1995

Insulin dependent diabetes mellitus: the affect of obesity on blood glucose control

Kathryn Fitzgerald
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INSULIN DEPENDENT DIABETES MELLITUS: 
THE AFFECT OF OBESITY ON BLOOD GLUCOSE CONTROL

by


A thesis submitted in partial fulfilment of the requirements for the

Master of Science (Nutrition and Dietetics)

from

University of Wollongong

1995
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ABSTRACT

Poor glycaemic control has recently been associated with the rate of onset and severity of long term complications associated with diabetes. Obesity is one of the factors known to influence the level of glycaemic control, however, few studies have looked at the relationship between obesity and glycaemic control in populations with insulin dependent diabetes mellitus (IDDM).

The aim of this study was to assess the level of glycaemic control of those above the acceptable weight range, to those within the acceptable weight, and to determine whether weight control is an important goal for the IDDM population.

Twenty one people with IDDM, aged between 18-30 years, from the Illawarra took part in the study. All were interviewed and anthropometric measurements and blood samples were taken. Weight status was determined by BMI and percent body fat, and glycosylated haemoglobin (HbA1c) levels indicated glycaemic control.

The results indicated that although increases in Body Mass Index (BMI) were associated with increases in HbA1c levels, which indicates poor control, the strength of this relationship was not strong. The importance of weight status on glycaemic control was also assessed in light of the impact of other known factors such as exercise and number of insulin injections. The majority of the population indicated that weight control is an important goal for them, and one which most appear to be making a conscious effort to control.

The lack of statistical significance of these results was thought to be due, to the small sample size and the fact that the majority of the population studied fitted within the acceptable weight range. Further investigations on a larger population would add weight to these conclusions and allow for further recommendations to be made concerning the emphasis which should be placed on weight control in the management of IDDM.
Introduction

Insulin dependent diabetes mellitus (IDDM) is a condition in which the body ineffectively metabolises glucose as there is little or no insulin produced by the body. Poorly controlled blood glucose can lead to the development of several acute and chronic complications. Therefore the main goal for IDDM management is "to maintain near normal blood glucose levels" (Franz et al, 1994) as much as possible.

Some people with IDDM manage to maintain fairly constant glucose control with treatment by insulin, diet and exercise (Zeman, 1991). However, blood glucose or glycaemic control is known to be influenced by a number of other factors also, such as weight status, exercise, stress levels and illness.

Although extensive research has been completed which looks at the affects of these factors in non insulin dependent diabetes mellitus (NIDDM), few have assessed the relationship between these factors and glycaemic control in IDDM populations specifically.

This study aims to assess and compare the level of glycaemic control of obese and overweight individuals with IDDM to non obese individuals with IDDM, and to determine whether, as recommended by many health professionals, the maintenance of weight within the healthy weight range is an important goal which people with IDDM are trying to achieve.
Objectives of the research are to;

- To determine what proportion of the population with IDDM are overweight or obese.

- To compare the blood glucose control of people with IDDM who are overweight or obese to those within the healthy weight range.

- To determine whether the IDDM population are trying to maintain an acceptable weight for height.
1.1 Prevalence of Insulin Dependent Diabetes Mellitus

Insulin dependent diabetes mellitus (IDDM) is characterised by a deficient production of insulin. IDDM can occur at any age but the onset is usually abrupt and symptomatic and mainly occurs during childhood, adolescence and early adulthood (McDonald & Roberts, 1990).

Of the total 4% of the Australian population diagnosed with diabetes mellitus (AIHW, 1994) IDDM effects approximately 15%. The remaining 85% have non insulin dependent diabetes mellitus (NIDDM). NIDDM usually has a later age of onset and may not require insulin for treatment.

Diabetes is the fifth major cause of death by disease in Australia (Diabetes Australia, 1994). Poor blood glucose or glycaemic control in IDDM can lead to the development of several acute and chronic conditions. Hypoglycaemia or insulin shock and ketoacidotic coma are both acute and can have fatal consequences. IDDM is also associated with an increased risk of several chronic conditions such as cardiovascular disease, and microvascular complications such as nephropathy, neuropathy and retinopathy which are related to poor glycaemic control (Coulson, 1994). Therefore, good glycaemic control is a major goal in the treatment of IDDM.
The management of IDDM relies heavily on regulation of insulin injections in conjunction with dietary management to normalise blood glucose levels, reduce the risk of hypoglycaemia and slow the development of long term complications (Franz et al, 1994). Other factors have also been shown to influence glycaemic control in IDDM such as exercise, stress, weight status and presence of illness and will be discussed later (see section 1.3).

1.2 Determination of Glycaemic Control

The level of glycosylated haemoglobin (HbA1c) present in the blood can be measured to assess the degree of blood glucose control over an extended period (Zeman, 1991). HbA1c is formed by a reaction between haemoglobin (red blood cells) and glucose (Zeman, 1991), and the concentration in which it is found reflects the episodes of high and low blood glucose levels.

The rate of formation of HbA1c depends on the concentration of glucose in the blood (Zeman, 1991). Hyperglycaemia causes increased glycosylation of haemoglobin and therefore an increased concentration in the blood. In the non-diabetic person HbA1c usually constitutes 5.4-7.4% of haemoglobin (Zeman, 1991), however, levels may reach as high as 15 % in uncontrolled diabetes mellitus (Zeman, 1991).
The categories used to describe the level of glycaemic control may vary depending on the purpose for the assessment of HbA1c (Zeman, 1991). The following categories are considered appropriate when HbA1c is being used as an indicator of glycaemic control in those already diagnosed with IDDM, and are the categories currently recommended for use by the Dietitians Association of Australia for such a purpose.

- Ideal control (normal) < 8%
- Good control 8%-10%
- Average Control 10% -12%
- Poor control > 12%

(Dept. Nutrition, Dietetics & Food Science Curtin University, 1992)

The reaction which allows HbA1c to form is slow and therefore represents extended periods of poor control. Levels can only decrease as the red blood cells which have reacted to form HbA1c are removed from circulation. Thus, HbA1c reflects the level of hyperglycaemia or hypoglycaemia over a period of 2-3 months (Zeman, 1991).

HbA1c concentration was considered an appropriate measure as it identifies the degree of glycaemic control of the population, and is an indicator of their long term management of diet and insulin therapy and is readily available.
1.3 Factors Affecting Glycaemic Control

There are many factors known to effect glycaemic control in people with IDDM, particularly short term control. Zeman, (1991) reports that exercise is one such factor.

It has long been known, that, in the short term, exercise increases glucose utilisation and insulin absorption in people with IDDM, resulting in a reduction of blood glucose after each exercise session (Lawrence, 1926). This reduction in blood glucose is usually adjusted for by changes in insulin dosage or food intake to ensure good glycaemic control.

Considering this acute reduction in blood glucose during exercise, it could be hypothesised that an improvement in long term glycaemic control would result from an increase in regular exercise.

Wallberg - Henriksson et al (1982) and Zinman et al (1984) carried out studies of 13 and 9 people aged over 25 years, with IDDM respectively, to determine the long term effect of regular exercise on blood glucose control over a 12 week period. As suggested above, the blood glucose level was found to be lowered by each exercise session, however, there was no demonstrable difference found between the HbA1c levels in those who had exercised compared to those who had not. This was thought to be due to an increase or 'liberalisation' of food consumption by those in the exercise group on exercise days. This suggests that if dietary intake is not increased on exercise days, a reduction in HbA1c levels may result, however, this concept has not been proven.
Although the effects of exercise on glycaemic control have been shown to be limited, the long term benefits of exercise, such as improved cardiovascular fitness, and psychological benefits (Kannel & Sorlie, 1979; Paffenbarger & Hyde, 1980) experienced by the general population are also experienced by the IDDM population (Wallberg - Henriksson, 1982). The IDDM population has also shown long term improvements in insulin sensitivity, and a reduction in blood cholesterol (Zinman et al, 1984) with regular exercise.

Factors such as stress and infection also effect blood glucose control (Zeman, 1991). They can stimulate the release of glucagon (an insulin antagonist), or result in increased insulin resistance, which may cause blood glucose levels to rise even though food intake is low. If these effects are not adjusted for by changes to food intake, insulin dosage, or timing of insulin injections, hyperglycaemia may occur and overall glycaemic control will be reduced (Zeman, 1991).

Body weight is another factor thought to influence blood glucose control in IDDM. The relationship between obesity and blood glucose control in people with IDDM has been shown in a study by Souissi et al (1993) and will be discussed below (see section 1.5.1).

1.4 Obesity

An increase in body fat or becoming obese is the result of excessive caloric intake compared to energy expenditure (Garrow, 1985; Bray, 1985; Miller, 1990). The cause is a
complex interaction between genetic and environmental factors, such as appetite regulation, food choices and physical activity (Franz et al, 1994).

1.4.1 Prevalence of Obesity

The prevalence of obesity in the IDDM population in the Illawarra has not been widely researched in the past, so obesity figures, specific to this population, are not available. Chaturvedi (1995) found that in a cohort study of 644 men and 576 women in Britain with IDDM, 10% showed a BMI < 20 or were "underweight", 64% had a BMI 20 - 26, ie, within the "acceptable range" set by this study and 26% had a BMI > 26 or, fitted the "most obese" category described in this study.

1.4.2 Factors which effect obesity

**Food Choices**

Food choices will influence the level of obesity in all people but are of special concern in the IDDM population. Food choices for these people will not only influence the level of obesity, but will also effect glycaemic control and the occurrence of other metabolic conditions, such as dyslipidemia, and ketoacidosis (Zeman, 1991). Good management of IDDM requires the adoption of a long term eating plan, adherence to which will help to maintain good glycaemic control and prevent complications (Rosenstock, 1985; DCCT, 1986).
Historically, adherence to such eating plans (particularly long term), has been below ideal (Worsley, 1989). Reasons for this are thought to include: a) low palatability of the high carbohydrate, high fibre, and low fat diet usually recommended, b) the feasibility of the foods recommended ie cost, convenience, accessibility and availability, c) the importance of social, career and personal goals which influence the significance of the diet and e) emotional factors such as the way the person copes with conflict, stress and anxiety and their use of food in these situations (House et al, 1986; Worsley, 1989; Schlundt et al, 1994)

Food is a major part of socialisation and communication in our society. It cannot be studied as a separate entity without making some consideration for environmental influences.

It is a combination of many of the factors outlined above, which dictate exactly which food choices will be made (Worsley, 1989), in people with IDDM, these decisions will effect the level of glycaemic control and the weight status maintained.

1.5 Obesity and IDDM

The general health risks associated with obesity, such as hyperlipidaemia, hypertension, and increased mortality have been widely reported (Lew & Garfinkel, 1979; Mallick,1983; Bray, 1985; Garrow, 1987) and for this reason dietetic advice to people with IDDM, and
the general population alike, concentrates on the maintenance of ideal body weight as a primary objective or goal of treatment (McDonald & Roberts, 1990; Miller, 1990).

1.5.1 Obesity and glycaemic control

Souissi et al (1993), has looked at the relationship between weight and glycaemic control in IDDM and particularly the glycaemic control of those who are overweight or obese. Chaturvedi et al (1995) also noted the effect of obesity on glycaemic control in a study looking at weight gain which is the result of improved glycaemic control.

Souissi et al (1993) looked specifically at the effects of obesity on glycaemic control in 13-20 year old girls with IDDM. Excess weight was evaluated using Z scores, corrected for age with reference to French standards. Participants with a Z score greater than 2 were considered obese and were found to have greater daily insulin doses and worse glycaemic control, (HbA1c 10.9 +/- 0.22 vs 10.2 +/- 2.0%) compared to non-obese individuals.

The study by Chaturvedi et al (1995) outlined above, looked at weight gain in the IDDM population who maintained strict glycaemic control, and primarily assessed the relative risk of weight gain on mortality. In this study it was noted, that people in the category described as the “most obese” (BMI > 26 kg/m sq), females particularly, showed the worst glycaemic control.
Thus, it may be suggested that people with IDDM and who are obese, will have worse glycaemic control compared to those within the healthy weight range, and that weight loss should be encouraged, not only to improve glycaemic control in the short term, but to reduce the health risks associated with obesity generally.

1.5.2 Glycaemic Control and Weight Gain

The DCCT (1986) and the Stockholm Diabetes Intervention Study (Reichard et al 1991) have concluded that even though the risk of microvascular complications in IDDM is reduced by strict glycaemic control, strict glycaemic control itself, has some notable disadvantages.

Strict glycaemic control has been found to “increase the frequency of severe hypoglycaemic episodes” (Amiel, 1993 p.881), causing many health professionals to question the degree of glycaemic control considered ideal and the costs associated with meeting those goals. (Lasker, 1993)

Strict glycaemic control has also been shown to be directly related to weight gain (Wing et al, 1990; Lasker, 1993). Wing et al (1990) completed a 4 year study of 405 adults aged over 21 years with IDDM, which looked specifically at weight gain associated with strict glycaemic control, a phenomenon also noted in the DCCT (1995). It was concluded that over the 4 year period, weight gain averaged 1.8 +/- 5.9 kg, and was significantly associated with improvements in HbA1c levels. ie, those who gained 3.4 kg had the
biggest improvements in control, whilst those who gained only 0.6 kg showed the smallest improvement.

Wing et al (1990) and Lasker (1993) propose some possible reasons for this weight gain. Although these reasons are not proven, the increase in weight is thought to be due to the nature of intensive insulin therapy affecting eating habits by causing an increase in dietary intake (Rodin et al, 1985; Campbell & Carlson, 1993). Another reason is thought to be due to a decreased metabolic rate (Leslie et al 1986, as cited in Chaturvedi et 1995), possibly the result of poor eating or anorexia due to illness prior to the study. Chaturvedi, 1995 suggests that ‘improving control restores anabolism and, hence, results in weight gain’ (p.764), in those who previously had poor glycaemic control.

1.5.3 Weight Control or Glycaemic Control?

In the context of dietetic counselling, it is important to consider weight, not only as it relates to glycaemic control, but also as a ‘side effect’ of improved glycaemic control. In light of this phenomenon the benefits and risks of improved glycaemic control and obesity need to be considered and weighed against each other.

A study by Winocour et al (1992), found that in a cross sectional study of 90 people with IDDM, aged between 17-70 years, weight (BMI) was not a predictor of coronary heart disease (CHD) risk in this population. CHD risk was found to be closely associated with increasing age, blood pressure and total serum lipids, in the IDDM population, however
increases in BMI was only found to be an additional predictor of CHD risk in the non-diabetic group. In the study by Chaturvedi et al 1995 (outlined above) mortality rates across the four heaviest categories ie BMI 20-<22, 22-<24, 24-<26, 26+ kg/m sq, were compared. Little difference was found, which suggests that even though glycaemic control was found to be worse in the most obese category, the risk of mortality, was not significantly effected by weight.

However, it should be noted that the BMI categories described in the study by Chaturvedi et al (1995), are actually categories within the scope of the ‘acceptable weight range’ (Miller,1990). Only the “most obese” category, is above the acceptable weight range. This category incorporates any BMI > 26. It groups overweight, obese and morbid obesity (Miller,1990) categories together and compares this as one group to 3 smaller sub groups within the acceptable weight range. Differences in glycaemic control may have been skewed by the categorisation of the data.

As studies to date do not include the obese (ie BMI 30-40) and morbidly obese (ie BMI 40+) portion of the IDDM population it is difficult to draw conclusions about the risk of mortality for these groups.

From the research which is available however, it can be concluded that weight increases which result from tight glycaemic control alone are not significantly associated with an increased rate of mortality, and that compared to the benefits derived from tight glycaemic
control (DCCT, 1986), should present little concern to health professionals and people with IDDM.

Care should be taken to not place too much emphasis on the importance of weight control within the acceptable weight range for all people with IDDM, as this may be to the detriment of good glycaemic control. The long term benefits of good glycaemic control have been shown in the DCCT, whilst the disadvantages of weight gain which may result from improved glycaemic control alone has been shown to have no direct impact on mortality rates for most people.

The emphasis required should be varied depending on the individual and the area which will offer the most advantages for them. For example, it is important that concern about weight gain does not restrict efforts to improve glycaemic control (Chaturvedi et al 1995) in those people within the acceptable weight range. However, the additional health risks associated with weight increases (Mallick, 1983; Bray, 1985; Garrow, 1987), in those already obese, might see emphasis being placed on the importance of weight control firstly and the improvement of glycaemic control secondly.

1.6 Selection of Methods Used

1.6.1 Weight Status

Body weight in relation to height is often used to determine the extent to which a person is above or below the acceptable or “healthy weight range” (standard weight for height of a
On this basis, obesity is defined as body weight 20% or more above the desirable level in women and 25% in men. This does not however, provide a distinction between muscle mass and body fat, for which body fat measurements are necessary (Zeman, 1991).

Some methods which estimate body fat include measurement of total body water, specific gravity, total body potassium, electrolytes, anthropometry, imaging and light absorption and muscle analysis. (Lukaski, 1987; Fuller et al, 1994)

All of these methods have different benefits and disadvantages. The benefits being improved accuracy and reproducibility and the disadvantages being cost, high level of skill in operation required and degree of personal invasion to the subject (Lukaski, 1987). All of these benefits and disadvantages need to be weighed up and the needs of the research viewed objectively.

Estimating total body fat and therefore the degree of overweight (Garrow, 1983) can be done through a range of measures. As mentioned above body weight fails to account for lean body mass and has seen the evolution of height to weight formulations, the most prominent being ‘Body Mass Index’ (BMI).
The BMI uses the formula “BMI = Weight (kg) / height (m sq)” and is widely accepted because it is independent of age and sex and correlates well with independent measures of body fat (Zeman 1991, & Miller 1990).

Miller, 1990 defines body fatness using BMI as:

<table>
<thead>
<tr>
<th>Definition</th>
<th>BMI (kg/m sq)</th>
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<tr>
<td>Underweight</td>
<td>&lt; 20</td>
</tr>
<tr>
<td>Acceptable Weight</td>
<td>20-25</td>
</tr>
<tr>
<td>Overweight</td>
<td>25-30</td>
</tr>
<tr>
<td>Obese</td>
<td>30-40</td>
</tr>
<tr>
<td>Morbidly Obese</td>
<td>&gt; 40</td>
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</table>

The acceptable weight range (BMI 20-25) shows the least risk of morbidity and minimal risk of mortality (Dept. Public Health & Nutrition, Curtin University, 1992). “It is also equivalent to a body fat composition of 12-22% in males and 22-33% in females” (Miller, 1990)

The BMI is calculated simply but still does not specifically differentiate percent lean mass from percent body fat or body fat distribution. For this reason other anthropometric measurements can also be taken. Skinfold thickness measurements and waist to hip ratios (WHR), give a good description of the degree of obesity and the distribution of fat on the body (Garrow, 1985; Bray, 1985; Egger, 1992).
Katch and McArdle, (1977) suggest that approximately half of the body's total fat is located beneath the skin and that skinfold measurements give a good indication of percentage body fat, adjusted for age and gender, without being difficult to measure or invasive to the subject. Egger & Champion, (1986) classify leanness and fatness based on % body fat as follows;

<table>
<thead>
<tr>
<th>%Body Fat</th>
<th>Men</th>
<th>Women</th>
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<tbody>
<tr>
<td>Lean</td>
<td>&lt; 12%</td>
<td>&lt;17%</td>
</tr>
<tr>
<td>Acceptable</td>
<td>12.0-20.9%</td>
<td>17.0-27.9%</td>
</tr>
<tr>
<td>Moderately obese</td>
<td>21.0-25.9%</td>
<td>28.0-32.9%</td>
</tr>
<tr>
<td>Obese</td>
<td>&gt;26.0%</td>
<td>&gt;33.0%</td>
</tr>
</tbody>
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The waist: hip ratio (WHR) can also be used as a measurement of obesity (Egger, 1992). It is a measurement which indicates the degree of upper body obesity, which can also be used to show an increased risk of coronary heart disease (CHD) (Egger, 1992). Excess fat in the abdominal region, which is called android obesity (apple shape), is metabolically more active than fat located on the hips and thighs (gynoid or pear shaped). A WHR higher than 0.90 for men and 0.80 for women indicates an increased risk of CHD (Egger, 1992).
CHAPTER 2: METHODOLOGY

2.1 Ethics Approval

Ethics approval was granted by the Human Research Committee at the University of Wollongong. The sampling procedures, recruitment of subjects, experimental procedures, questionnaire format, handling and analysis of data and general conduct of this research have been considered to be ethical and suitable for human experimentation.

2.2 Subject Recruitment

The study population consisted of people aged between 18-30 years with IDDM, who were registered with the Diabetes Education and Information Unit, Illawarra Area Health Service, between January 1984 and December 1994, and who reside in the Illawarra Region.

Subjects were recruited from lists obtained from the Diabetes Education Centre in Wollongong. Seventy one people were invited to take part in the study. A letter introducing and outlining the study was sent, along with an information sheet. A copy of the initial contact letter and the information sheet can be found in Appendix 1 and 2 respectively.
2.3.1 Questionnaire Format

This study formed part of a larger population study which was designed to collect extensive baseline data. For this reason several questionnaires were used to gather this information. However, only two questionnaires were used in this particular study, copies of which can be found in Appendix 3. All questionnaires were self-administered by the participants at the research centre.

- The Demographic Questionnaire: obtained information about age, sex, marital status, socioeconomic status, diabetes and health history and current diabetes management regimen being followed.

- The Lifestyle Questionnaire: covered specific aspects of diabetes management, particularly, exercise and weight history.

The weight history questions were developed specifically for this project and used an open ended approach, as the number of possible answers given for each of the questions was self limiting and because this style of question allowed the respondents to indicate any attempts being made by them to influence their weight status. It was thought closed questions would effect responses, by offering limited and perhaps skewed answers from which the participants could choose (Foddy, 1994).

In order to determine the awareness the respondents had of their ideal weight it was necessary to ask them to quantify it. It was expected that anyone who understood the
importance of weight control to diabetes, or those actively trying to reduce, maintain, or increase their weight would be aware of this information. The figure could then be compared to the table of acceptable weights-for-heights for Australian men and women aged 18 years or more, published by the National Health & Medical Research Council, (1984), and the accuracy of their understanding could be assessed.

2.3.2 Consultative Process

To ensure that the personal interviews were structured the same for each of the 7 interviewers, protocols were developed, particularly for the taking of the anthropometric measurements.

Anthropometric Measurements:

Anthropometric measures such as height, weight, waist to hip ratio (WHR) and skinfold thicknesses (Durnin & Wommersley, 1974) were then taken and recorded on the Anthropometric Measures form. A copy of this form can be found in Appendix 4.

The participants current weight (to the nearest 0.5 of a kilogram with indoor clothing and no shoes), and height (to the nearest 0.5 cm without shoes) were determined using the same Seca spring scales and non-stretchable tape for each participant. The Body Mass Index (BMI) was then calculated (Bray, 1985; Garrow, 1985)
Harpenden Mechanical Callipers were used to take skinfold thickness measurements. The four specific sites measured were subscapular, bicep, suprailiac, and tricep, all were taken on the right side of the body for each participant and were chosen based on research by Durnin and Wommersley (1974).

Measurements were taken three times to within one millimetre to minimise error, and the average of the three readings was used.

Estimations of percentage body fat was determined from these readings using the equation developed by Durnin and Womersley (1974) suitable for males and females aged over 17 years.

The waist to hip ratio (WHR) was also used as an indicator of obesity based on research by Egger (1992).

Blood Sample:
A non-fasted venous blood sample was taken at the Pathology Department at Illawarra Regional Hospital - Wollongong Campus. A whole blood sample was used, and HbA1c was determined using in house high performance liquid chromatography (Biochemistry Department, Illawarra Regional Hospital - Wollongong Campus).
2.4 Data Analysis

Nutrient analysis of the diet history was performed with Diet/1 Nutrient Calculation Software (Version 3) which uses the NUTTAB data base (1992), at The University of Wollongong.

The data collected from the questionnaires and interview was quantitative and was coded for analysis on JMP. Analysis of variance was used to test for significance between HbA1c and the factors thought to effect it.
CHAPTER 3: RESULTS & DISCUSSION

3.1 Description of the sample

Based on the register held by the Diabetes Education Centre of 71 people with IDDM residing in the Illawarra, only 41 were able to be contacted. Of those, 5 were ineligible for the study (3 were NIDDM, 1 not IDDM, 1 in hospital).

Of the 36 people able to be contacted, 15 people declined participation in the study with reasons such as work or study commitments and disinterest given. A total of 21 people (15 male, 6 female) were involved in the study.

The average current age of the sample was 23 years (see Table 3.1), with 6.8 years as the average length of diagnosis of IDDM. Demographic data indicated that all of the participants were either single (n = 12) or married (n = 9) and 95 percent were born in Australia. Twenty-six percent, indicated they had completed the HSC, 44 percent had begun tertiary education and 30 percent had completed tertiary education and the average family income was estimated to be between $32,001 - $40,000.

The mean height of the sample was 173.7 cm and weight was 76.3 kg (see Table 3.1). The mean body mass index (BMI) of the study population was 25.1 kg/m sq (see Table 3.1), which lies just above the acceptable range of 20-25 kg/m sq (Egger, 1992). This result means that the average BMI of the sample population is within the overweight range, as
research categorises a BMI between 25-30 kg/m sq for men and women above 18 years, as overweight (Egger, 1992).

The mean percentage of body fat in this sample was 20.6%. The % body fat of the male population was 16.6%, which is within the acceptable category for men of this age group (Egger & Champion, 1986), whilst the mean % body fat of the female population was 29.9%, which is within the moderately obese category for this age group (Egger & Champion, 1986).

The average waist: hip ratio (WHR) of the female participants was 0.76, and 0.89 for the male participants. The result for this sample is as expected for a mostly lean population. It shows that based on their waist: hip measurements, neither males nor females have a high degree of upper body obesity, and using this as an indicator of risk, the IDDM population is shown to be outside the high risk category for coronary heart disease.

The data is summarised in Table 3.1
Table 3.1: Data of population.

<table>
<thead>
<tr>
<th></th>
<th>Mean ± SD</th>
<th>Range</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>23 ± 8</td>
<td>18 - 31</td>
<td>21</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>173.7 ± 19.3</td>
<td>154 - 192</td>
<td>21</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>76.3 ± 57.9</td>
<td>57.8 - 134</td>
<td>21</td>
</tr>
<tr>
<td>BMI (kg/ m sq)</td>
<td>25.1 ± 11.1</td>
<td>21.8 - 36.23</td>
<td>21</td>
</tr>
<tr>
<td>WHR: female (cm)</td>
<td>0.76 ± 0.08</td>
<td>0.68 - 0.89</td>
<td>6</td>
</tr>
<tr>
<td>WHR: male (cm)</td>
<td>0.89 ± 0.11</td>
<td>0.77 - 1.02</td>
<td>15</td>
</tr>
<tr>
<td>Body Fat (%)</td>
<td>20.6 ± 18</td>
<td>10 - 32</td>
<td>21</td>
</tr>
<tr>
<td>Body Fat: female (%)</td>
<td>29.9 ± 1.6</td>
<td>28 - 31</td>
<td>6</td>
</tr>
<tr>
<td>Body Fat: male (%)</td>
<td>16.6 ± 16.4</td>
<td>9.6 - 32</td>
<td>15</td>
</tr>
</tbody>
</table>

3.2 Weight Status

Based on the body mass index (BMI) value, the proportion of the total sample population found to be within the acceptable or 'healthy' weight range was 62 percent (n = 13).

33 percent (n=7) were found to be in the overweight category whilst 5 percent (n = 1) of the participants were found to be in the obese category. Thus, a total of 38% of the IDDM population studied was overweight or obese.
The weight status of the sample population is illustrated in Figure 3.1.

**Figure 3.1: Weight Status of IDDM Population**

<table>
<thead>
<tr>
<th>Body Mass Index (BMI)</th>
<th>No. of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20</td>
<td>0</td>
</tr>
<tr>
<td>20 - 25</td>
<td>13</td>
</tr>
<tr>
<td>25 - 30</td>
<td>7</td>
</tr>
<tr>
<td>&gt; 30</td>
<td>1</td>
</tr>
</tbody>
</table>

It should be noted, that there were no participants whose weight was below the acceptable weight range in this sample, and that the number of participants in the obese category is also very low.

This may be due, in part, to the voluntary nature of the selection process. It is possible that only those who are enthusiastic and motivated in the management of their diabetes and who feel they have good diabetic control, participated in the study, and may explain why such a large proportion of the sample fits within the acceptable weight range or just above. These results are however, similar to those noted in the study by Chaturvedi et al.
(1995), with the majority of the IDDM population based within the healthy or "acceptable" weight range, BMI 20-25, with the category with the next largest population, the "overweight / obese" category ie, BMI > 26.

Thus, it may also be possible, that those who declined participation in the study, were those who have poor diabetic control, and are not interested in medical or dietetic intervention. This may also be the portion of the population which is underweight or obese, and would explain their limited representation.

WHR and percentage body fat levels support the findings that the majority of this sample population is within acceptable weight range, they also show, that as a subgroup, females had more of a tendency towards being overweight than males.

3.3 Obeseity and Blood Glucose Control

Blood glucose control (HbA1c) was compared between the three BMI groups and the results are summarised in Table 3.2.

Table 3.2: HbA1c Levels from BMI groups

<table>
<thead>
<tr>
<th>BMI Group</th>
<th>Mean HbA1c ± SD</th>
<th>Range</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: 20-25 BMI</td>
<td>8.9 ± 2.8</td>
<td>7.2 - 11.7</td>
<td>12</td>
</tr>
<tr>
<td>2: 25-30 BMI</td>
<td>9.4 ± 1.8</td>
<td>7.6 - 11.2</td>
<td>7</td>
</tr>
<tr>
<td>3: 30 +</td>
<td>10.1</td>
<td>10.1</td>
<td>1</td>
</tr>
</tbody>
</table>

(NB: Total n=20 as one participant refused blood sample)
Although no statistical difference was detected by analysis of variance, a positive relationship between HbAlc levels and BMI groups was evident. This relationship shows that the obese category had the worst glycaemic control (10.1) followed by the overweight category (9.4 ± 1.8), and that the acceptable weight category (8.9 ± 2.8) showed the lowest average HbAlc.

It is important to note that based on the standards of reference for HbAlc categories outlined in the literature review, both the acceptable and overweight categories showed mean HbAlc levels within the category of ‘good control’ (Dept. Nutrition, Dietetics & Food Science Curtin University, 1992) and that the obese category, which was shown to have the worst control, still fitted into the ‘acceptable control’ category (Dept. Nutrition, Dietetics & Food Science Curtin University, 1992).

The small size of the sample population may, on its own skew the results obtained. The further division of the data into subgroups i.e., BMI groups means that again some information is lost. For this reason, the presence of a relationship between individual body mass indices and HbAlc control was also tested for significance.

Analysis of variance between individual BMI and glycaemic control (HbAlc) however, also showed no statistical significance (Prob > F: 0.54), indicating that there was not a strong relationship between BMI or weight status and glycaemic control. A trend was
evident however, which suggests that there was some relationship present. It is possible 
that a larger sample population may render these affects statistically significant.

The trend noted was similar to the results reported by Chaturvedi et al (1995) and Souissi 
(1993), that BMI increases were significantly correlated with a reduction in glycaemic 
control.

This study shows evidence of the same relationship in a broader IDDM population than 
those looked at in the above mentioned studies, and is illustrated in Figure 3.2.

**Figure 3.2: Relationship between BMI and Glycaemic Control (HbA1c)**

![Graph showing the relationship between BMI and HbA1c](image)

It should be noted that the outlying HbA1c result shown for a BMI of 36.2, made no 
significant difference to the trend observed in the total population. The effect of removing
this outlier would mean that only comparison of HbA1c in participants who were within
the overweight and healthy weight ranges, was possible, and would have effectively
removed the obese category altogether.

3.4 Factors Affecting Blood Glucose Control

Given the poor statistical association between weight status and glycaemic control, it is
necessary also to look at the other factors known to influence glycaemic control, such as
the number of insulin injections and exercise.

3.4.1: Number of Insulin Injections

Glycaemic control was found to be significantly affected by the number of insulin
injections taken each day, using analysis of variance (p < 0.05). Glycaemic control was
shown to decrease in proportion to an increase in the number of insulin injections taken
per day.

Although 3 people failed to answer this question, and 1 gave no blood sample, 53% (n=9)
of the sample population were receiving 2 or more injections per day and had a mean
HbA1c 8.95 ± 2.75.

41% of the population (n=7) received 3 or more doses of insulin per day and had a mean
HbA1c level of 9.5 ± 2.1, whilst 7% of the population (n=1) indicated he/she did not have
a set insulin regimen and that the number of insulin injections varied from day to day. The
HbA1c for this client was 11.2.
This is opposite to the response noted in the DCCT, (1987). In that study it was shown that intensive therapy, a part of which included multiple daily injections (3 or more / day), and the close monitoring of blood glucose levels, resulted in improved glycaemic control, and led to a reduction in HbA1c levels. In the DCCT, this effect was thought to be due to the patients’ ability to make necessary changes to food intake or insulin, to counteract a high or low blood glucose reading quickly, and thus reduce the duration and number of episodes of poor control.

The result obtained in this study is difficult to explain. It is possible that, even though multiple insulin injections were being taken, regular blood glucose monitoring was not being used widely by this sample population. Thus, immediate blood glucose information used to alter dietary and insulin regimens as suggested in the DCCT, may not have been available before and after every injection for these individuals.

It is also possible that this type of active self-regulation of blood glucose, may not be widely advocated by the diabetes specialists seeing this population. It is also possible that the principles of intensive insulin and dietary regulation as outlined in the DCCT are not being recommended for this population, given the negative side affects which have been noted (Lasker, 1993).

It is also possible that the small sample size may have skewed the results. Given that there was only 1 participant who indicated anything other than 2 or 3+ injections per day, and
none which took only one injection per day. It may be necessary to increase the sample size and obtain a more even representation of different insulin regimens, to enable this relationship to be accurately portrayed.

3.4.2 Exercise

Exercise is another factor known to influence blood glucose levels. However, analysis of variance showed there was no statistical difference between the HbA1c levels of the 38% (n=8) who exercised more than 3 x 20 min sessions per week, and the 62% (n=13) who did not. There was however, evidence to suggest that exercise had some affect on average HbA1c. Figure 3.4 shows this relationship

Figure 3.3: Glycaemic control and regular exercise
The affect of regular exercise on HbA1c for this sample was similar to that noted by (Wallberg - Henriksson et al, 1982 and Zinman et al, 1984). They too found that long term glycaemic control was not significantly affected by regular exercise, and suggested that this affect may be due to an increase in food consumption by those who regularly exercised, compared to those who did not. It may be possible that the drop in blood glucose following exercise was counterbalanced by an increase in food consumption, and that the long term affects of these episodes of lowered blood glucose were not fully felt.

Although exercise was not found to be a statistically significant factor which affects glycaemic control, the relationship between the two is still important. From this, it can be concluded that, although the strength of its association is not a strong one, regular exercise has some role to play in improving glycaemic control.

3. Lifestyle Questionnaire: Weight Control

Acceptable Weight Category

Qualitative data suggested that, 77 percent (n = 10) of the 13 participants who were already within the acceptable weight range ie, BMI 20-25, were actively trying to maintain that weight. Some examples of steps being taken to ensure this included regular exercise, and the control of food intake (diet), and are listed below:

- controlled diet
- lots of walking and eat the right foods
- sticking to diet
7.6 percent (n=1) were trying to increase their weight, 7.6 percent (n=1) were trying to reduce their weight and 7.6 percent (n=1) indicated they were taking no specific steps to affect their weight either way, which may suggest that some participants are not completely certain of their ideal body weight.

Overweight Category

Fifty seven percent (n=4) of the 7 participants in the overweight category ie, BMI 25-30, indicated they were trying to reduce their weight. Some of the steps being taken to ensure this occurred include restrictions on food intake, increases in exercise and efforts to reduce the amount of fat in the diet.

Twenty eight percent (n=2) of those in the overweight category also indicated that they were trying to maintain their current weight. This may suggest that they have reached a target weight previously set by themselves or their health care team, or may indicate that they have a goal weight set for them which is above the acceptable weight range.

Fifteen percent of those in the overweight category indicated they are not actively trying to influence their weight either way at present.

Obese Category

The participant who was in the obese category, ie BMI >30, (total n = 1) indicated he/she was actively trying to reduce his/her weight by restricting food intake and exercising. It is important not to draw too much from this data, given the limited size of this subgroup.
A larger sample within this weight category is needed to make a valuable assessment of the importance placed on weight status by this group.

Overall however, the IDDM population studied appears to be trying to maintain an acceptable weight, given that 62 percent of the population is within the acceptable weight range, and that the mean BMI of the total population was 25.1.

The majority, (83 percent), of those who were overweight or obese, indicated they were trying to reduce their weight and showed realistic goal weights and a clear understanding of the measures to take in order to achieve them.

Only 22 percent of the total population indicated they are currently doing nothing to influence their weight, across all weight categories, with the majority of these people already within the acceptable weight range anyway.
CHAPTER 4: CONCLUSIONS

The following conclusions can be drawn from this study:

The proportion of the IDDM population in the Illawarra which is overweight was found to be 33%, whilst the proportion found to be obese, was only 5%. This gives a total of 38% which have a weight above their ideal. The majority of the population, 62%, falls within the acceptable weight range, where there is least risk of morbidity and mortality.

When comparing blood glucose control with weight status, statistical analysis showed no significant difference in the blood glucose control of those who are overweight or obese, compared to those within the acceptable weight range. Individual Body Mass Index (BMI) scores were analysed for their effect on HbA1c levels and no significant correlation was found between the two.

There was also no statistical difference evident when the three weight categories were compared for their effect on glycaemic control.

Even though there was no statistical significance found, a trend did exist however, which suggests that, as BMI increases, the level of glycaemic control is reduced. It is possible that an increase in the sample size may provide statistical evidence of this relationship, and stronger proof of this trend.
Although it has been shown to have some effect, the weak relationship between BMI or weight status and glycaemic control leads us to question the importance of weight control in the management of IDDM.

Given the poor statistical association between weight status and glycaemic control, it is difficult to comment on the importance of emphasising the maintenance of weight within the healthy weight range for the IDDM population. Comparisons were also made between the other factors known to influence glycaemic control, so that the value of weight status as a tool for improving glycaemic control could be put into perspective. These include the number of insulin injections and exercise.

Weight control within the acceptable weight range, like exercise was shown to have some effect on glycaemic control, even though that effect was not a strong one.

Conclusions may be drawn, that weight control within the IDDM population is important, but that its value comes from the reduction of the health risks associated with obesity, rather than from the improvements in glycaemic control.

The advantages of weight control within the acceptable weight range for those who have already achieved it, will be difficult to measure, as no specific improvements will be evident. In the long term however, the benefits should present as a slowing in the
development of chronic complications which is usually the result of poor glycaemic control.

Those people in the overweight and obese categories should be encouraged to try to reduce and maintain their weight within the acceptable weight range, primarily to reduce the risks associated with obesity (Bray, 1985: Garrow, 1987), as the association between weight reduction and glycaemic control was not as strong for this population as expected.

A reduction in weight would be expected to result in slight improvement in glycaemic control, however, further investigation with a larger population would be necessary to predict the amount of possible improvements in HbA1c which may be expected, and thus the degree by which the development of chronic complications can be slowed.

Seventy one percent of the IDDM population studied appeared to be making a conscious effort to maintain their weight within the acceptable weight range, with appropriate dietary and lifestyle changes indicated as the methods used to make the necessary changes.

Seventy one percent of the population also appeared to have a clear understanding of their ideal weight by indicating a weight which falls within the BMI range of 20-25 for their height as their ideal or goal weight.
CHAPTER 5: LIMITATIONS OF THE STUDY & AREAS FOR FURTHER INVESTIGATION

5.1 Response Rate

This study aimed to determine whether the presence of obesity reduces glycaemic control in IDDM, and whether those people who are overweight are trying to reduce their weight to within the healthy weight range.

It must be remembered that the respondents agreed to be involved in this research, meaning that as a group they were enthusiastic to have an assessment of their progress done and motivated to help with research.

The participants willingness to participate, may indicate the level of enthusiasm and motivation they have in the management of their diabetes. It is possible that only those who consciously try to maintain good glycaemic, and weight control were willing to participate, thus, the results may not truly represent all people with IDDM in the Illawarra.

Fifteen people declined participation with reasons given for non-participation including work or study commitments and disinterest in participation in research. Some form of incentive to participate, and perhaps the support of local doctors or media, may increase the response rate obtained and give a clearer idea of the size of the IDDM population in the Illawarra.
5.1.1 Sample Size

The small number of participants taking part in this study was a limiting factor. Numbers were not only limited by peoples willingness to participate but also by the initial selection process and the selection criteria for eligibility, such as age and residential location. The sample size of this study was disappointing, as, the IDDM population was expected to be approximately 1800 people, given that the size of the population in the Illawarra Region is approximately 300,000 (based on data from Diabetes Australia, as outlined in Chapter 1).

The records kept at the Diabetes Education Centre provided contact details about IDDM clients from their initial consultation but did not provide updated information. As this is the principle referral service for diabetes specialist in the Illawarra area this may indicate that patients are not seeing local specialists regularly, or that they are seeing specialists outside the Illawarra. It may also mean that they have moved away from the area completely or that they no longer seek medical help in the management of their diabetes and perhaps have poor control.

Thus, it is difficult to determine how much of the actual population has been studied, or whether this is a representative sample of the IDDM population of the Illawarra.

Contact with the IDDM population may be better obtained through a community based association with which this population has regular contact or obtains benefits from. One
such organisation for this population may be Diabetes Australia. Support from such an association would need to be in line with privacy laws, and be deemed ethical for the study undertaken. Diabetes Australia may be able to provide a channel through which the target population could be contacted.

The small sample size meant that comparisons between subgroups within this population were difficult and provided only evidence of trends, rather than strong statistical associations or correlations.

5.2 Questionnaires

The questionnaires provided a large part of the information gathered for this study. Even though the process of data collection was found to be appropriate, the sheer volume of questions which had to be answered as part of the larger baseline data study, may have effected the value of the information obtained.

There were several comprehensive questionnaires to be completed by the participants, the accuracy of the responses given and the degree of consideration given to each question may have been greatly reduced by the time the respondents reached the final questionnaire, which was the lifestyle questionnaire.
5.3 Timeframe

The timeframe for this study did not allow for follow up, or assessment of changes in weight status. It may be possible that those who exhibited poorer control have been ill recently or under high levels of stress, both factors which could not be controlled for or the effects of which determined in a once off HbA1c reading.

Further assessments of glycaemic control for this population would allow mean HbA1c levels to be determined, this would take into account stress and illness, and would be a better indicator of long term glycaemic control.

Follow up would also allow for changes in weight status and their effects on glycaemic control to be assessed on an individual basis. Trends may be noted from this type of research which may influence the direction or amount of emphasis placed on weight status.

Long term follow up, would also allow for the monitoring of the development of long term complications for each weight category. From this, long term effects of poor weight control could be quantified. This is not possible from a pilot study such as this, but would provide valuable insight, and provide recommendations on the degree of emphasis which should be being placed on weight control for this population and it importance in preventing the onset or severity of long term complications.
REFERENCES


Department of Nutrition, Dietetics and Food Science, School of Public Health (1992) Dietitians Pocket Book Curtin University of Technology, Perth, Western Australia.


APPENDIX 1: INTRODUCTORY LETTER
Dear «name2»

As part of the effort to improve the management of diabetes mellitus, we are about to conduct a study on the way people with insulin-dependent diabetes in the Illawarra area manage their diabetes. We hope to contact all younger adults (aged 18-30 initially) with this type of diabetes in the Illawarra. I obtained your name from the Diabetes Education Centre, to which you were referred. This letter is written to ask if you would take part in this study, which will be important in helping us plan diabetes care services and which will give you information on your diabetes management.

The study involves an interview, in which one of our interviewers asks questions about diabetes, a questionnaire to be filled in (at home, if you wish) and, if you agree, a blood test. We want to find out about diet (what does the person with diabetes normally eat?), insulin, the degree to which diabetes is controlled (for which a blood test is needed) and factors influencing "quality of life". All this is confidential information, and no identifying information will be given to anyone without your specific consent. (We shall ask whether you would like us to send your results to a GP or medical specialist.) Neither you nor your doctor will be identified in any report arising from this study. The study is not primarily aimed at being an assessment of your diabetic control. Rather, we will use the group results to assess current management strategies throughout the Illawarra area. Your results will of course be passed on to you, as will the group results if you wish.

We are working in collaboration with a steering committee with representatives from the Illawarra Area Health Service, the IAHS Diabetes Education Centre, the NSW Health Department, the Illawarra Division of General Practice, and a local endocrinologist.

If you do not want to be part of this study I would be very pleased if you could let us know as early as possible. Please write to, or phone, my secretary, Mrs Elaine Knight, at the above address (phone 266 594). If you are happy to continue, you will be contacted by a nutritionist, Ms Farideh Tahbaz, or by an assistant, Ms Cate Kelly, and they will forward further information and/or make an appointment to have these aspects of your diabetes management checked by one of our team. In order to have a good picture of current diabetic management, it is important to have input from as many people as possible, whether or not they have good diabetes control.

I believe that this is an important step in working to improve diabetes management in Australia. I hope you will be able to help.

Yours sincerely

Dennis Calvert
Professor of Medicine and Public Health
APPENDIX 2: PARTICIPANT INFORMATION SHEET
UNIVERSITY OF WOLLONGONG

ILLAWARRA AREA HEALTH SERVICE

INFORMATION SHEET

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.
APPENDIX 3 : THE QUESTIONNAIRES
DEMOGRAPHIC QUESTIONNAIRE
**UNIVERSITY OF WOLLONGONG**
**MEDICAL RESEARCH UNIT**
**INSULIN DEPENDENT DIABETES STUDY**

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:

1. **Sex:**
   - Female ☐ 1
   - Male ☐ 2

2. **Marital Status:**
   - Single ☐ 1
   - Married ☐ 2
   - Separated/Divorced ☐ 3
   - Widowed ☐ 4

3. **Date of Birth:**
   - Day: ☐ ☐
   - Month: ☐ ☐
   - Year: 19☐☐

4. **Country of Birth:**
   - Australia ☐ 1
   - Not Australia ☐ 2
   
   If not Australia, what is your country of birth? ---------------

5. **How long have you been resident in Australia?**
   - Months ☐
   - Years ☐

6. **Where were members of your family born?**
   - Your father ---------------
   - Your father’s father (paternal grandfather) ---------------
   - Your father’s mother (paternal grandmother) ---------------
   - Your mother ---------------
   - Your mother’s father (maternal grandfather)
   - Your mother’s mother (maternal grandmother)

7. **Are you of Aboriginal or Torres Strait Islander origin?**
   (If of mixed origin indicate the one to which you belong)
   - No ☐ 1
   - Yes, Aboriginal ☐ 2
   - Yes, Torres Strait Islander ☐ 3
DIABETES HISTORY:

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

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 □1
   - Yes □2

4. Have you ever taken oral drugs (tablets) for diabetes?
   - No □1
   - Yes □2
   
   a. If yes, are you currently taking oral drugs (tablets)?
      - No □1
      - Yes □2

   b. If no, how long ago did you stop taking oral drugs (tablets)?
      - Mo □ Yr □□ □1
      - Unknown □2

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

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

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

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

If yes to #5 or #8, what is your current insulin regimen? (answer one)

   one injection daily □ 1
   two injections daily □ 2
   three or more injections daily □ 3
   pump □ 4
   other □ 5
   Specify:---------------------
9. Have you ever been hospitalized for diabetes ketoacidosis?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>□ 1</td>
</tr>
<tr>
<td>Yes</td>
<td>□ 2</td>
</tr>
<tr>
<td>Unknown</td>
<td>□ 3</td>
</tr>
</tbody>
</table>

**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?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>□ 1</td>
</tr>
<tr>
<td>Yes</td>
<td>□ 2</td>
</tr>
<tr>
<td>Unknown</td>
<td>□ 3</td>
</tr>
</tbody>
</table>

If yes please specify: ________________________________

2. Laser treatment?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>□ 1</td>
</tr>
<tr>
<td>Yes</td>
<td>□ 2</td>
</tr>
<tr>
<td>unknown</td>
<td>□ 3</td>
</tr>
</tbody>
</table>

3. Impairment of vision?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>□ 1</td>
</tr>
<tr>
<td>Yes</td>
<td>□ 2</td>
</tr>
<tr>
<td>Unknown</td>
<td>□ 3</td>
</tr>
</tbody>
</table>

4. Cataracts?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>□ 1</td>
</tr>
<tr>
<td>Yes</td>
<td>□ 2</td>
</tr>
<tr>
<td>Unknown</td>
<td>□ 3</td>
</tr>
</tbody>
</table>

5. Detached retina?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>□ 1</td>
</tr>
<tr>
<td>Yes</td>
<td>□ 2</td>
</tr>
<tr>
<td>Unknown</td>
<td>□ 3</td>
</tr>
</tbody>
</table>

**B. Kidney problems:**

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

1. Diabetic kidney problem?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>□ 1</td>
</tr>
<tr>
<td>Yes</td>
<td>□ 2</td>
</tr>
<tr>
<td>Unknown</td>
<td>□ 3</td>
</tr>
</tbody>
</table>

2. Protein or albumin in the urine?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>□ 1</td>
</tr>
<tr>
<td>Yes</td>
<td>□ 2</td>
</tr>
<tr>
<td>Unknown</td>
<td>□ 3</td>
</tr>
</tbody>
</table>
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:
LIFESTYLE QUESTIONNAIRE
**Practical Aspects of IDDM - Questionnaire**

For the following questions please tick the response that best applies to yourself.

<table>
<thead>
<tr>
<th>DIETARY ADHERENCE</th>
<th>Office use only</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Questions 1 - 3, we want to find out about your adherence to a diabetic diet, and the difficulties that you may experience keeping to a diabetic diet.</td>
<td></td>
</tr>
</tbody>
</table>

1. In general, how often do you routinely follow a carbohydrate portion plan on a typical day? For example do you have a pattern of carbohydrate "portions" you follow over the day, such as 3 portions for breakfast, 2 portions for morning tea, 4 for lunch, etc.

I follow my carbohydrate portion plan:

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Days per Week</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always</td>
<td>7 days</td>
<td>1</td>
</tr>
<tr>
<td>Usually</td>
<td>5-6 days</td>
<td>2</td>
</tr>
<tr>
<td>Sometimes</td>
<td>3-4 days</td>
<td>3</td>
</tr>
<tr>
<td>Not very often</td>
<td>1-2 days</td>
<td>4</td>
</tr>
<tr>
<td>No</td>
<td>0 days</td>
<td>5</td>
</tr>
<tr>
<td>Don’t Know</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

2. We would like to know what specific factors prevent you from routinely following a carbohydrate "portion" meal plan or from following it as often as you might otherwise. You may tick more than one response or write your own down on the space provided.

- It didn’t give me good blood sugar control when I tried it before 1
- I am tired of following a set plan 2
- My work is too hectic 3
- My family life makes it difficult 4
- Family/friends are not supportive enough 5
- I crave food I shouldn’t eat 6
- Other. Please Specify: 7

3. I generally find it....

<table>
<thead>
<tr>
<th>Difficulty</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very difficult</td>
<td>1</td>
</tr>
<tr>
<td>Moderately difficult</td>
<td>2</td>
</tr>
<tr>
<td>Neither difficult or easy</td>
<td>3</td>
</tr>
<tr>
<td>Moderately easy</td>
<td>4</td>
</tr>
<tr>
<td>Very easy</td>
<td>5</td>
</tr>
</tbody>
</table>

to adhere to my diabetic diet

If don’t follow a set carbohydrate controlled meal plan it is because:
<table>
<thead>
<tr>
<th><strong>ALCOHOL INTAKE</strong></th>
<th><strong>Office use only</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>In Questions 8-9 we want to find out about the amount of alcohol you drink</td>
<td>294 □</td>
</tr>
</tbody>
</table>

8. How often do you usually drink alcohol?

<table>
<thead>
<tr>
<th>Option</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>I don't drink alcohol</td>
<td>1 □</td>
</tr>
<tr>
<td>Less than once a week</td>
<td>2 □</td>
</tr>
<tr>
<td>On 1 or 2 days a week</td>
<td>3 □</td>
</tr>
<tr>
<td>On 3 or 4 days a week</td>
<td>4 □</td>
</tr>
<tr>
<td>On 5 or 6 days a week</td>
<td>5 □</td>
</tr>
<tr>
<td>Every day</td>
<td>6 □</td>
</tr>
</tbody>
</table>

9. On a day when you drink alcohol, how many drinks do you usually have?

<table>
<thead>
<tr>
<th>Option</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 or 2 drinks</td>
<td>1 □</td>
</tr>
<tr>
<td>3 or 4 drinks</td>
<td>2 □</td>
</tr>
<tr>
<td>5 to 8 drinks</td>
<td>3 □</td>
</tr>
<tr>
<td>9 to 12 drinks</td>
<td>4 □</td>
</tr>
<tr>
<td>13 to 20 drinks</td>
<td>5 □</td>
</tr>
<tr>
<td>more than 20 drinks</td>
<td>6 □</td>
</tr>
</tbody>
</table>
EXERCISE

In questions 9-12, we want to find out about the exercise you had during the PAST 2 WEEKS
* For recreation, sport or health-fitness purposes
* As part of your tasks at work and around the house
Please distinguish between vigorous and exercise which made you breathe harder or puff and pant, and less vigorous exercise.

RECREATION, SPORT OR HEALTH-FITNESS

9. In the PAST 2 WEEKS, did you engage in vigorous exercise - exercise which makes you breathe harder or puff or pant? (eg vigorous sports such as football, netball, tennis, squash, athletics: jogging or running: keep fit exercises: vigorous swimming: etc.)

   No 1 □
   Yes 2 □

If yes, how many sessions of vigorous exercise did you have over the 2 week period? __________

Please estimate the TOTAL TIME spent exercising vigorously during the PAST 2 WEEKS.

   __________ hours __________ minutes

10. In the PAST 2 WEEKS, did you engage in less vigorous exercise for recreation, sport or health-fitness purposes which did not make you breathe harder or puff and pant?

   No 1 □
   Yes 2 □

If yes, how many sessions of less vigorous exercise did you have over the 2 week period? __________

Please estimate the TOTAL TIME spent exercising less vigorously each week.

   __________ hours __________ minutes

11. In the PAST 2 WEEKS, did you walk for recreation or exercise for periods of 20 minutes or longer?

   No 1 □
   Yes 2 □

If yes, how many times? __________
VIGOROUS TASKS AT WORK AND AROUND THE HOUSE (paid or unpaid work)

12. In the PAST 2 WEEKS, did you engage in vigorous activity, apart from exercise, which makes you breathe harder or puff and pant? (eg carrying loads, heavy gardening, chopping wood, labouring - at home, during employment or anywhere else).

No  
Yes  

1  
2  

If yes, how many sessions of these types of vigorous activity did you have over the 2 week period?

Please estimate the TOTAL TIME spent in these types of vigorous activity during the past 2 weeks: hours minutes

Thank you for taking time to complete these questions 😊
### WEIGHT CONTROL

In Questions 4 - 7 we want to find out about your weight maintenance.

<table>
<thead>
<tr>
<th>Question</th>
<th>Number</th>
<th>Choice</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you currently trying to reduce your weight? (please indicate)</td>
<td></td>
<td>1</td>
<td>Yes</td>
</tr>
<tr>
<td>Are you currently trying to reduce your weight? (please indicate)</td>
<td></td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>If yes what measures are you taking?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you trying to maintain your current weight? (please indicate)</td>
<td></td>
<td>1</td>
<td>Yes</td>
</tr>
<tr>
<td>Are you trying to maintain your current weight? (please indicate)</td>
<td></td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>If yes what measures are you taking?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you currently trying to increase your weight? (please indicate)</td>
<td></td>
<td>1</td>
<td>Yes</td>
</tr>
<tr>
<td>Are you currently trying to increase your weight? (please indicate)</td>
<td></td>
<td>2</td>
<td>No</td>
</tr>
<tr>
<td>If yes what measures are you taking?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Please indicate what you think is your ideal goal weight: _____kg</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Office use only

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293
APPENDIX 4 : ANTHROPOMETRIC MEASUREMENT FORM
Anthropometric Measurements:

Weight
1. ----------- kg  2. ----------- kg  av: -----------

Height
1. ----------- cm  2. ----------- cm  av: -----------

BMI: ----------- kg/m2

Skinfold thickness:

biceps (mm):
1. _ _ _  2. _ _ _  av: _ _ _

triceps (mm):
1. _ _ _  2. _ _ _  av: _ _ _

subscapular (mm):
1. _ _ _  2. _ _ _  av: _ _ _

suprailiac (mm):
1. _ _ _  2. _ _ _  av: _ _ _

Sum of skinfold measurements: _ _ _

Circumference Measurements:

Waist: ----------- cm

Hip circumference: ----------- cm

Waist/Hip: -----------

Blood Pressure:

Systolic (mm Hg):
1. -----------  2. -----------  av: -----------

Diastolic (mm Hg):
1. -----------  2. -----------  av: -----------

Mean Blood Pressure: ----------- (mm Hg)