in the withdrawal of insulin therapy or sulphonylureas in nine from ten subjects who were receiving less than thirty units of insulin daily. Similar results were found by Anderson et al. (1979).

In contrast to these findings, studies conducted by Jenkins et al. (1977); Miranda et al. (1978), found that with the use of high carbohydrate, high fibre diets the postprandial glucose values were reduced but the insulin doses remained stable with the majority of subjects requiring over forty units of insulin. Similarly Lindsay et al. (1984), found that children requiring more than forty units of insulin demonstrated no significant changes in insulin dose requirements.

The studies conducted by Kiehm et al. (1976); Anderson et al. (1979), report that there were reductions in insulin requirements in only those patients who were receiving less than thirty units of insulin. The quantity of insulin therapy (less than thirty units) may have played an influential role in reducing the insulin therapy requirements. In addition, the studies conducted by Jenkins et al. (1977) and Miranda et al. (1978), did not distinguish between IDDM and NIDDM subjects. This may have played an influential role in the results achieved.

Although the high complex carbohydrate, high fibre diet has shown to be beneficial in the management in adults with diabetes, Lindsay et al. (1984), have not found similar results in children. They found that a high complex carbohydrate diet with sixty percent carbohydrate and thirty grams per day of dietary fibre had no significant effect on blood glucose levels preprandially, postprandially and fasting compared with a low
carbohydrate, low dietary fibre diet. It was concluded from this study that a high carbohydrate, high fibre diet had a limited effect on children with IDDM with no residual beta cell function. Further studies need to be conducted on the paediatric population to draw on any conclusion.

How important is the percentage of total energy from carbohydrate in the control of IDDM?

Studies conducted by Simpson et al. (1979); Jenkins et al. (1980); Rivelesse et al. (1980); Anderson et al. (1991); Riccardi et al. (1991), have identified that the amount of complex carbohydrate in the diet along with the high dietary fibre content have an effect on the diabetes control in subjects with IDDM. For example, the studies conducted by Simpson et al (1979); Anderson et al. (1991), found that the people with IDDM in the group that were on a high complex carbohydrate (sixty percent carbohydrate), high fibre diet had a greater improvement in their diabetes control than the people with IDDM who were on a low carbohydrate diet (forty percent carbohydrate). The high carbohydrate group showed an overall mean reduction in their fasting glucose levels with increased insulin sensitivity. The average glycosylated haemoglobin however, had no significant difference between the two carbohydrate groups. The mean low density lipoprotein fraction was reduced and the cholesterol concentration fell on average.

Similarly, Jenkins et al. (1980), in their study examining the ideal level of carbohydrate intake for diabetes on a high fibre diet found that when complex carbohydrate formed greater than forty percent of the total kilojoules intake there was a mean sixty four percent reduction in glucosuria. No such reduction was observed in those patients on a low carbohydrate diet. It may be concluded from these studies that a high complex carbohydrate intake along with a high fibre content has a positive effect on the glycaemic control. It is therefore, an important constituent in the overall dietary treatment of IDDM.
2.6 GLYCAEMIC INDEX

Glycaemic index is a recent concept which "ranks foods on the basis of their acute glycaemic impact". (Brand Miller. 1994; 747S). The concept was proposed by Jenkins et al. (1981), to determine the effect on blood glucose concentration of equal amounts of carbohydrate found in different foods, compared to a reference food. The reference food is a slice of white bread or glucose, depending upon the information source. The reference food is given a value of one hundred. (G.I. = 100). The majority of researchers use glucose as the reference food. The use of bread as a reference food may influence the results as the glycaemic index of bread may vary due to the type of flour used in the production, the milling, the process of manufacture. (Brand Miller. 1994).

The glycaemic index concept attempts to discredit the long held belief that the blood glucose responses to foods were determined by the carbohydrate component of the food. The past and current dietary recommendations for diabetes, being high complex carbohydrate and low simple carbohydrate is just a myth according to the glycaemic index concept. (Macdonald. 1995).

The glycaemic indices of foods is not only determined by the amount of sugars in the food. An example raised by Macdonald. (1995), is that the glycaemic response to glucose and potato is similar.

The glycaemic index of foods may be influenced by a number of variables. These include:

- Carbohydrate composition of the food.
- Fibre content of the food.
- Type of starch.
Brand Miller (1994), in the study examining the importance of the glycaemic index in both the subjects with IDDM and NIDDM found that the glycaemic control improved on the low glycaemic index diet in comparison to the high glycaemic index diet (p < 0.05). The mean HbA1c was eleven percent lower at the end of the low Glycaemic Index diet than high glycaemic index diet.

The results from eleven cross over medium to long term studies (one IDDM, one IDDM children, two IDDM & NIDDM, four NIDDM, one healthy and two hyperlipidemic subject groups), reviewed by Brand Miller (1994); Brand Miller et al. (1994), indicated that there was a slight improvement in the blood glucose concentrations and lipid concentrations when half of the high glycaemic foods were replaced with low glycaemic index foods. From these findings Brand Miller et al. (1995; p622), states that "the original rationale, that sugary foods produce uniquely large fluctuations in the blood glucose levels appears no longer valid".
Used as a therapeutic tool for diabetes, there are limitations. Firstly the glycaemic response varies between people, similar responses may not be visible between persons. The composition of the food varies from country to country, hence affecting the intercountry comparisons. The glycaemic indices are influenced by a variety of factors previously mentioned, these having an effect on the overall glycaemic response. The glycaemic index concept is therefore, not the most reliable measure of glycaemic response to foods. It does however, provide a guide as to the possible glycaemic response to various foods.

The glycaemic index concept is useful in comparing single carbohydrate food items. When applied in a mixed meal, the concept does not appear as useful. With the addition of lipids, protein and other food components the effect of the glycaemic index concept is questionable. Studies have shown that high glycaemic index foods when part of a mixed meal, do not have such an adverse effect on the glycaemic response as do single foods. (Brand Miller. 1994; Wolever et al. 1995).

The glycaemic index of a mixed meal is calculated using the average of the glycaemic indices of all the carbohydrate foods in that meal. Brand Miller (1994), has reviewed fifteen studies looking at the effect that the glycaemic index has on mixed meals. Eleven out of the fifteen studies found that the glycaemic response was determined by the single foods and not the glycaemic response to the meal.

A study conducted by Jenkins et al. (1984), examining the glycaemic responses to foods with the possible difference between IDDMs and NIDDMs have found that both groups had similar glycaemic responses to foods. The subjects with IDDM had greater variability in their glycaemic responses. The researchers have concluded that subjects with IDDM may, in addition to the actual food, have other factors which influence their diabetes hence, their glycaemic responses to foods such as insulin and exercise.
With the introduction of the glycaemic index concept health professionals have come to believe that "providing the total carbohydrate content of the meal does not alter, the substitution of sugar for high glycaemic index starch in meals reduces the Glycaemic Index of the meal in proportion to the amount of sugar added". (Macdonald.1995; p4).

In 1991 the American Diabetes Association incorporated the glycaemic index concept into their dietary recommendations for diabetes. They stated that low glycaemic index foods may be incorporated into the diabetic diet as long as the patient may still maintain normoglycaemia. (Coulston. 1994a).

The International Diabetes Institute in Melbourne has also included the glycaemic index concept into their guidelines for diabetes. (Macdonald. 1995). They suggest having one low glycaemic index food in each meal. This is easy for patients to remember and hence may increase compliance.

Overall, the glycaemic index concept has been described by Brand Miller (1994; 752S), as "user friendly". The incorporation of the glycaemic index theory into the currently recommended diet for IDDM may be more palatable and easier to adhere to for the people with IDDM, than the currently recommended high complex carbohydrate, high fibre diet.

Currently the dietary recommendations for people with IDDM are based on a high complex carbohydrate, high fibre diet. However, they have incorporated the glycaemic index concept, especially with respect to the simple carbohydrate recommendations in the diet.
2.7 EXERCISE IN IDDM

Exercise reduces the blood glucose level. (Zeman. 1991). With an increase in exercise, additional complex and simple carbohydrate are required to be ingested. Persons with IDDM undertaking exercise will therefore need to adjust their carbohydrate intake depending upon the amount of exercise undertaken and their metabolic control.

Exercise in people with IDDM is encouraged. Exercise has the ability to increase the patients cardiovascular fitness, psychological wellbeing and promote social interaction. (Diab. Care. 1993b).

"Physical activity requires the metabolism of bodily fuel reserves to provide energy for muscle contraction". (Sherman et al. 1995; p228S). Fat and carbohydrate are the major fuels that provide energy for exercise. Very small amounts of protein are metabolised for the production of energy during exercise. Carbohydrate for energy are stored in muscle (seventy nine percent) or liver (fourteen percent) in the form of glycogen and a small amount in the blood (seven percent). These stores of carbohydrate must be maintained and replenished before, during and after exercise. (Sherman et al. 1995).

There are many factors which may influence the metabolic responses to exercise. These variables include:

1. The patients metabolic control.
2. The relationship of the time of exercise to insulin injection.
3. The time of exercise, with respect to the time of meals.
4. The meal patterns.
5. Quantity of food ingested.
6. Quantity of insulin dose.
Exercise increases the glucose utilisation and hence, may provoke hypoglycaemia in the person with IDDM. This may be overcome by either increasing the food intake and/or reducing the insulin dosage. Each person with IDDM's glycaemic response to exercise differs therefore, blood glucose values before and after exercise should be used as a guideline to assist in determining the required food and/or insulin dose adjustments. (Zeman. 1991).

For people with IDDM engaging in infrequent exercise it is recommended that they increase their food intake rather than adjust their insulin doses. This is an easier routine to recall, when undertaking exercise. Regular exercisers, on the other hand, may adjust their insulin doses according to the extent and duration of the exercise and their blood glucose values.

Carbohydrate containing foods and snacks are the foods which are recommended to be consumed to increase the energy intake required for exercise. An adequate amount should be consumed to provide sufficient glucose for the exercise period, for repletion of muscle and liver glycogen stores which have been depleted during exercise and prevent post exercise hypoglycaemia. (Diab. Care. 1993a).

If the exercise is for a short period of time it is often easiest to delay the food intake until after the exercise. As a general guideline however, ten to fifteen grams of carbohydrate should be eaten prior to or after one hour of moderate exercise. If undertaking vigorous exercise an additional ten to fifteen grams of carbohydrate may be required. For prolonged exercise, additional carbohydrate may be required at
various intervals throughout the exercise period and also post exercise. As previously mentioned however, this will depend upon the blood glucose readings pre and post exercise. (Franz et al. 1994).

Frequently exercising people with IDDM should have a meal plan and corresponding insulin doses designed, based on their usual exercise patterns. These should be outlined on the basis of their blood glucose levels pre and post exercise.
3. METHODS OF DATA COLLECTION.

3.1. INTRODUCTION

The project is part of a larger research study conducted by the Medical Research Unit of Wollongong hospital. The project has been supervised by Professor Dennis Calvert and Doctor Barbara Meyer of the Medical Research Unit.

The aim of the overall project, conducted by Farideh Tahbaz (Ph. D. student), is to examine the current management and achievement of goals for people with Insulin Dependent Diabetes Mellitus. Six Master of Science nutrition students; Erin Kirk, Elizabeth Hadfield, Judith Pryke, Kathy Fitzgerald, Therese Ermers along with myself, Kathy Hodson have conducted our major projects within the overall research project.

The study is based on the findings of the DCCT project, conducted in Massachusetts in the U.S.A. The DCCT project was conducted by the American Diabetes Association. (DCCT research group. 1993). The research project also draws on a study which had been carried out by another Master of Science nutrition student, Effie Tsivis. Effie's major project involved the "Australianisation" of the Food Pattern and Food Preparation questionnaires from the DCCT study.

3.2 ETHICS.

Ethical approval for the study was sought from the University of Wollongong's Human Research Ethics Committee.

The participants of the study were given a study information sheet to read and a consent form to sign if agreeing to partake in the study.

A copy of the Information Sheet and the Consent Form are found in Appendix 1.
3.3 INTERVIEW METHOD

Participants who agreed to participate in the study were given an appointment date and time. The project was conducted at 108 New Dapto Road, Wollongong. The participants attended at their designated time. They were met by Cate Kelly (research assistant) and the interviewer and the formalities of the project were explained.

The same interview procedure was conducted on each subject by each interviewer. The process was as follows:

1. Patient arrives at the interview site.
2. The patient was given their booklet and asked to respond to the Characteristics of the Subject questionnaire, Food Patterns questionnaire, Food Preparation questionnaire. (Tsivis. 1995. unpub.).
3. The diet history interview was performed. (Burke. 1947).
4. Anthropometric measures were taken. (Durnin et al. 1974; Bray. 1985).
5. Subjects were asked to respond to the Quality of Life, SF - 36 (DCCT research group. 1988), Practical Aspects of IDDM questionnaire's.
6. Urine sample were taken.
7. Non fasted blood samples were taken and the subjects blood pressure was measured at the Medical Research Unit, Wollongong hospital.

3.4 DATA COLLECTION.

The project utilised the dietary method which was used in the DCCT study, the modified Burke Diet History. (Burke. 1947). The modified Burke diet history method used in the DCCT study consisted of three components. These are;

1. Patients Characteristics.
2. Dietary interviews.
3.4.1. The Characteristics of the Subject Questionnaire.

It was designed to identify the characteristics of the patients thus, providing the researcher with a larger view of the subjects lifestyle, family and medical history. The Characteristics of the Subject questionnaire is found in Appendix 2.

3.4.2. Diet Interview.

The dietary interview was undertaken to obtain the subjects usual intake of foods and to determine their usual patterns of eating. Food models and standard measuring equipment were used to assist in determining the quantities of food and drink products consumed. The information obtained from the dietary interview was analysed on Diet 1 software, Nuttab database program (Xyris software). From the results obtained from the Diet 1 an analysis of both the macronutrients and micronutrients of the subjects diet were given.

3.4.3. The Food Pattern and Food Preparation Questionnaires.

They were used as a cross check tool to verify the dietary information obtained via the diet interview and provide additional dietary information. The Food Pattern questionnaire includes a food frequency component and examines the subjects meal patterns. (Tsivis. 1995. unpub.). A copy of the questionnaire is found in the Appendix 3. The Food Preparation questionnaire is designed to be completed by the person who usually prepares the food at home and examines the types of fats, sugar, salt used in meal preparations. (Tsivis. 1995 unpub.). The Food Preparation questionnaire is found in Appendix 4.
3.5 STANDARDISATION OF THE DATA COLLECTION METHOD.

With six researchers conducting the dietary interviews the need for standardisation of the interview technique was paramount. To try to eliminate error due to the number of interviewers, a standard protocol for the dietary interviews was developed.

All six Master of Science nutrition students were trained in taking diet histories by Linda Tapsell, lecturer in Nutrition and Dietetics at the University of Wollongong. During this teaching process the students were all observed by Linda Tapsell in conducting diet histories at the teaching clinics at the Wollongong hospital in 1994. In addition, the six Master of Science nutrition researchers met with Farideh Tahbaz on several occasions to standardise the questioning style in order to acquire accurate dietary information.

3.6 SUBJECT RECRUITMENT.

The possible participants for the study were recruited from the Diabetes Education Centre lists for the Illawarra area. The lists included persons diagnosed with IDDM between January 1984 - December 1994. The study sample group selected were people aged between eighteen and thirty one years of age with IDDM, who resided in the Illawarra area.

In total seventy one subjects with IDDM came within these parameters. These people were asked to participate in the study. The people with IDDM were requested to invite an associate who does not have diabetes and is of similar age and gender to come along to partake as a control in the study.
3.7 BLOOD ANALYSIS.

The venous non fasted blood samples were taken at the Medical Research Unit of Wollongong hospital. Blood analysis was performed at the Medical Research Unit and the hospital biochemical laboratories at Wollongong.

The blood analysis performed to determine the glycaemic control was the Glycosylated Haemoglobin- HbA1c. HbA1c involves the glycosylation reaction which occurs between the red blood cells - haemoglobin and glucose. This increases when the glucose level in the blood increases. With the lifespan of the red blood cell being, on average, one hundred and twenty days the amount of glycosylated haemoglobin indicates the average blood glucose level for the previous three months. (Zeman. 1991).

The procedure for HbA1c assay analysis involves the High Performance Liquid Chromatography method. (Gonen et al. 1977).

The expected HbA1c values for people with diabetes are as follows:

- <8% Ideal Control
- 8-10% Good Control
- 10 -12% Average Control
- >12% Poor Control ( QEII Medical Centre. 1982).

3.8 STATISTICAL ANALYSIS.

The JMP statistics package was used for analyses of the data.

To investigate the comparison between the subjects with IDDM carbohydrate intake with the recommendations by the American Diabetes Association, the subjects' responses were categorised into two groups. These groups included:
1. Successful
2. Not successful

The successful group consisted of participants who's total percentage of energy from carbohydrate was within the American Diabetes Associations recommendations of fifty to sixty percent of total energy. After each subject received a successful or not successful rating for their total intake of carbohydrate, the number of subjects who achieved the successful rating were calculated.

To assess the participants with IDDMs dietary fibre and simple carbohydrate intake compared to their recommendations, outlined by the American Diabetes Association, the same process was performed as described above.

Regression analysis was performed to investigate the relationship between the percentage of carbohydrate intake with the people with IDDMs glycaemic control - HbA1c.

"Regression is a process of constructing a mathematical model of the relationship". (Hindle. 1994.(103). It illustrates the link between two variables. The two variables of interest are: percentage carbohydrate in the diet (X variable) and HbA1c value (Y variable). The X variable is known as the independent variable. The carbohydrate content in the diet is hypothesised to be the variable to affect the change in the dependent Y variable the glycaemic control. (Hindle. 1994).

The relationship between the two variables is illustrated on the scatter diagram. If there is a strong dependence of the variables then the points on the scatter diagram would be clustered together, resembling a line or curve. (Bury. 1975).
4. RESULTS

4.1 SAMPLE.

Seventy one letters were sent out to possible subjects requesting them to partake in the study. The eligibility of the subjects to participate in the study is illustrated in table 2.

**TABLE 2 - ELIGIBILITY TO PARTICIPATE IN THE STUDY**

<table>
<thead>
<tr>
<th>ELIGIBLE</th>
<th>INELIGIBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>63</td>
<td>8</td>
</tr>
</tbody>
</table>

The eight that were ineligible included: one non diabetic subject, three have NIDDM, one patient was in hospital and three unable to attend as they were undertaking the High School Certificate. Of the sixty three eligible subjects for the study, only twenty one attended the study. The explanation for other possible subjects non attendance to the study is illustrated in table 3.
To assist in contacting possible subjects the local General Practitioners were approached with a list provided by the Diabetes Education Centre of their patients with IDDM names. The doctors were asked to provide contact information about any of these patients with IDDM. From this process five patients were able to be contacted. In addition, through the electoral rolls Cate Kelly and Farideh Tabhaz attempted in contacting more possible subjects. This process only gave contact to four more possible subjects.

The subjects were asked to invite an associate to participate as a control in the study. Nine of the controls were provided by the subjects. An additional six controls were matched for gender and age by the researchers. In total fifteen controls were interviewed in the study.

<table>
<thead>
<tr>
<th>PATIENTS CAN'T CONTACT</th>
<th>DECLINED</th>
<th>MOVED</th>
<th>CANCELLED</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>14</td>
<td>13</td>
<td>9</td>
</tr>
</tbody>
</table>

**TABLE 3 SAMPLE GROUPS ATTENDANCE, NON ATTENDANCE TO THE STUDY**
The subjects with IDDM ages ranged from eighteen to thirty one years. The mean age was twenty three years. The distribution of subjects by gender is illustrated in table 4.

**TABLE 4 DISTRIBUTION OF SUBJECTS WITH IDDM BY GENDER**

<table>
<thead>
<tr>
<th></th>
<th>MALE</th>
<th>FEMALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUMBER</td>
<td>15</td>
<td>6</td>
</tr>
</tbody>
</table>

**4.2 GLYCOSYLATED HAEMOGLOBIN - HbA1c**

The HbA1c values ranged from seven percent to twelve percent with the mean HbA1c value at nine percent. Figure 1 shows the distribution of HbA1c for the subjects with IDDM.
FIGURE 1 - THE DISTRIBUTION OF GLYCOSYLATED HAEMOGLOBIN FOR PEOPLE WITH INSULIN DEPENDENT DIABETES MELLITUS
4.3 CARBOHYDRATE INTAKE OF PEOPLE WITH IDDM

When comparing the percentage carbohydrate intake of people with IDDM with the percentage carbohydrate recommended, by American Diabetes Association, seven from twenty one subjects were consuming the recommended amount. Ten from twenty one subjects were consuming a carbohydrate intake between forty to fifty percent of total energy. Four subjects consumed less than forty percent carbohydrate. The mean carbohydrate intake by people with IDDM was forty six percent of total energy. The distribution of percentage carbohydrate is illustrated in Figure 2.

FIGURE 2 - SUBJECTS WITH IDDM DISTRIBUTION OF PERCENTAGE CARBOHYDRATE
The subjects were ranked according to their success with meeting the carbohydrate intake recommendations. The success rate is illustrated in Table 5.

**TABLE 5 - SUBJECTS WITH IDDM CARBOHYDRATE INTAKE AS COMPARED WITH THE RECOMMENDATIONS**

<table>
<thead>
<tr>
<th>SUCCESSFUL</th>
<th>UNSUCCESSFUL</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-60% CHO</td>
<td>40-50% CHO</td>
</tr>
<tr>
<td>No. subjects</td>
<td>7</td>
</tr>
</tbody>
</table>

33.3% of subjects consumed a carbohydrate intake within the recommendations of fifty to sixty percent carbohydrate of total energy.

**4.4 DIETARY FIBRE INTAKE OF PEOPLE WITH IDDM**

The dietary fibre intake of the people with IDDM compared to the dietary fibre recommendations as outlined by the American Diabetes Association, were analysed. The mean dietary fibre intake was thirty five grams per day. The subjects distribution of dietary fibre is illustrated in Figure 3.
The subjects with IDDM were ranked according to their success rate with the recommended amount of dietary fibre. This is illustrated in Table 6.
TABLE 6 - SUBJECTS WITH IDDM DIETARY FIBRE INTAKE COMPARED WITH THE RECOMMENDATIONS

<table>
<thead>
<tr>
<th></th>
<th>SUCCESSFUL</th>
<th>UNSUCCESSFUL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;25 g/day fibre</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>&lt;25 g/day fibre</td>
<td>2</td>
<td>15</td>
</tr>
</tbody>
</table>

Ninety percent of subjects with IDDM consumed a dietary fibre intake as recommended by the American Diabetes Association.

4.5 SIMPLE CARBOHYDRATE INTAKE OF THE PEOPLE WITH IDDM

The simple carbohydrate content of the diet is recommended, by the American Diabetes Association, to be less than ten percent of total energy and / or less than thirty percent of the total carbohydrate content. The mean simple carbohydrate intake was thirty four percent.
The subjects with IDDM were ranked according to their success rate of complying with
the recommendations. This is illustrated in Table 7.

**TABLE 7 - SUBJECTS WITH IDDM SIMPLE CARBOHYDRATE INTAKE COMPARED WITH THE RECOMMENDATIONS**

<table>
<thead>
<tr>
<th>SUCCESSFUL</th>
<th>UNSUCCESSFUL</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30% CHO</td>
<td>30-40% CHO</td>
</tr>
<tr>
<td>No. subjects</td>
<td>6</td>
</tr>
</tbody>
</table>

Twenty nine percent of subjects with IDDM consumed a diet with less than thirty
percent simple carbohydrate, as recommended by the American Diabetes Association.

**4.6 RELATIONSHIP BETWEEN CARBOHYDRATE INTAKE AND HbA1c.**

A regression analysis examining the relationship between the subjects with IDDM
carbohydrate intake with HbA1c indicated that there was no linear relationship between
the two variables. This is illustrated in Figure 4.
4.7 CARBOHYDRATES AND EXERCISE.

Responses to the question, "Do you change your meal pattern / insulin routine when you exercise?" which was found in the Food Patterns Questionnaire, question number six (copy of the Food Patterns Questionnaire is found in Appendix 3) are illustrated in Table 8.
TABLE 8 - CHANGES TO MEAL PATTERNS / INSULIN ROUTINE WHEN EXERCISING.

<table>
<thead>
<tr>
<th></th>
<th>NO</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Insulin</td>
<td>Food</td>
</tr>
<tr>
<td>No. subjects</td>
<td>7</td>
<td>1</td>
</tr>
</tbody>
</table>

Fourteen from twenty-one subjects altered their insulin dosage and/or food intake when undertaking exercise. Seven from the fourteen subjects changed both their insulin dose and food intake. With the majority decreasing their insulin dose and increasing their carbohydrate intake. In total, thirteen subjects from twenty-one (sixty two percent) increased their carbohydrate intake when undertaking exercise.
5. DISCUSSION.

The sample size of the study represented only thirty percent of the total number of subjects originally asked to participate in the study. The sample size was hence, very small and does not represent the entire population requested to participate in the study. This may have influenced the results. With a larger sample group the results may have differed. However, the majority of similar studies consisted of sample groups ranging from nine to twenty subject's with IDDM. (Anderson et al. 1979; Simpson et al. 1979; Simpson et al. 1981).

The glycosylated haemoglobin values obtained in the study were high, compared with the expected values for people with diabetes. (QEII Medical Centre. 1982). Some subject's with IDDM possessing a HbA1c value of twelve percent, indicating poor glycaemic control.

When comparing the carbohydrate intake of the subjects with IDDM with the recommended level as outlined by the American Diabetes Association, only thirty three percent of subjects were consuming this quantity of carbohydrate. Forty eight percent of subject's were consuming a carbohydrate intake between forty to fifty percent of total energy. Two thirds of subjects were therefore, not currently consuming the recommended amount of carbohydrate in their diet. When undertaking exercise sixty two percent of subjects increased their carbohydrate intake. In light of the fact that the American Diabetes Association has encouraged subjects with IDDM to increase their carbohydrate intake when exercising, only a moderate amount of subjects are demonstrating this requirement.

The correlation between the subjects with IDDM dietary fibre intake with the recommended quantity identified that ninety percent of subjects were consuming the recommended amount of dietary fibre in their diet. Diets high in dietary fibre have
been advocated, for some time by the American Diabetes Association, for people with IDDM. As health professionals it is pleasing to identify that such a high percentage of people with IDDM, in the study, are consuming the recommended amount of dietary fibre.

When comparing the simple carbohydrate intake of the subjects with the recommendations for simple carbohydrate, only twenty nine percent of subjects were consuming the suggested amount of simple carbohydrate, as outlined by the American Diabetes Association. The majority of subject's with IDDM were hence, consuming a diet higher in simple carbohydrate than the suggested value. In light of the glycaemic index concept sucrose and other simple carbohydrates have not been found to influence the glycaemic response to foods as was previously believed. (Brand Miller. 1994). With the subjects who were able to maintain relatively adequate glycaemic control (HbA1c < 10%), the need for strict simple carbohydrate regulations need not apply. Those subject's with HbA1c values of twelve percent, on the other hand, may require reductions in their simple carbohydrate content, if it influences their glycaemic control.

No relationship between the percentage of carbohydrate intake and glycaemic control - HbA1c values were identified. These results oppose the results found in other studies where an association between carbohydrate intake and glycaemic control had been found, such as Brunzell et al. (1971); Kiehm et al. (1976); Anderson et al. (1979); Anderson et al. (1991). There are a number of possible contributing factors which may have caused this studies results to have differed from the other studies listed above, these include:

The studies conducted by Brunzell et al. (1971); Kiehm et al. (1976); Anderson et al. (1979); Anderson et al. (1991), contained diets which consisted of very high quantities of carbohydrate (greater than sixty percent) and dietary fibre (greater than sixty five
grams). These studies found that an association exists between high carbohydrate, high dietary fibre and the subject with IDDMs glycaemic control. These results however, have not been demonstrated in studies which utilised a smaller percentage of total energy from carbohydrate such as that conducted by Shimakawa et al. (1993). They found no association between the carbohydrate intake and the HbA1c value, with a mean carbohydrate intake of forty three percent of total energy and twenty grams of dietary fibre. Similarly, studies have found that diets, of people with IDDM, with over sixty percent carbohydrate had a greater influence on the subjects glycaemic control than the diets with forty percent carbohydrate. (Simpson et al. 1979; Jenkins et al. 1980; Rivelesse et al. 1980; Anderson et al. 1991; Riccardi et al. 1991).

In this study only one third of the subjects consumed a diet with greater than fifty percent carbohydrate. Therefore, the majority of subjects consumed a diet moderate in carbohydrate (forty to fifty percent carbohydrate) and this may have played a role in causing no association between this level of carbohydrate intake on glycaemic control to be identified. The results from this study are supported by the findings from other studies, such as Shimakawa et al. (1993). Furthermore, it may be stated that the percent of energy from carbohydrate has an effect on the glycaemic control, of people with IDDM, only with the use of a high carbohydrate diet, over fifty percent of total energy.

In addition, diets high in soluble fibre are believed to have an effect on the glycaemic control. (Jenkins et al. 1976; Jenkins et al. 1977; Hockaday et al. 1990). However, these studies only found that this association was evident with certain types of soluble fibre, such as guar gum. Such an association has not been found with less viscous fibres. It has not been possible to conclude that all soluble fibres have a positive effect on the subjects glycaemic control. (Nuttal. 1993). In this study, although ninety percent of subjects consumed a diet high in dietary fibre, the fibre content in the diet consisted of both insoluble and soluble fibres and not only guar gum. For this reason,
the dietary fibre may have played a lesser role in influencing the glycaemic control of
the subjects, than the influence that viscous soluble fibres have been found to have had
in previous studies.

From the relationship between the carbohydrate intake and the HbA1c (Figure 4) it
was however, found that forty three percent of subjects who consumed a diet high in
carbohydrate had poor glycaemic control, HbA1c value of greater than eleven
percent. On the other hand, there were those subjects who consumed a diet moderate
in carbohydrate and still sixty percent managed to maintain good glycaemic control,
HbA1c less than nine percent. However, due to the small number of subjects in the
study, no conclusions from these findings may be drawn.

After reviewing the findings in the literature and the results of this study it may be
concluded that a high quantity of both carbohydrate (over fifty percent of total energy)
and dietary fibre are required to show a relationship between the carbohydrate content
and the glycaemic control. The quantity of carbohydrate in the subject's with IDDM in
this study, although combined with a high dietary fibre content, was insufficient to
show an association between the carbohydrate content and the glycaemic control.
6. CONCLUSION.

This study has found that thirty three percent of subjects with IDDM carbohydrate intake was within the carbohydrate recommendations, as outlined by the American Diabetes Association, for people with diabetes. Two thirds of the subjects with IDDM were therefore, not consuming the recommended amount of carbohydrate.

Interestingly, ninety percent of people with IDDM were consuming a diet with the recommended quantity of dietary fibre, as proposed by the American Diabetes Association. This result is pleasing, as a diet high in dietary fibre for people with IDDM has been encouraged.

Unfortunately, only twenty nine percent of subjects were consuming the suggested amount, as recommended by the American Diabetes Association, of simple carbohydrate. As previously mentioned however, according to the glycaemic index theory such restrictions on the simple carbohydrate content (less than thirty percent of total carbohydrate intake) are not required if patients may still maintain good glycaemic control.

There was no relationship identified between the people with IDDM carbohydrate intake and their glycaemic control. This is hypothesised to be due to the fact that the carbohydrate intake of the subjects in the study, was not sufficiently high enough to influence the glycaemic control. Similar findings have been found in other studies such as Shimakawa et al. (1993).

In conclusion, the study has identified that people with IDDM are consuming a diet moderate in carbohydrate, high in dietary fibre and higher than recommended in simple carbohydrate intake.
carbohydrate. The majority of subjects increase their carbohydrate intake when they exercise. The subjects' glycaemic control is average, with a mean of nine percent. However, no association was found between the subjects' carbohydrate intake and their glycaemic control, this is presumed to be due to the lower carbohydrate intake of the people with IDDM in this study, than has been utilised in other studies.
7. LIMITATIONS OF THE STUDY

As researchers we are all confronted with limitations in our research projects. These limitations place unexpected pressure on the research project. In this study, there were a number of limitations.

The lists obtained from the Diabetes Education Centre with the names of possible participants for the study were not accurate. From the list of seventy one persons, only sixty three were eligible candidates for the study. It was anticipated that contacting and requesting these possible subjects to partake in the project would be relatively manageable. As the project commenced, it became evident that on the contrary, contacting the selected sample was an extremely difficult task. From a total of seventy one subjects asked to participate in the study, only twenty one (thirty percent) of the subjects participated in the study.

The sample group were a difficult group to contact. They are a very mobile group, possibly due to their age (eighteen to thirty one years). The majority of the group worked during the working hours of the week and hence, were unable to attend the study. When they were requested to attend the study in the evenings and / or weekends, some were hesitant. Cate Kelly however, persisted in contacting possible subjects and finding suitable times for them to attend the project. Without her persistence, the study would not have received this quantity of subjects.
The project required control subjects to partake as controls in the project. People with IDDM participating in the study were requested to invite an associate to the study to be their control. Only nine subjects with IDDM brought a control to the study. The rest of the controls were matched for gender and age by the researchers. This process may have introduced bias into the study results as this may have limited the type of people selected for the study.
8. RECOMMENDATIONS.

The project was a pilot study and hence, encountered some difficulties. In order to improve the project in the future, the following recommendations have been proposed:

A project of this magnitude requires more time than the time that was allocated for the major project, to be completed to its fullest potential. In particular, with more time the researchers may have contacted extra participants and therefore, obtained additional data. A larger data pool would more closely represent the entire population group.

To obtain a more accurate and up to-date list of possible subjects, the local General Practitioners should be contacted and requested to list their patients with IDDM. This information, in addition to that provided by the Diabetes Education Centre, may increase the overall number of participants to the study.

The content of the project requires condensing. In particular the questionnaires, of which there are six, need to be reduced. The food frequency component of the food patterns questionnaire may group foods, rather than inquiring about every possible food variant. The food preparation questionnaire may also be more generalised for example, asking questions about a food but not every possible food item in that food group. This will reduce the quantity of dietary information obtained however, is sufficient for use in this project. Additionally it may produce a study that is more “participant friendly”, by reducing the amount of time that subjects require to complete the questionnaires.
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BIBLIOGRAPHY


11. APPENDICES.
## LIST OF APPENDICES

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<th>Page</th>
</tr>
</thead>
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<td>66</td>
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<td>Appendix 2</td>
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<td>67</td>
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<td>68</td>
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</tr>
</tbody>
</table>
APPENDIX 1.
ASSESSMENT OF INSULIN-DEPENDENT DIABETES MANAGEMENT

We plan to carry out an evaluation of the way in which people with insulin-dependent diabetes mellitus manage the diabetes. We hope as a result of this evaluation to be able to recommend ways in which management guidelines or services may be improved to provide the best possible outcomes for people with diabetes.

We have explained to you how we obtained your name, and we have reassured you that this information, and indeed any information we discover about you, is confidential and will not be released to anybody, unless you give us specific consent to pass information to your doctor. Any other information about this study that is published or passed to other bodies (for instance, the NSW Health Department) will be in such a form that no individuals can be identified. We shall, of course, send you a copy of your results, and (if you wish) the group results when they are available.

We will ask if we can interview you. Interviews will be conducted by Ms Farideh Tahbaz, who is a nutritionist with a Masters degree in nutrition or a graduate in nutrition who is studying for a Masters Degree. Ms Tahbaz, or a colleague will give you a standard questionnaire to fill out, which contains information on your own circumstances, on the way you manage your diabetes, on the way in which insulin is prescribed, and on the way you feel you manage your diabetes and your reactions to diabetes.

You will be asked if you can give a blood and urine specimen, to check the degree to which your diabetes is controlled, and have your height and weight and degree of fatness estimated. Blood would normally be taken from a vein in the arm. You will be asked for further information on the details of your usual diet.

It should be clear that there are no right or wrong answers on diet or diabetes management; we wish to obtain an accurate picture of current management, in its diversity, in the Illawarra.

Please feel free to ask Ms Tahbaz any questions that occur to you. We will ask you if we can write to your doctor and let him/her know the results of your blood test and if you wish, the dietary analysis.

If there are any outstanding questions, please ring Professor Dennis Calvert, phone (042) 266 594. If you have any queries regarding the conduct of the research, please contact the Secretary of the Human Research Ethics Committee on (042) 214 457.
CONSENT FORM
FOR PARTICIPANTS WITH DIABETES

ASSESSMENT OF INSULIN-DEPENDENT DIABETES MANAGEMENT

This research on the current management of diabetes in the Illawarra is being conducted by a group of clinicians and scientists supported by a steering committee with representatives from the Illawarra Area Health Service, the NSW Health Department, and the medical profession. Professor Dennis Calvert in the Medical Research Unit (Illawarra Area Health Service/University of Wollongong) heads the group, and Ms Farideh Tahbaz is coordinating.

Information relating to this study is detailed in the attached information sheet.

You are free to withdraw from all or part of this research program at any time without penalty, and without compromising in any way your treatment or access to services.

The ethical aspects of this study have been approved by the University of Wollongong Human Research Ethics Committee, which is responsible for the ethical aspects of research involving people in the Illawarra. If you have any enquiries regarding the conduct of the research please contact the Secretary of the University of Wollongong Human Research Ethics Committee on (042) 21 3079.

I understand that the information collected in this research will be used for the assessment of insulin-dependent diabetes management and I consent for the data to be used in that manner.

If you wish to take part in this research please sign below

Name ..................................  Signature ..................................  Date /.........../......
APPENDIX 2.
Please indicate your answer by ticking the appropriate box 🟡 or by writing your answer in the space provided. If you are uncertain about the answer to any of the questions leave them blank and ask the receptionist to help you.

### Characteristics of the subject:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sex:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female 🟡 1</td>
</tr>
<tr>
<td></td>
<td>Male 🟡 2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Marital Status:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>🟡 1</td>
</tr>
<tr>
<td>Married</td>
<td>🟡 2</td>
</tr>
<tr>
<td>Separated/Divorced</td>
<td>🟡 3</td>
</tr>
<tr>
<td>Widowed</td>
<td>🟡 4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Date of Birth:</th>
<th>Day: □ □ Month: □ □ Year: 19□□</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>🟡 □</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Country of Birth:</th>
<th>Australia 🟡 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not Australia 🟡 2</td>
</tr>
</tbody>
</table>

If not Australia, what is your country of birth? ----------------------

<table>
<thead>
<tr>
<th>5. How long have you been resident in Australia? Months □ Years □</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>6. Where were members of your family born?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>- Your father -------------------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>- Your father’s father (paternal grandfather) ----------------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>- Your father’s mother (paternal grandmother) ----------------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>- Your mother --------------------------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>- Your mother’s father (maternal grandfather) ---------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>- Your mother’s mother (maternal grandmother) ---------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. Are you of Aboriginal or Torres Strait Islander origin? (If of mixed origin indicate the one to which you belong)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>🟡 1</td>
</tr>
<tr>
<td>Yes, Aboriginal</td>
<td>🟡 2</td>
</tr>
<tr>
<td>Yes, Torres Strait Islander</td>
<td>🟡 3</td>
</tr>
</tbody>
</table>
**DIABETES HISTORY:**

1. What date was diabetes diagnosed?  Mo Q/Yr Q Q  

2. What is the name and address of your doctor who normally treats your diabetes?  

3. Do you want us to send any results to your doctor (eg. diet and blood test results)?  
   - No Q 1  
   - Yes Q 2  

4. Have you ever taken oral drugs (tablets) for diabetes?  
   - No Q 1  
   - Yes Q 2  
   a. If yes, are you currently taking oral drugs (tablets)?  
      - No Q 1  
      - Yes Q 2  
   b. If no, how long ago did you stop taking oral drugs (tablets)?  
      - Mo Q Yr Q Q 1  
      - Unknown Q 2  

5. Are you currently taking insulin?  
   - No Q 1  
   - Yes Q 2  

6. When did you begin permanent use of insulin?  
   - Mo Q Yr Q Q 1  
   - Unknown Q 2  

7. What is your current total daily dose of insulin: ----- ----- units  

8. Are you currently taking oral drugs and insulin?  
   - No Q 1  
   - Yes Q 2  

If yes to #5 or #8, what is your current insulin regimen? (answer one)  
   - one injection daily Q 1  pump Q 4  
   - two injections daily Q 2  other Q 5  
   - three or more injections daily Q 3  Specify:-------------------  

Office use only  

| 1 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
9. Have you ever been hospitalized for diabetes ketoacidosis?

No □ 1
Yes □ 2
Unknown □ 3

MEDICAL HISTORY:

A. Eye problems:

Have you ever been told by a health care professional that you have or had:

1. Any diabetes related eye problems?

No □ 1
Yes □ 2
Unknown □ 3

If yes please specify: ________________________________

2. Laser treatment?

No □ 1
Yes □ 2
unknown □ 3

3. Impairment of vision?

No □ 1
Yes □ 2
Unknown □ 3

4. Cataracts?

No □ 1
Yes □ 2
Unknown □ 3

5. Detached retina?

No □ 1
Yes □ 2
Unknown □ 3

B. Kidney problems:

Have you ever been told by a health care professional that you have or had:

1. Diabetic kidney problem?

No □ 1
Yes □ 2
Unknown □ 3

2. Protein or albumin in the urine?

No □ 1
Yes □ 2
Unknown □ 3
Have you ever had:

3. Kidney transplant?
   No □ 1
   Yes □ 2
   Unknown □ 3

4. Kidney dialysis?
   No □ 1
   Yes □ 2
   Unknown □ 3

C. Cardiovascular (heart or circulation) problems:

Have you ever been told by a health care professional that you have or had:

1. Any problems with heart or blood vessels?
   No □ 1
   Yes □ 2
   Unknown □ 3

   If yes, please specify: --------------------------------------------

2. Abnormal Electrocardiogram?
   No □ 1
   Yes □ 2
   Unknown □ 3

Have you ever had:

3. Heart pains or angina?
   No □ 1
   Yes □ 2
   Unknown □ 3

4. Heart attack?
   No □ 1
   Yes □ 2
   Unknown □ 3

5. Coronary bypass surgery?
   No □ 1
   Yes □ 2
   Unknown □ 3
6. Stroke?
   No  □ 1
   Yes □ 2
   Unknown □ 3

7. High blood pressure?
   No  □ 1
   Yes □ 2
   Unknown □ 3

8. Drug treatment for high blood pressure?
   No  □ 1
   Yes □ 2
   Unknown □ 3

If yes, are you currently receiving drug treatment?
   No  □ 1
   Yes □ 2
   Unknown □ 3

D. Peripheral vascular complications:

Have you ever been told by a health care professional that you have or had:

1. Any trouble with circulation in legs?
   No  □ 1
   Yes □ 2
   Unknown □ 3

2. Foot ulcers?
   No  □ 1
   Yes □ 2
   Unknown □ 3

3. Gangrene?
   No  □ 1
   Yes □ 2
   Unknown □ 3

Have you ever had:

4. Non-traumatic amputation?
   No  □ 1
   Yes □ 2
   Unknown □ 3
E. Other major medical disease?

1. Do you have any serious medical problems not mentioned yet?
   - No □ 1
   - Yes □ 2
   - Unknown □ 3

Specify: -----------------------------------------------

F. Are there any people with diabetes in your family?

   - No □ 1
   - Yes □ 2

If yes what is his/her relation with you? ---------------
Information on your background:

1. Education

What is the highest level of your education?
(Please tick and complete level if appropriate)

- commenced primary school
- finished primary school
- commenced high school
- finished high school
- university or other tertiary schooling (eg. TAFE) started
- university or other tertiary schooling (eg. TAFE) finished

2. Economic data:

2.1 What is the total estimated family income before taxes?

- less than $12000
- $12000 - $15000
- $15001 - $18000
- $18001 - $22000
- $22001 - $26000
- $26001 - $32000
- $32001 - $40000
- $40001 - $50000
- $50001 and over

2.2 Occupation

What is your current occupation (if applicable)?

Do you want a summary of the study results when available?

- No
- Yes

Contact address (to send you a summary of the results if you wish, and for future follow up):

Tel:
APPENDIX 3.
## Diabetes Control and Complications Trial (DCCT) - Australian Version*

This questionnaire asks general questions about your food choices and eating habits. Answer as best you can. If you have any questions about the form you may ask the dietitian. More information will be collected during the clinic visit.

Thank you for your co-operation in providing this information.

<table>
<thead>
<tr>
<th>Participant's Name:</th>
<th>Date:</th>
<th>Dietitian:</th>
<th>Telephone:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Has your general pattern of eating changed in the last year?
   - [ ] yes  [ ] no  If yes, describe:

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

2. Are you or have you in the past year been on any special diet in addition to a diabetic diet? (such as low salt, vegetarian, weight loss etc).
   - [ ] yes  [ ] no  If yes, describe this diet:

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
3. Are you currently increasing or decreasing your intake of any particular foods or beverages (such as foods high in fibre, caffeine, alcohol etc)?

☐ yes  ☐ no  If yes, describe:

____________________________________

____________________________________

____________________________________

____________________________________

4. Does your meal pattern tend to vary from week to week? (due to shift work, sports activities, weekends etc).

☐ yes  ☐ no  If yes, describe:

____________________________________

____________________________________

____________________________________

____________________________________

5. In the last year, have you taken any vitamin and/or mineral supplements?

☐ yes  ☐ no  If yes, specify brand name, amount and how often taken

____________________________________

____________________________________

____________________________________

____________________________________
6. Do you change your meal pattern/insulin routine when you exercise? (e.g. do you eat additional carbohydrate before exercise or change your insulin dose etc...)

[ ] yes  [ ] no  If yes, describe how:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

7. How do you treat hypos (low blood sugar)?

List food/beverages and amounts consumed:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

8. Do you use sugar or an artificial sweetener?

[ ] yes  [ ] no

If yes, specify which foods/beverages you add it to (such as cereal, fruit, coffee, tea, other):

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

If you use an artificial sweetener, specify brand name:
9. Do you add salt to your food at the table?
   ☐ always  ☐ occasionally  ☐ never, Go to Q11

10. How would you rate the amount of salt you add?
    ☐ light  ☐ moderate  ☐ heavy

11. Do you use a salt substitute at the table such as Lite, Co-salt, No-salt etc?
    ☐ always  ☐ occasionally  ☐ never
    If used, specify brand name: ____________________________________________

12. Do you regularly use other salt seasonings at the table such as Chicken salt, onion salt, garlic salt?
    ☐ yes  ☐ no
    Specify kind(s):
    ____________________________________________
    ____________________________________________
    ____________________________________________
Indicate below your usual meal and snack patterns:

For each meal state the usual time you eat it, for example breakfast at 7:30am and then state the number of times a week you would eat it at home, take from home etc.. Repeat this for each meal time.

<table>
<thead>
<tr>
<th>Usual Time of Meal</th>
<th>Eat at Home</th>
<th>Take from Home</th>
<th>Buy from Takeaway Outlet - Cafeteria, Cafe/Restaurant</th>
<th>Do not Eat</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning meal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Breakfast)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning snack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noon meal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Lunch)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afternoon snack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evening meal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Dinner)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evening snack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Supper)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional snack</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14. Who prepares most of your home-cooked meals?

Self  Parent  Spouse  Other Household Member

[ ]  [ ]  [ ]  [ ]
Please estimate how often you eat the following foods by ticking the appropriate box. Include diet foods and other special products in the general food categories. For example include low calorie beer with beer. If they are diet/special products please indicate this in the comments section. You may also use the Comments Section for details such as seasonal variation or the brand/product name. Feel free to use the bottom of each page for any additional comments.

<table>
<thead>
<tr>
<th>BEVERAGES</th>
<th>Daily</th>
<th>4-6 times a week</th>
<th>1-3 times a week</th>
<th>1-3 times a month</th>
<th>1-3 times a year or never</th>
<th>Comments eg seasonal variation, low fat, product name etc...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coffee-regular or decaffeinated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coffee substitute (eg Ecco, Caro)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tea-regular, decaf, herbal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinking chocolate, Milo, Ovaltine etc</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beer, ale</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirits, cocktails</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liqueur, Port, Brandy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wine, dry or sweet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soft drinks- cola and non-cola</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diet soft drinks-cola and non-cola</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Cordial (regular or low joule)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAIRY PRODUCTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk-whole, skim, reduced fat, powdered UHT, buttermilk, etc</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cottage/ricotta cheese</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheese- block, slice, cheese spread</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yoghurt, plain</td>
<td></td>
<td></td>
<td></td>
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<td>Yoghurt, sweetened</td>
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<td>Ice cream regular</td>
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<tr>
<td>Ice confectionary/low calorie ice cream</td>
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<td>DAIRY PRODUCTS (continued)</td>
<td>Daily</td>
<td>4-6 times a week</td>
<td>1-3 times a week</td>
<td>1-3 times a month</td>
<td>1-3 times a year or never</td>
<td>Comments eg seasonal variation, low fat, product name etc...</td>
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<td>Milk shakes, smoothies</td>
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<tr>
<td>Eggs</td>
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<tr>
<td>Egg substitutes</td>
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<tr>
<td>(eg Scramblers)</td>
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<td>BREADS &amp; CEREALS</td>
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<td>Bread and rolls-wholemeal, mixed grain</td>
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<td>Plain Sweet Biscuits</td>
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<td>Fancy Biscuits</td>
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<td>(eg cream, choc-coated etc)</td>
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<td>Bagels, English muffins, crumpets</td>
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<td>Sweet bun, Danish, doughnuts</td>
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<td>Pancakes, pikelets, waffles</td>
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<td>Cereals-Porridge/Oatmeal</td>
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<tr>
<td>Muesli</td>
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<tr>
<td>Other Breakfast Cereals</td>
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<td>Pasta, Noodles</td>
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<td>Rice-brown, white, rice mixes</td>
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<td>Crackers/Crispbreads</td>
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<td>Popcorn</td>
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<tr>
<td>Chips-potato, corn etc</td>
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<tr>
<td>Muesli/Health bars</td>
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<tr>
<td>DESSERTS</td>
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<td>Puddings, custards</td>
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<tr>
<td>Bars, slices</td>
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<tr>
<td>Cakes</td>
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<tr>
<td>DESSERTS (continued)</td>
<td>Daily</td>
<td>4-6 times a week</td>
<td>1-3 times a week</td>
<td>1-3 times a month</td>
<td>1-3 times a year or never</td>
<td>Comments e.g. seasonal variation, low fat, product name etc...</td>
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<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Pies, fruit crumbles</td>
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<tr>
<td>Gelatine desserts - Jelly etc</td>
<td></td>
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<tr>
<td>Other, specify:</td>
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</tbody>
</table>

| MEAT, POULTRY, FISH   |       |                  |                  |                  |                         |                                                               |
| Pork                  |       |                  |                  |                  |                         |                                                               |
| Lamb, Veal            |       |                  |                  |                  |                         |                                                               |
| Beef                  |       |                  |                  |                  |                         |                                                               |
| Sausages/Continental Sausages |       |                  |                  |                  |                         |                                                               |
| Bacon                 |       |                  |                  |                  |                         |                                                               |
| Frankfurts, Saveloys |       |                  |                  |                  |                         |                                                               |
| Luncheon meats- ham, devon, salami , corned beef etc |       |                  |                  |                  |                         |                                                               |
| Variety/Organ meats- liver, tongue, kidney etc |       |                  |                  |                  |                         |                                                               |
| Chicken, turkey       |       |                  |                  |                  |                         |                                                               |
| Duck, quail           |       |                  |                  |                  |                         |                                                               |
| Fish, fresh or frozen- perch, salmon, hake, cod, sole etc |       |                  |                  |                  |                         |                                                               |
| Shellfish, fresh or canned - lobster, prawn, crab, mussels, scallops etc |       |                  |                  |                  |                         |                                                               |

<p>| MEAT SUBSTITUTES      |       |                  |                  |                  |                         |                                                               |
| Peanut butter         |       |                  |                  |                  |                         |                                                               |
| Nuts or seeds         |       |                  |                  |                  |                         |                                                               |
| Canned or dried beans, lentils, split peas, lima beans, baked beans |       |                  |                  |                  |                         |                                                               |
| Soy protein foods such as tofu |       |                  |                  |                  |                         |                                                               |</p>
<table>
<thead>
<tr>
<th>MIXED DISHES, SOUPS</th>
<th>Daily</th>
<th>4-6 times a week</th>
<th>1-3 times a week</th>
<th>1-3 times a month</th>
<th>1-3 times a year or never</th>
<th>Comments e.g. seasonal variation, low fat, product name etc...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pizza, lasagne, macaroni &amp; cheese, ravioli, spaghetti bolognaise etc</td>
<td></td>
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<tr>
<td>Tacos, enchiladas, burritos, chilli etc</td>
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<tr>
<td>Hamburger</td>
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<tr>
<td>Stews/Casseroles/ Curry/Goulash</td>
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<tr>
<td>Meat Loaf</td>
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<tr>
<td>Quiche, souffle</td>
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<tr>
<td>Stir fry meat and vegetable dishes</td>
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<tr>
<td>TV/frozen dinners eg McCain, Findus</td>
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<tr>
<td>Soups, including cream soups, chowders</td>
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<tr>
<td>Sausage Roll, Pastie, Meat Pie</td>
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<tr>
<td>Canned meals eg Heinz, Kraft beef and vegetables</td>
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<tr>
<td>Other mixed dishes commonly eaten Specify:</td>
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<table>
<thead>
<tr>
<th>VEGETABLES</th>
<th>Daily</th>
<th>4-6 times a week</th>
<th>1-3 times a week</th>
<th>1-3 times a month</th>
<th>1-3 times a year or never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potatoes-baked, boiled, mashed, hot chips etc</td>
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<tr>
<td>Sweet potatoes</td>
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<tr>
<td>Green vegetables-peas, broccoli, spinach, beans, cabbage etc</td>
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<tr>
<td>Other cooked vegetables-pumpkin, carrots, corn etc</td>
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<tr>
<td>Category</td>
<td>Daily</td>
<td>4-6 times a week</td>
<td>1-3 times a week</td>
<td>1-3 times a month</td>
<td>1-3 times a year or never</td>
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<td>VEGETABLES (continued)</td>
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<tr>
<td>Salads, raw vegetables</td>
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<tr>
<td>Vegetable juices-V8, tomato juice</td>
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<tr>
<td>FRUIT AND FRUIT JUICES</td>
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<tr>
<td>Fruit juice</td>
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<tr>
<td>Fruit-flavoured drinks-Tang etc</td>
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<tr>
<td>Citrus fruits-oranges, grapefruits</td>
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<tr>
<td>Canned fruits in natural juice/water</td>
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<tr>
<td>Dried fruits-raisins, dates, prunes, apricots etc</td>
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<td>Avocado</td>
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<td>SUGAR-FREE PRODUCTS</td>
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<tr>
<td>Artificial sweeteners</td>
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<td>Lollies, chewing gum</td>
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<td>Chocolate</td>
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<tr>
<td>Syrups, jams</td>
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<tr>
<td>Ice cream</td>
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<tr>
<td>Biscuits, cake</td>
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<tr>
<td>Jelly</td>
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<tr>
<td>Puddings, custards</td>
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<tr>
<td>MISCELLANEOUS</td>
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<tr>
<td>Soy milk</td>
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<tr>
<td>Vegemite/marmite</td>
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<td>Fish paste</td>
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<tr>
<td>Pickles, relish, chutneys</td>
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<tr>
<td>Olives</td>
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</table>
## MISCELLANEOUS (continued)

<table>
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<th>1-3 times a week</th>
<th>1-3 times a month</th>
<th>1-3 times a year or never</th>
<th>Comments e.g seasonal variation, low fat, product name etc...</th>
</tr>
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<tbody>
<tr>
<td>Steak sauces, mustard</td>
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<tr>
<td>Tomato sauce, chilli sauce</td>
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<tr>
<td>Soy sauce, teriyaki sauce</td>
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<tr>
<td>Confectionary, gum, cough lozenges</td>
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<tr>
<td>Spreads- jam, honey, syrup, marmalade</td>
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<tr>
<td>Chocolate bars</td>
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## DIETARY SUPPLEMENTS

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<th>1-3 times a week</th>
<th>1-3 times a month</th>
<th>1-3 times a year or never</th>
<th>Comments e.g seasonal variation, low fat, product name etc...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamins and/or minerals</td>
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<tr>
<td>Bran</td>
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<td>Wheat germ</td>
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<td>Other supplements</td>
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<td>Specify:</td>
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</table>

## OTHER COMMONLY CONSUMED FOODS OR BEVERAGES NOT INCLUDED IN PREVIOUS GROUPS

<table>
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<th>Item</th>
<th>Daily</th>
<th>4-6 times a week</th>
<th>1-3 times a week</th>
<th>1-3 times a month</th>
<th>1-3 times a year or never</th>
<th>Comments e.g seasonal variation, low fat, product name etc...</th>
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</thead>
</table>


*ADAPTED FROM THE FOOD PATTERN QUESTIONNAIRE
DEVELOPED BY:
The Nutrition Coordinating Centre
2829 University Avenue SW
MINNEAPOLIS, MN 55414
APPENDIX 4.
Diabetes Control and Complications Trial (DCCT) - Australian Version*

This questionnaire is to be completed by the person who usually prepares the food in your home. If this is not possible then please fill the form out as best you can. This questionnaire is important for analysis of the dietary component of the study. If you have any questions about the form you can ask the dietitian.

Thank you for your co-operation.

<table>
<thead>
<tr>
<th>Participant's Name:</th>
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</thead>
<tbody>
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<table>
<thead>
<tr>
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<table>
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<th>Dietitian:</th>
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<table>
<thead>
<tr>
<th>Telephone:</th>
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<tbody>
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<td></td>
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</tbody>
</table>

1. What relationship are you to the participant?

- [ ] self
- [ ] parent
- [ ] spouse
- [ ] other, specify __________

2. If the following foods are prepared at home, tick the type of sweetener usually used:

<table>
<thead>
<tr>
<th>Fruit juices</th>
<th>Sugar Added</th>
<th>Artificial Sweetener Added (give name)</th>
<th>Other eg honey</th>
<th>None Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh fruit</td>
<td></td>
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<tr>
<td>Canned fruit</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Beverages (tea, coffee, milk drinks etc)</td>
<td></td>
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<tr>
<td>Baked goods (cakes, biscuits etc)</td>
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<tr>
<td>Other (specify)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. Tick whether salt or a salt substitute is usually added in preparing the following foods:

<table>
<thead>
<tr>
<th>Food</th>
<th>Salt</th>
<th>Salt Substitute</th>
<th>Seasoning Salts</th>
<th>None Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasta, such as noodles, spaghetti, etc</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Rice</td>
<td></td>
<td></td>
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<tr>
<td>Potatoes, hot chips</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Other Vegetables</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Meat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other: Specify</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

If salt substitute, specify kind/brand: ...........................................

4. Are the following cooking oils/fats and spreads used (please tick):

a) Butter
   - [ ] yes Specify: [ ] regular
   - [ ] no
   - [ ] salt reduced
   - [ ] diet/reduced fat

b) Margarine
   - [ ] yes Specify: [ ] regular
   - [ ] no
   - [ ] salt reduced
   - [ ] diet/reduced fat
Specify the brand(s) of butter/margarine used:

---

**c) Vegetable oil (such as olive, canola, safflower, sunflower etc)**

- [ ] yes
- [ ] no

Specify types and/or brands used:

---

**d) Oil Sprays (eg Pure and Simple, Golden Canola etc)**

- [ ] yes
- [ ] no

Specify brand:

---

**e) Solid oils/fats (eg Frymaster, Fairy, Copha, Tulip etc)**

- [ ] yes
- [ ] no

Specify types and/or brands used:

---

**f) Other cooking fats (such as lard, ghee, beef dripping etc)**

- [ ] yes
- [ ] no

Specify types and/or brands used:

---
5. Tick the type of oil/fat most often used in preparing each of the following foods:

<table>
<thead>
<tr>
<th></th>
<th>Butter</th>
<th>Margarine</th>
<th>Oil Sprays</th>
<th>Vegetable OIL</th>
<th>SOY OIL</th>
<th>TABLE</th>
<th>OIL</th>
<th>Table Fats</th>
<th>Added Fats</th>
<th>Grease, Lard, Melt</th>
<th>Added Grease</th>
<th>Don't Cook</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggs, fried</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Eggs, scrambled</td>
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<tr>
<td>Toast/Sandwiches</td>
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<tr>
<td>Potatoes, mashed</td>
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<td></td>
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<tr>
<td>Potatoes, baked</td>
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<tr>
<td>Hot Chips</td>
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<tr>
<td>Green Vegetables</td>
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<tr>
<td>Other Vegetables</td>
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<td></td>
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<tr>
<td>Beans, lentils</td>
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</tr>
<tr>
<td>Gravy</td>
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<td></td>
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<tr>
<td>Sauces eg white, mushroom</td>
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<tr>
<td>Pastry</td>
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</tbody>
</table>
6. Indicate the most usual method of preparing each of the following. If you fry any of them, comment on whether the item is dipped in flour or batter or crumbed before frying and what oil/fat is used for frying. Also tick whether gravy or sauce is prepared. If sauce is prepared state what type it is (e.g Maggi satay packet mix, Masterfoods chilli sauce, homemade etc...)  

<table>
<thead>
<tr>
<th>ITEM</th>
<th>METHOD OF COOKING (eg baking, grilling, pan fry, deep fry etc)</th>
<th>KIND OF FAT USED (if any)</th>
<th>GRAVY or SAUCE</th>
<th>IF SAUCE, SPECIFY TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamburger</td>
<td></td>
<td></td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Steaks</td>
<td></td>
<td></td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Chops</td>
<td></td>
<td></td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Chicken</td>
<td></td>
<td></td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Fish</td>
<td></td>
<td></td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Shellfish (prawn, lobster etc)</td>
<td></td>
<td></td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Liver, kidney etc</td>
<td></td>
<td></td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Other, specify</td>
<td></td>
<td></td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>

7. If you prepare gravies, do you usually use:  

- [ ] cornflour  - [ ] flour  - [ ] packet mix eg Gravox  

Is the liquid usually:  

- [ ] milk  - [ ] water  - [ ] other, specify __________________________
8. Tick how much fat is usually trimmed from the meat before cooking or eating:

- [ ] trim most or all
- [ ] trim some
- [ ] usually don’t trim

9. Tick the type of salad dressing **most often** used with the following salads (specify brand(s) where possible):

<table>
<thead>
<tr>
<th></th>
<th>Regular mayonnaise such as Praise, Kraft</th>
<th>Reduced fat mayonnaise such as Kraft Light, Weight Watchers</th>
<th>Oil free dressing such as Praise No Oil, Fountain No Oil, Kraft Free</th>
<th>Other-specify type e.g., Italian, Thousand Island etc.- OR Homemade (list ingredients)</th>
<th>Don’t use salad dressing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato salad</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Coleslaw</td>
<td></td>
<td></td>
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<tr>
<td>Tossed salad</td>
<td></td>
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<tr>
<td>Pasta salad</td>
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<td></td>
</tr>
<tr>
<td>Other, specify</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Prepared by Effie Tsivis, Dietitian, July 1995.

ADAPTED FROM THE FOOD PREPARATION QUESTIONNAIRE
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