# CHAPTER 4

# RESULTS AND DISCUSSION

The purpose of this study was to gain insight into the: knowledge, attitudes, beliefs and practices of insulin dependent diabetics with respect to exercise/physical activity, in conjunction with diet and medication, in the management of IDDM. Accordingly the results are presented under the following sub-section:

4.1 Medication routine
4.2 Dietary habits; and
4.3 Exercise practices

## 4.1 MEDICATION ROUTINE

The results pertaining to the medication routine of the respondents are discussed following presentation in tabular and graphic form in Tables 4.1.1 to 4.1.3 and Figures 4.1.1 to 4.1.6, respectively.

**TABLE 4.1.1: KNOWLEDGE OF NORMAL BLOOD GLUCOSE LEVELS (ITEM 10)**

| GLUCOSE LEVELS | OVERALL (n=197) | | EXERCISERS (n=172) | | NON-EXERCISERS (n=25) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| 7-15 mmol/L | 32 | 16.20 | 26 | 15.12 | 6 | 24.00 |
| 4-8 mmol/L | 129 | 65.50 | 116 | 67.44 | 13 | 52.00 |
| 2-10 mmol/L | 11 | 5.60 | 11 | 6.40 | 0 | 0.00 |
| Don't know | 25 | 12.70 | 19 | 11.05 | 6 | 24.00 |
| | p<0.001 | | p<0.1 | | | |

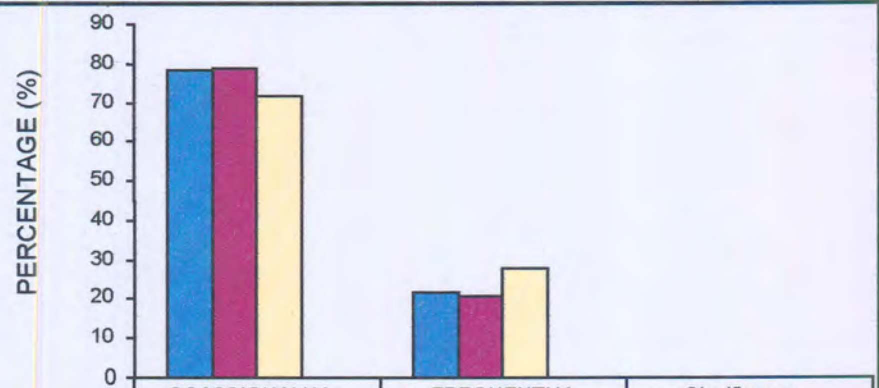
Table 4.1.1 summarizes the respondent's knowledge of the normal range of blood glucose levels. Overall, a significant ($p<0.001$) number of respondents (66%) stated the correct response of 4-8 mmol/L. This was also the case among exercisers (67%) and non-exercisers (52%). There was a significant difference ($p\leq0.1$) in the response of exercisers and non-exercisers. Attempts to achieve near-normoglycemia require education about prevailing glycemic levels. This has become possible with a wide variety of SMBG equipment that is available, which allows blood glucose levels to be measured easily (Matthews *et al.*, 1987). Values should be in the range 4-8 mmol/L for diabetics in whom "good control" is being attempted (Howe-Davis *et al.*, 1978).

**TABLE 4.1.2: KNOWLEDGE OF NORMAL BLOOD GLUCOSE RESPONSES (ITEM 5)**

| GLUCOSE RESPONSE | OVERALL (n=199) | | EXERCISERS (n=173) | | NON-EXERCISERS (n=26) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Normal | 10 | 5.0 | 10 | 5.78 | 0 | 0 |
| Increased | 67 | 33.7 | 57 | 32.95 | 10 | 38.46 |
| Decreased | 4 | 2.0 | 4 | 2.31 | 0 | 0 |
| Increased/Decreased | 102 | 51.3 | 89 | 51.45 | 13 | 50.0 |
| Don't know | 16 | 8.0 | 13 | 7.51 | 3 | 11.54 |
| | p<0.001 | | p>0.10 | | | |

In probing the respondents knowledge of normal blood glucose responses, the main aim was to determine whether they knew what the resultant blood glucose responses in uncontrolled diabetes would be, i.e. whether glucose levels remained normal; increased; decreased; increased and/or decreased (Table 4.1.2). Overall analysis showed that a significant ($p\leq0.001$) majority (51%) of the respondents knew the correct response, indicating an increased and/or decreased glucose response. In comparing the exercisers to the non-exercisers the results yielded no significant difference ($p\geq0.1$) in response. It was observed that although some of the respondents did not exercise, they were still knowledgeable about what impact uncontrolled diabetes would have on their glucose levels. It is not yet known as to whether tight glycemic control can prevent chronic diabetic complications; it is reasonable at present to aim for near-normoglycemia in most diabetics (Pickup & William, 1991). A diabetic who is confronted with uncontrolled diabetes could experience constant hypoglycemia and/or hyperglycemia, which indicate uncontrolled diabetes.

**FIGURE 4.1.1: FREQUENCY OF HYPERGLYCEMIA (ITEM 47)**




| | OCASSIONALLY | FREQUENTLY | Significance |
|---|---|---|---|
| OVERALL | 78.2 | 21.8 | p<0.001 |
| EXERCISERS(E) | 79.07 | 20.93 | p<0.001 |
| NON-EXERCISERS (NE) | 72 | 28 | p<0.001 |
| EX vs NE | NS | NS | |

A significant ($p<0.001$) overall majority of the respondents (78%) characterized their glucose levels as being occasionally high, whist the remaining minority (22%) stated that they experience hyperglycemia on a frequent basis. The 22% who stated that they frequently experience hyperglycemia, in all probability have poor glucose management (Figure: 4.1.1). The two general guidelines concerning metabolic control before exercising is the participant's responses to hyperglycemia and hypoglycemia. Diabetics should avoid exercising if fasting glucose levels are more than 14 mmol/L and ketosis is present, and use caution if glucose levels are more than 17 mmol/L and no ketosis is present. The same observations with no significant differences (p>0.1) were made in comparing the groups with 72% of non-exercisers and 79% of exercisers experiencing occasional hyperglycemia, and only 28% of non-exercisers and 21% of exercisers experiencing frequent hyperglycemia. Exercisers and non-exercisers, who experience hyperglycemia occasionally, thus displayed good management (insulin administration, diet and exercise), which helps stabilize glucose levels. Many of the subjects felt that exercise itself, always reduces blood glucose levels or that exercise combined with a small dose of short acting insulin also caused a reduction in glucose levels.

Medication administration varies from individual to individual, depending on the insulin regime. Out of all 200 respondents, 5.5% injected themselves once a day, 24% injected themselves twice a day, 16% injected three times a day, and a significant (p<0.001) proportion of 54% inject themselves three and more times a day (Figure 4.1.2). Usually insulin administration is done 3 times and more, depending on the type of insulin used, i.e. short-acting, intermediate-acting, and long-acting. A similar pattern emerged when comparing exercisers with non-exercisers, with no significant difference (p>0.1) being observed between the two groups.

Many types of insulin injection regime are available. Intermediate or long-acting insulin is injected once or twice daily, provides the basal requirement and short - acting insulin injected 30-40 minutes before meals covers the additional prandial needs. A common problem with twice daily intermediate and short-acting insulin is the relatively short action profile of the intermediate insulin, which when injected in the early evening tends to terminate a few hours before breakfast and thus exacerbates fasting hyperglycemia. This may be overcome by injecting intermediate-acting insulin before bedtime (Pickup & Williams, 1991). As stated previously insulin injections vary from person to person, usually people who exercise regularly require less insulin (in terms of dosage), than people who don't exercise. Regular physical activity improves blood glucose control by increasing the body's sensitivity to insulin (Colberg, 2001).

Below follows the explanation for abbreviations used in Figure 4.1.3:

BB-before breakfast

BL-before lunch

BS-before supper

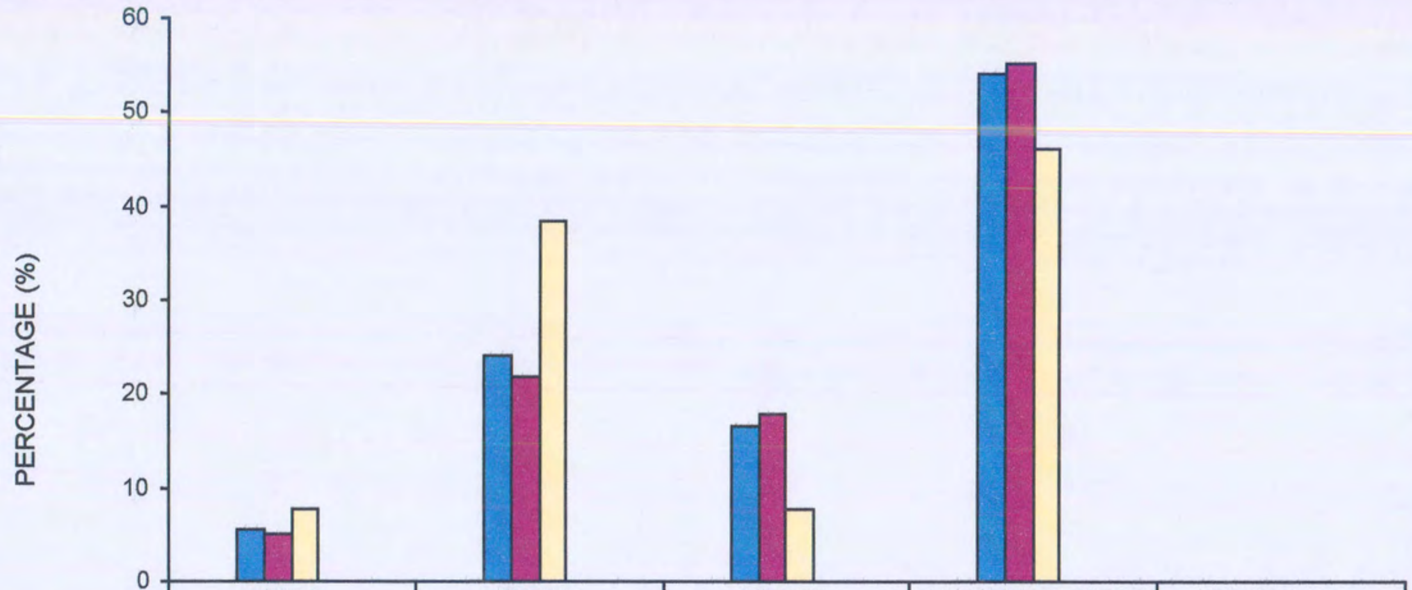
AB-after breakfast

AL-after lunch

AS-after supper

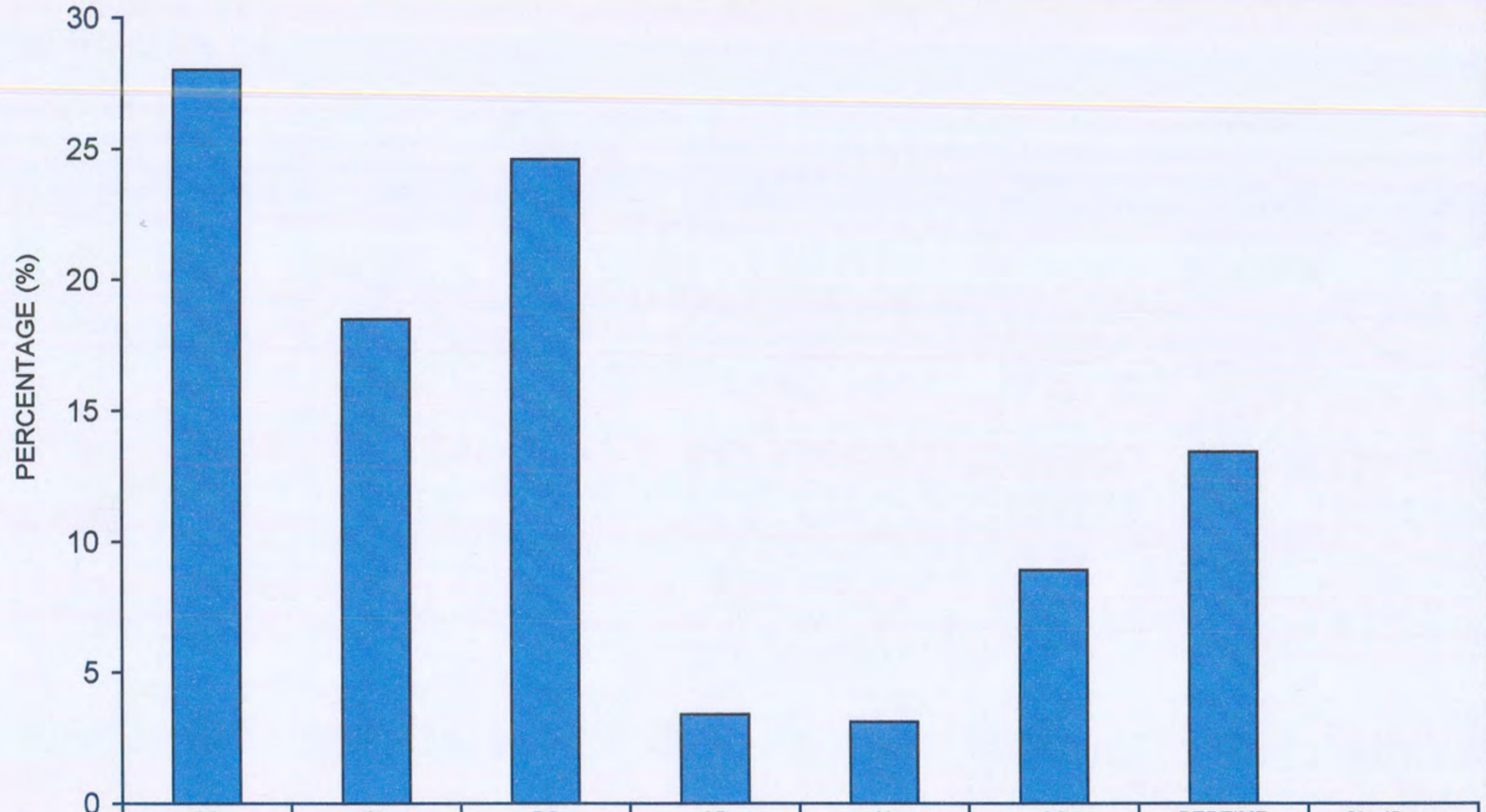
Figure 4.1.3 shows that 28% of respondents injected before breakfast, 3.4% injected after breakfast, 19% injected before lunch, 3.1% injected after lunch, 25% injected before supper, 9% injected after supper, and 13.4% at bedtime. It is evident that the significant ($p<0.001$) majority of the respondents (71.1%) injected before meals, in order for insulin to circulate in the bloodstream and facilitate absorption of glucose. In most instances the respondents would have selected more than one option, purely because the respondents would have to inject themselves each time they have a substantial meal in order to enable the cells to absorb the glucose from the bloodstream.

**FIGURE 4.1.2: DAILY INSULIN ADMINISTRATION (ITEM 44)**



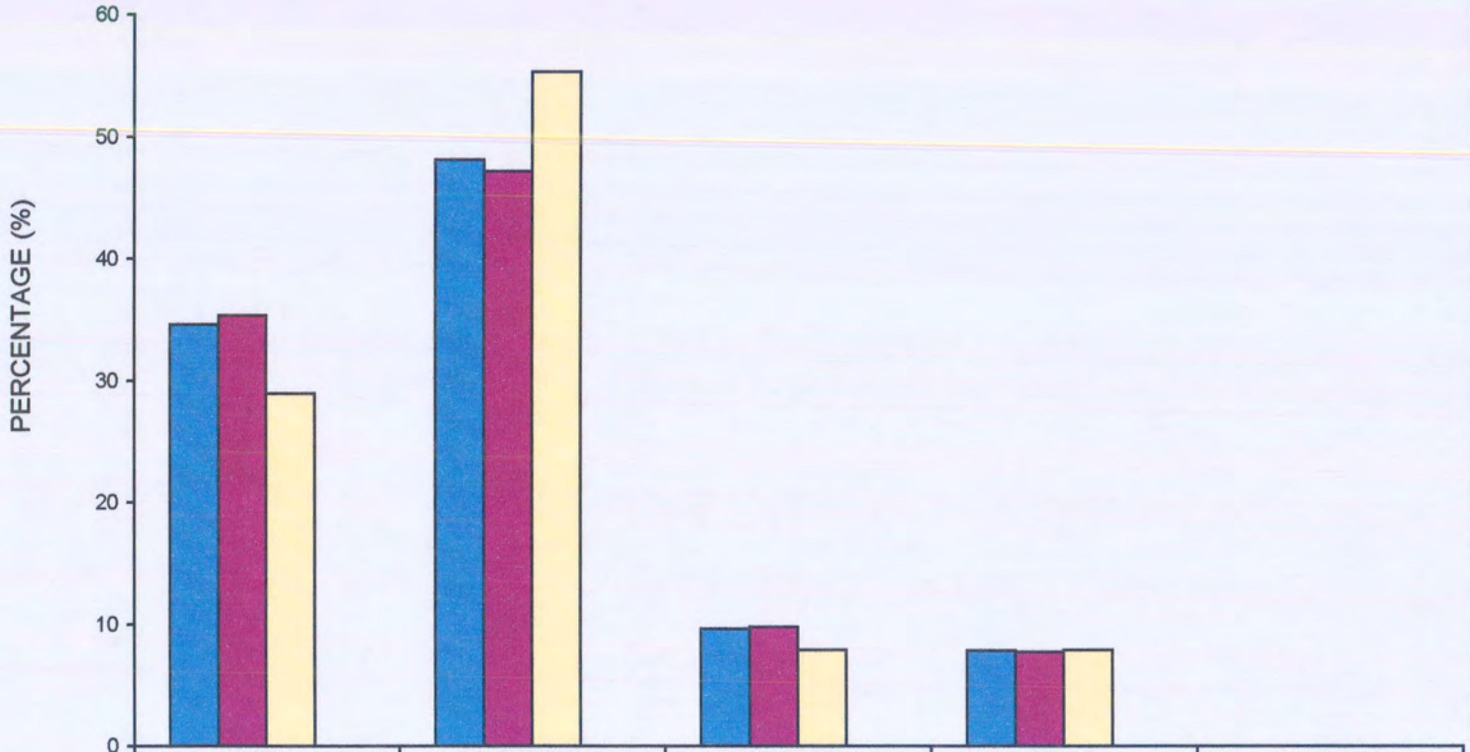

| | ONCE | TWICE | THREE | THREE AND MORE | Significance |
|---|---|---|---|---|---|
| OVERALL | 5.5 | 24 | 16.5 | 54 | p<0.001 |
| EXERCISERS (E) | 5.17 | 21.84 | 17.82 | 55.17 | p<0.001 |
| NON-EXERCISERS (NE) | 7.69 | 38.46 | 7.69 | 46.15 | p<0.001 |
| E vs NE | NS | NS | NS | NS | |

**FIGURE 4.1.3: DAILY INSULIN ADMINISTRATION TIME (ITEM 45)**




| | BB | BL | BS | AB | AL | AS | BEDTIME | Significane |
|---|---|---|---|---|---|---|---|---|
| MEALTIME | 28 | 18.5 | 24.6 | 3.4 | 3.1 | 8.9 | 13.4 | $p<0.001$ |

## FIGURE 4.1.4: DAILY INSULIN ADMINISTRATION SITES (ITEM 46)

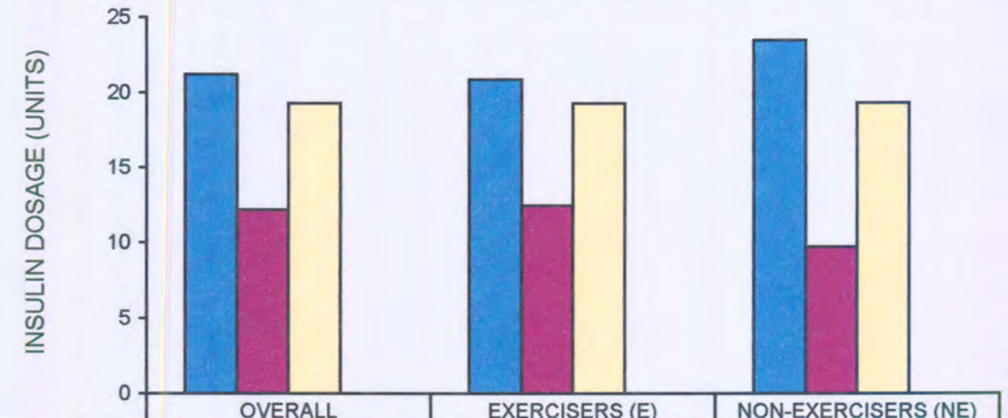



| | THIGHS | ABDOMINALS | GLUTEUS | OTHER | Significance |
|---|---|---|---|---|---|
| OVERALL | 34.6 | 48.1 | 9.6 | 7.8 | 0.001 |
| EXERCISERS (E) | 35.35 | 47.14 | 9.76 | 7.74 | 0.001 |
| NON-EXERCISERS (NE) | 28.95 | 55.26 | 7.89 | 7.89 | 0.001 |
| E vs NE | NS | NS | NS | NS | |

Diabetic individuals most commonly use the following injection sites: thigh, abdominal area, gluteus, and arm. Respondents would select more than one option, because injection sites need to be rotated. Figure 4.1.4 indicates that overall, significantly ($p<0.001$) more respondents stated they inject themselves in the thigh (35%), and abdominal areas (48%), than on the gluteus area (10%), and the arm (other-8%). There was no significant difference ($p\geq 0.1$) at various sites between the exercisers and non-exercisers. Therefore it was not possible to state whether different injection sites effected respondents glucose absorption.

Exercise can increase the absorption rate of injected insulin regardless of the area of subcutaneous fat the insulin is injected into. Circulating insulin levels may increase during exercise but then be deficient later when insulin has been prematurely absorbed, especially with the use of intermediate or long-acting insulin (Colberg, 2001). When comparing exercisers to non-exercisers, it is evident that fewer non-exercisers inject themselves in the thigh that was specified, as compared to exercisers. Diabetic people are advised to avoid exercise for one hour when using those muscles that short-acting insulin was injected into.

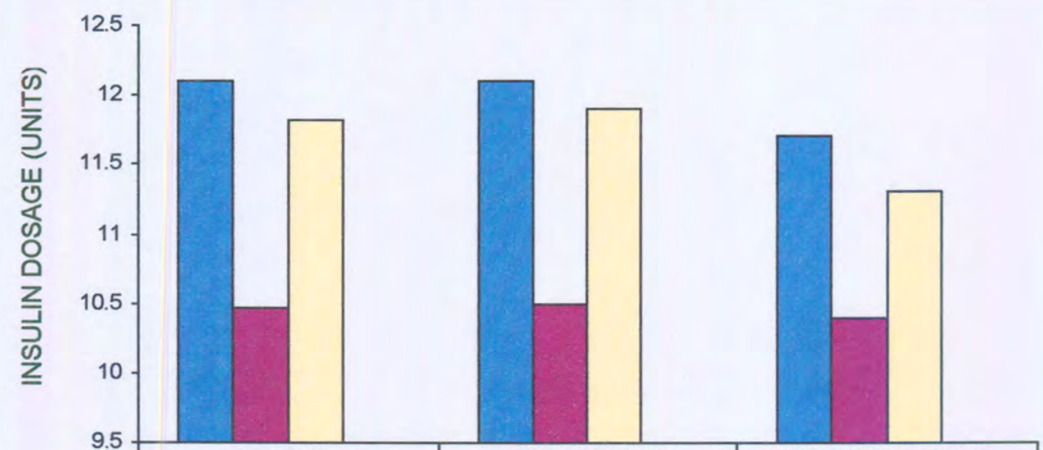
**FIGURE 4.1.5: DOSAGE OF LONG-ACTING INSULIN (ITEM 7)**




| | OVERALL | EXERCISERS (E) | NON-EXERCISERS (NE) |
|---|---|---|---|
| BREAKFAST | 21.2 | 20.9 | 23.5 |
| LUNCH | 12.2 | 12.5 | 9.75 |
| SUPPER | 19.3 | 19.3 | 19.32 |
| E vs NE | p<0.001 | p<0.1 | p<0.1 |

Figure 4.1.5 illustrates the mean long-acting insulin dosage for breakfast, lunch and supper. The mean overall dosage for lunch (12.2 units) was significantly lower (p<0.1) than for breakfast and supper, however there was no significant difference (p>0.1) between the breakfast and supper dosages. The same pattern was observed for non-exercisers and exercisers.

**FIGURE 4.1.6: DOSAGE OF SHORT-ACTING INSULIN (ITEM 8)**




| | OVERALL | EXERCISERS (E) | NON-EXERCISERS (NE) |
|---|---|---|---|
| BREAKFAST | 12.1 | 12.1 | 11.7 |
| LUNCH | 10.47 | 10.5 | 10.4 |
| SUPPER | 11.82 | 11.9 | 11.3 |
| E vs NE | p<0.1 | p<0.1 | NS |

Figure 4.1.6 illustrates the mean short-acting insulin dosage over mealtimes for the overall group as well as the means for exercisers and non-exercisers. The mean overall dosage for lunch (10.5 units) was significantly lower (p<0.1) than for breakfast and supper, however there was no significant difference (p>0.1) between the breakfast and supper dosages. The same pattern was observed for non-exercisers and exercisers.

## BEDTIME INSULIN ADMINISTRATION (ITEM 9)

Sixty five (33%) respondents stated that insulin injections where also administered at bedtime and were usually 10 units and more. Bedtime insulin is known as long-lasting insulin, which is administered to normalize glucose levels during the course of the night until the morning when intermediate-acting or short -acting insulin is administered at breakfast.

## TABLE 4.1.3: TYPES OF INSULIN REGIMES (ITEM 6)

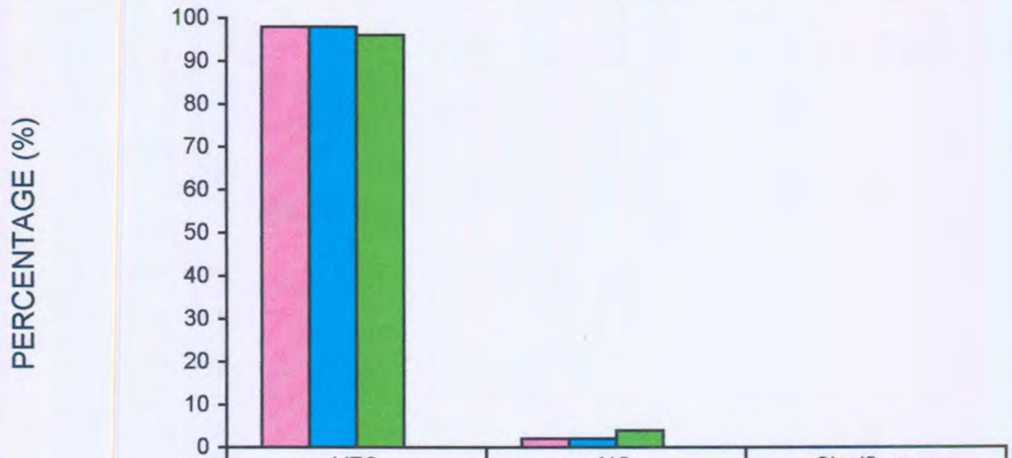
| | INSULIN TYPE | (n) | | INSULIN TYPE | (n) |
|---|---|---|---|---|---|
| 1 | ACTRAPHANE | 44 | 9 | HUMULIN 30/70 | 8 |
| 2 | ACTRAPID | 95 | 10 | HUMULIN 20/80 | 5 |
| 3 | MIXTARD 10/90 | 1 | 11 | HUMULIN L | 77 |
| 4 | MIXTARD 20/80 | 3 | 12 | HUMULIN N | 11 |
| 5 | MIXTARD 50/50 | 1 | 13 | HUMULIN R | 15 |
| 6 | MIXTARD 40/60 | 1 | 14 | HUMULIN U | 3 |
| 7 | MONOTARD | 21 | 15 | HUMALOG | 29 |
| 8 | PROTOPHANE | 42 | 16 | OTHER | 5 |

Diabetes mellitus may be managed from a choice of four types of insulin (animal/ human origin or biosynthetic), which are short-acting, intermediate-acting, long-acting and biphasic. As the names suggest short-acting insulin is of rapid onset (0-20 min), long-acting insulin is of longer duration (2-4 hours onset of action), whilst intermediate-acting insulin is of intermediate duration (30 min onset of action). Biphasic insulin is a mixture of short and long acting insulin (MacPherson, 1990). Respondents were expected to indicate which of the 20 insulin regimes they administered to themselves; item 6 in the questionnaire represents the different types of insulin currently available to South Africans. Table 4.1.3 consists of short acting insulin, long acting insulin, intermediate insulin, and biphasic. From the data provide (Table 4.1.3), the majority of the respondents used the following insulin's, actraphane-biphasic/premixed (n=44), actrapid-short acting (n=95), monotard-intermediate (n=21), protophane-intermediate (n=42), humulin L-long acting (n=77), humalog-short acting (n=29). There are two reputable companies that suppliey insulin to South Africa, namely: Lilly and Nova Nordisk. In many governmental and public sectors Nova Nordisk products are used because it is more cost efficient than some of the insulins manufactured by Lilly which supplies mainly the private sectors and, are more expensive. Respondents would have selected more than one response because they all use a combination of the three types of insulin. The reason as to why there are a large number using these insulin regimes can be ascribed to most of these being found in governmental hospitals and them being inexpensive. On the other hand insulin like humalog, is modified human insulin in which the reversing amino acids result in a very rapid onset of action, within 15 minutes of injection and is more expensive insulin manufactured by Lilly. It is mostly available at private medical practices or on medical aid. Actrapid, which is short acting insulin, is manufactured by Novo Nordisk and is similar to humulin R manufactured by Lilly. Actrapid is used in most governmental hospitals and is cheaper than humalin R. From the data provided it is evident that most people administer actrapid (n=95) because it is cheaper and available at provincial hospitals (Appendix 3).

## 4.2 DIETARY HABITS

The results pertaining to the dietary habits of the respondents are discussed following presentation in graphic form in Figures 4.2.1 to 4.2.12, respectively.

**FIGURE 4.2.1: KNOWLEDGE OF CORRECT DIETARY CONTROL (ITEM 52)**




| | YES | NO | Significance |
|---|---|---|---|
| OVERALL | 98 | 2 | p<0.001 |
| EXERCISERS (E) | 98 | 2 | p<0.001 |
| NON-EXERCISERS (NE) | 96 | 4 | p<0.001 |
| N vs NE | NS | NS | |

Good diet is an important factor when trying to achieve near normoglycemia. Figure 4.2.1 indicates that the overall significant ($p<0.001$) majority (98%) of respondents stated that good dietary control is an important factor for a diabetic person, and the remaining 2% stated that diet is not an important criterion. In comparing exercisers to non-exerciser with respect to the knowledge on diet and diabetes there was no significant difference ($p>0.1$) with a significant majority of both exercisers (98%) and non-exercisers (96%) stating that a good dietary control is and important factor to a diabetic person. The role of diet in the treatment of IDDM is first to minimize the short-term fluctuations in blood glucose, particularly hypoglycemia, and to reduce the risks of long-term complications. Previous dietary recommendations in diabetes have concentrated on eating less carbohydrate, thus encouraging excessive fat intake to make up energy requirements. This high fat, low carbohydrate diet contributed to accelerated cardiovascular disease, while the diets lower in fats and higher in carbohydrate, found in developing countries, are associated with much lower rates of macro-vascular diseases (Pickup & Williams, 1991).

**IMPORTANCE OF CORRECT DIET (ITEM 53)**

Many respondents felt that good diet contributes to good glucose control, minimizes complications, ensures correct nutrient, ensures a healthy lifestyle and maintains ideal weight. These open responses were valid as good diet is of vital importance when one is a diabetic.

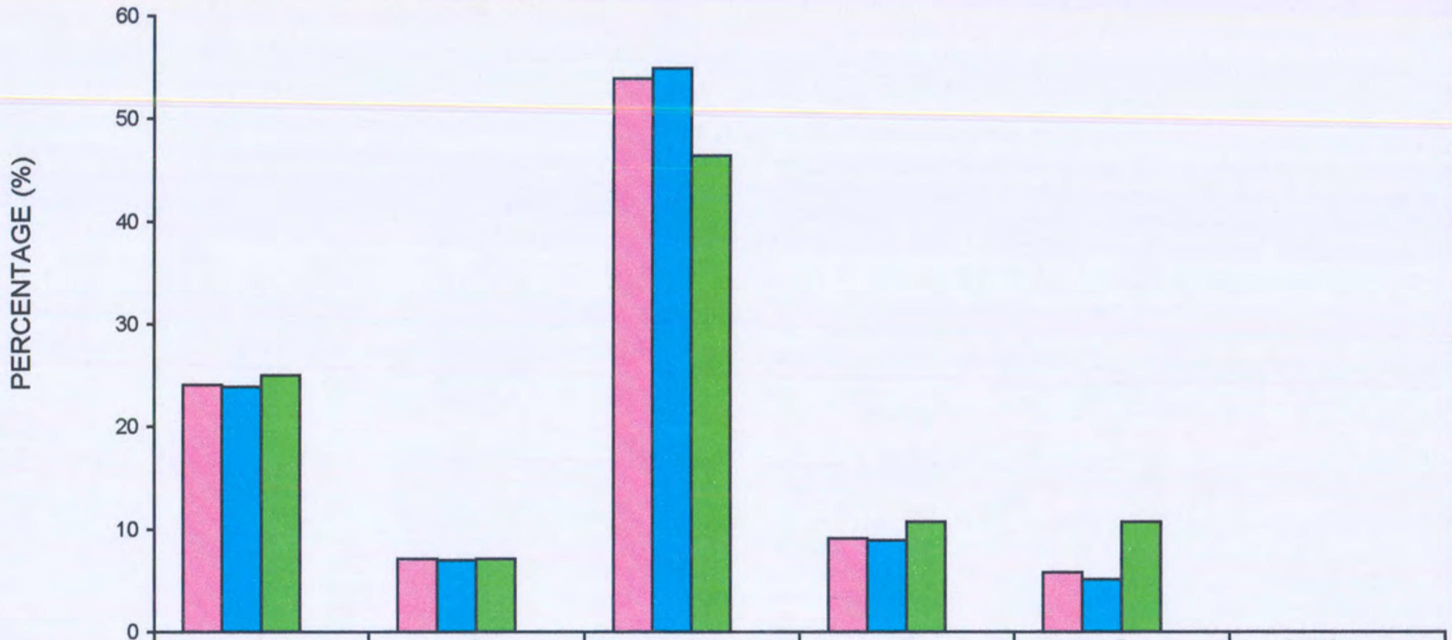
It is recommended that diabetics should vary their diet, substituting different food from the diet exchange list. Respondents where probed about their knowledge of what constitutes correct dietary practice regarding the following principles (Figure 4.2.2):

A: represents food cooked separately;
B: represents food being eaten at the same time each day;
C: represents variation;
D: represents eating the same food cooked for the family; and
E: I don't know

Overall, 6% indicated that they were unsure, 24% indicated that their food should be cooked separately from the family, 9% stated that they should eat the same food cooked for the family, 7% stated the same food should be eaten at the same time each day and the significant ($p<0.001$) majority (54%) indicated the correct response, of varying their diet. The other 46% needs to be educated in this regard. In comparing exercisers to non-exerciser the same trend was observed but no significant difference ($p>0.1$) between groups.

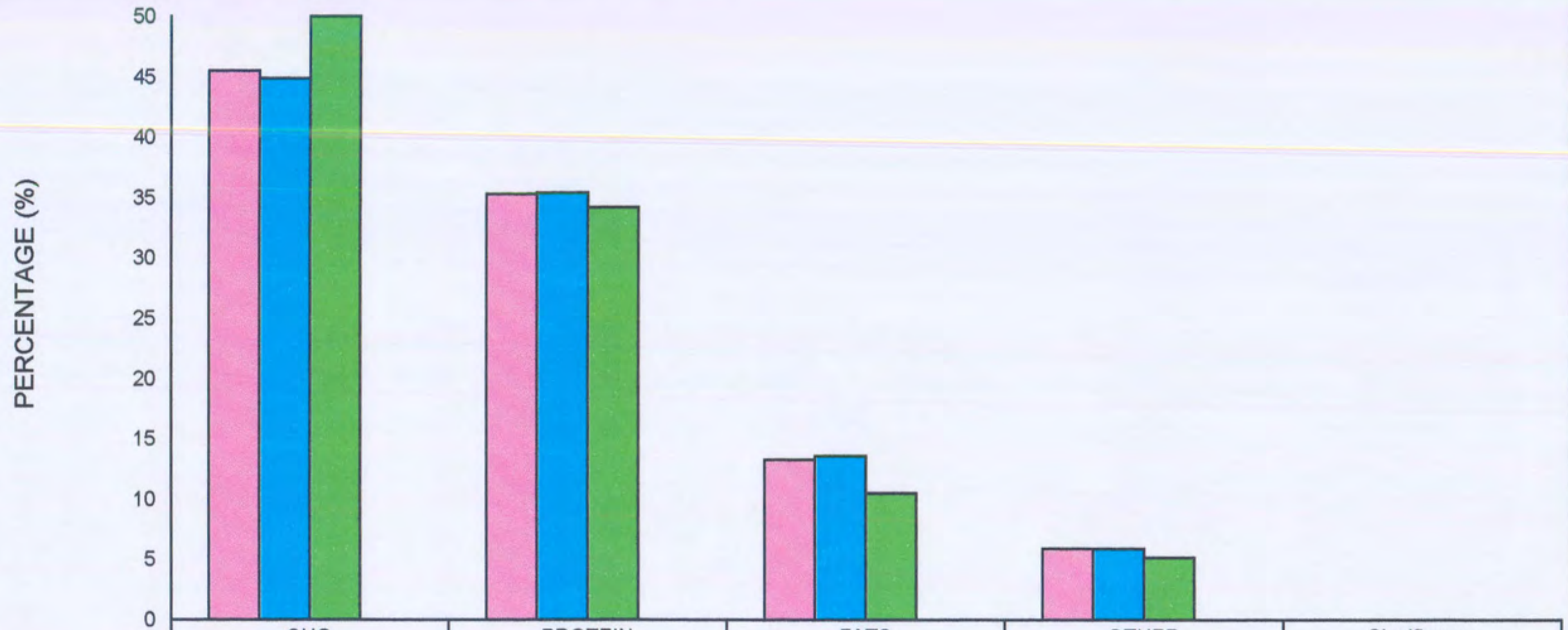
Determining the nature of the food types eaten by respondents (Figure 4.2.3) is indicative of how knowledgeable they are regarding appropriate meal composition. Overall, the significant ($p<0.001$) majority of the respondent's meals constituted mainly of carbohydrate (46%) and protein (35%), followed by fats (13%) and other types of food (6%). In comparing exercises to non-exercisers the same trend was observed but no significant difference ($p>0.1$) between groups.

**FIGURE 4.2.2: KNOWLEDGE OF APPROPRIATE DIETARY PRACTICE (ITEM 54)**



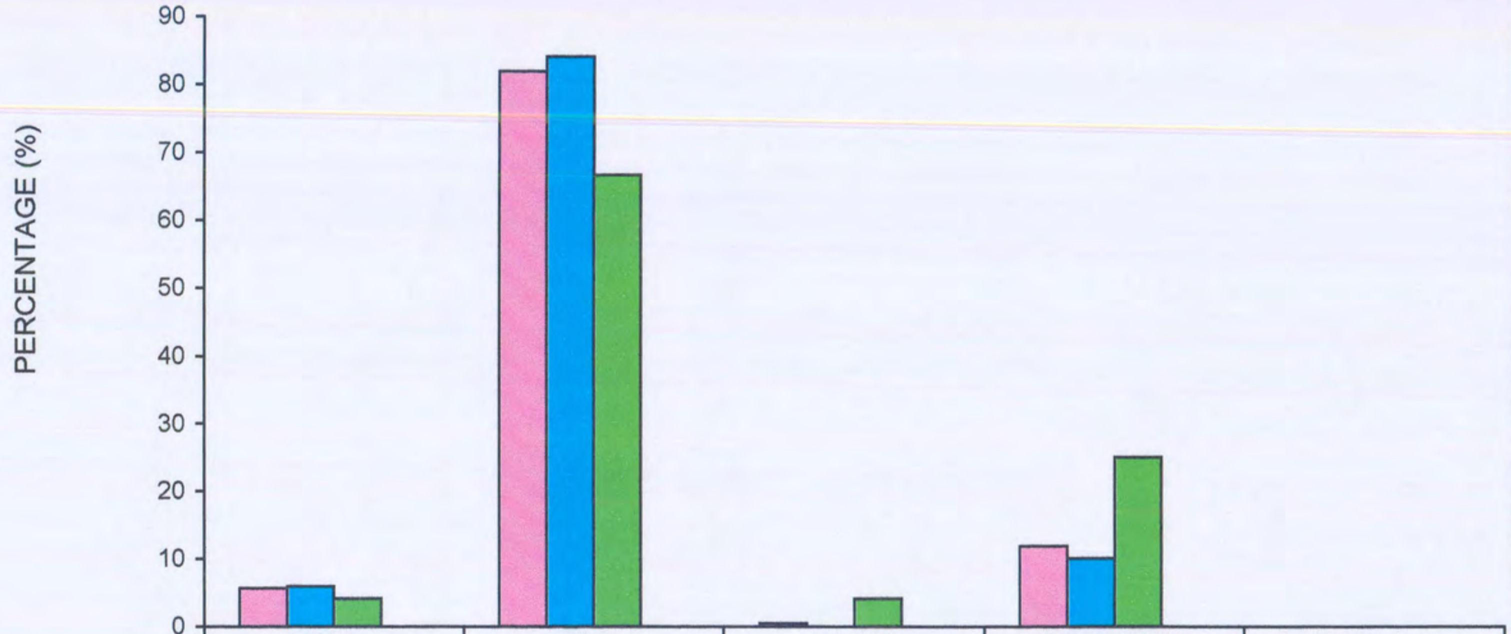

| | A | B | C | D | E | Significance |
|---|---|---|---|---|---|---|
| OVERALL | 24.1 | 7.1 | 53.9 | 9.1 | 5.8 | p<0.001 |
| EXERCISERS (E) | 23.9 | 7 | 54.9 | 8.9 | 5.1 | p<0.001 |
| NON-EXERCISERS (NE) | 25 | 7.1 | 46.4 | 10.7 | 10.7 | p<0.001 |
| N vs NE | NS | NS | NS | NS | NS | |

## FIGURE 4.2.3: NATURE OF MEAL COMPOSITION (ITEM 55)




| | CHO | PROTEIN | FATS | OTHER | Significance |
|---|---|---|---|---|---|
| OVERALL | 45.5 | 35.3 | 13.3 | 5.9 | p<0.001 |
| EXERCISERS (E) | 44.9 | 35.4 | 13.6 | 5.9 | p<0.001 |
| NON-EXERCISERS (NE) | 50 | 34.21 | 10.53 | 5.2 | p<0.001 |
| N vs NE | NS | NS | NS | NS | |

## FIGURE 4.2.4: KNOWLEDGE Of FOOD TYPES (ITEM 56)

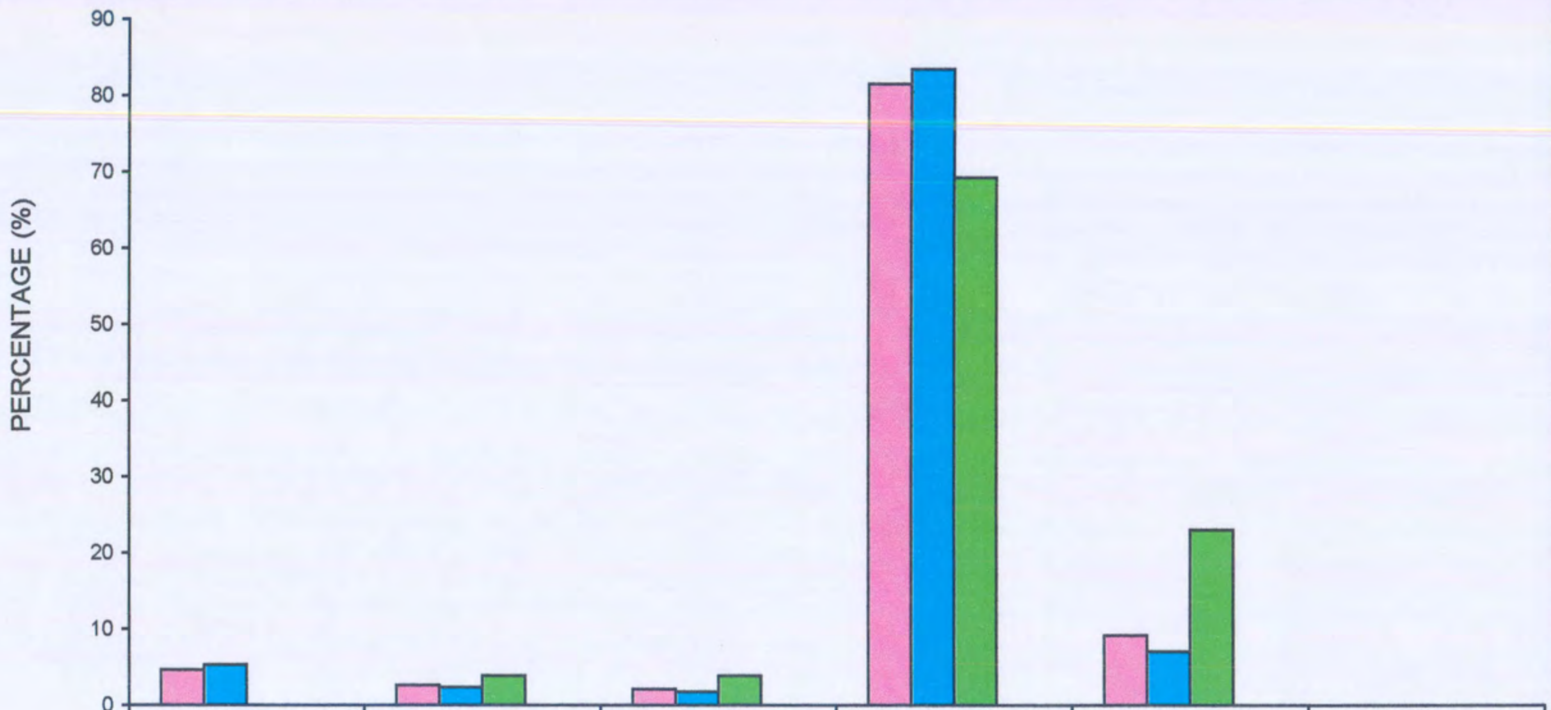



| | PROT | CHO | MIN/VIT | DON'T KNOW | Significance |
|---|---|---|---|---|---|
| OVERALL | 5.7 | 81.9 | 0.5 | 11.9 | p<0.001 |
| EXERCISERS (N) | 5.92 | 84.02 | 0 | 10.06 | p<0.001 |
| NON-EXERCISERS (NE) | 4.17 | 66.67 | 4.17 | 25 | p<0.001 |
| N vs NE | NS | p<0.1 | NS | NS | |

The respondent's knowledge on the categorization of food types was also evaluated (Figure 4.2.4). The researcher probed whether respondents were knowledgeable as to which groups certain food types, such as rice being classified as protein (PROT), carbohydrate (CHO), or mineral and vitamins (MIN/VIT). Overall, the significant ($p<0.001$) majority (82%) indicated the correct response (which is carbohydrate), whilst the remaining 18% require education in this respect. When comparing exercisers and non-exercisers a similar observation was made, but significantly ($p<0.1$) more exercisers (84%) were aware that rice belonged the carbohydrate food group, than did non-exercisers (67%).

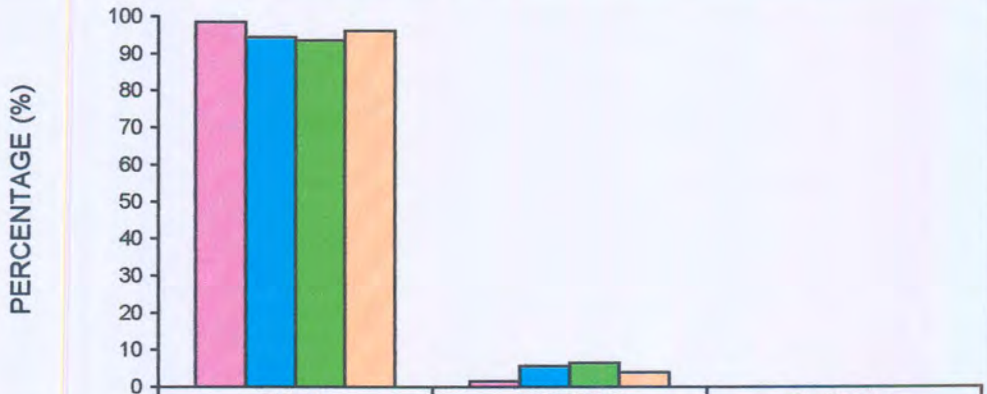
Carbohydrate is one of the main constituents of any diet, and should make up about 60% of any meal. Respondents were required to identify the source of carbohydrate from four food types, viz. meat, eggs, butter or maize (Figure 4.2.5). Overall, the significant ($p<0.001$) majority (81.5%) indicated the correct response (being maize), whilst the remaining 18.6% require education in this regard. When comparing exercisers and non-exercisers a similar observation was made, but significantly ($p<0.1$) more exercisers (83%) were aware that maize was rich in carbohydrate, than did non-exercisers (69%).

**FIGURE 4.2.5: KNOWLEDGE OF CARBOHYDRATE SOURCES (ITEM 57)**




| | MEAT | EGGS | BUTTER | MAIZE | DON'T KNOW | Significance |
|---|---|---|---|---|---|---|
| OVERALL | 4.6 | 2.6 | 2.1 | 81.5 | 9.2 | p<0.001 |
| EXERCISERS (E) | 5.33 | 2.37 | 1.78 | 83.43 | 7.1 | p<0.001 |
| NON-EXERCISERS (NE) | 0 | 3.85 | 3.85 | 69.23 | 23 | p<0.001 |
| E vs NE | NS | NS | NS | p<0.1 | NS | |

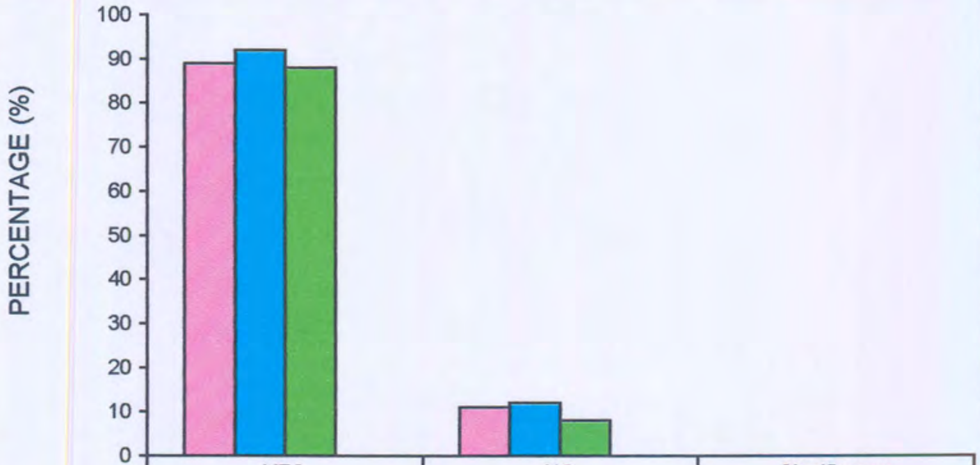
**FIGURE 4.2.6: PERCEIVED OUTCOMES OF APPROPRIATE DIETARY HABITS (ITEM 58-61)**




| | AGREE | DISAGREE | Significance |
|---|---|---|---|
| NORMOGLYCEMIA | 98,5 | 1,5 | p<0.001 |
| GLYCEMIC CONTROL | 94,4 | 5,6 | p<0.001 |
| IDEAL BODY MASS | 93,5 | 6,5 | p<0.001 |
| DECREASED VASCULAR COMPLICATION | 96 | 4 | p<0.001 |

In probing the respondent's attitudes/beliefs on the aims of correct dietary management, the researcher posed four questions all dealing with dietary habits and their implications in diabetes management. The first question probed the respondents as to whether they felt good dietary management was important in achieving normoglycemic control. Overall analysis showed that a significant ($p<0.001$) majority (98.5%) felt that good a good diet is important as compared to the other 1.5%. The second question enquired as to whether the respondents felt good diet was important in reducing the risks of hypoglycemia and hyperglycemia. A significant ($p<0.001$) majority (94.4%) agreed that good diet is important, compared to 5.6% that thought otherwise. The third question investigated how the respondents felt about diet and ideal body weight. Feedback from respondents highlighted that a significant ($p<0.001$) majority (93.5%) agreed that a good diet is important in achieving ideal body weight as compared to the 6.5% who stated otherwise. Lastly in probing the respondents attitudes towards good dietary management and its impact on minimizing risk factors, a significant ($p<0.001$) majority (96%) stated that good dietary management helped reduced risk factors as compared to the minority (4%) that stated otherwise. A similar pattern emerged when comparing exercisers to non-exercisers, with no significant difference (p>0.1) for all four questions investigated above.

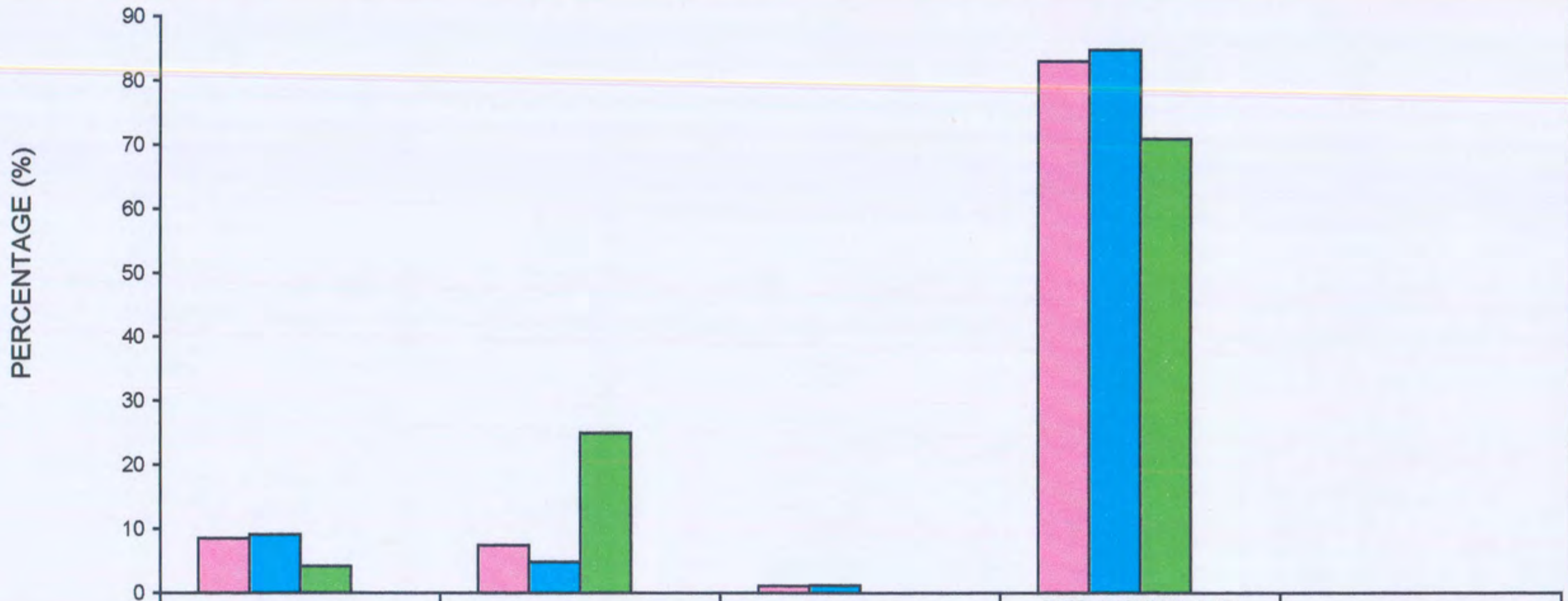
**FIGURE 4.2.7: KNOWLEDGE OF FOOD VOLUME AND BLOOD GLUCOSE RESPONSE (ITEM 62)**




| | YES | NO | Significance |
|---|---|---|---|
| OVERALL | 89 | 11 | p<0.001 |
| EXERCISERS (E) | 92 | 12 | p<0.01 |
| NON-EXERCISERS (NE) | 88 | 8 | p<0.001 |
| E vs NE | NS | NS | |

In probing the respondents knowledge on the volume of food consumed and the effects it has on glucose levels, a significant (p<0.001) majority (89%) of the respondents agreed that it does impact on glucose levels whilst the remaining minority (11%) felt there is no relationship between the amount of food eaten and glucose levels. In comparing the exercising and non-exercising groups the results yielded a similar trend with no differences (p>0.1) between the groups.

**FIGURE 4.2.8: KNOWLEDGE OF DIABETES MANAGEMENT PRINCIPLES (ITEM 63)**

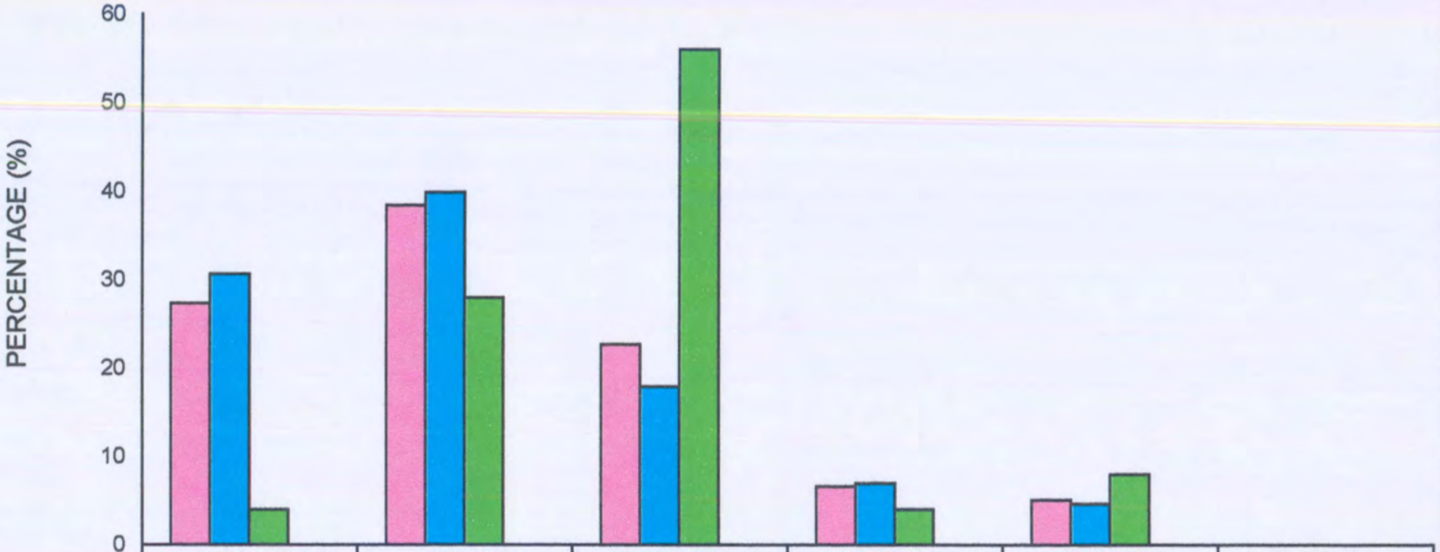



| | DIET ONLY | DIET AND INSULIN | INSULIN ONLY | DIET, INSULIN, AND EXERCISE | Significance |
|---|---|---|---|---|---|
| OVERALL | 8.5 | 7.4 | 1.1 | 83 | p<0.001 |
| EXERCISERS (E) | 9.15 | 4.88 | 1.22 | 84.76 | p<0.001 |
| NON-EXERCISERS (NE) | 4.17 | 25 | 0 | 70.83 | p<0.001 |
| E VS NE | NS | NS | NS | p<0.1 | |

In Figure 4.2.8 the respondent's knowledge of good diabetes management goals is reflected. It was observed that the overall significant ($p<0.001$) majority (83%) stated the correct option i.e. diet, insulin and exercise. The remaining 17% who stated otherwise require education on the importance of integrating the three components in the management of diabetes. A similar observation was made among exercisers and non-exercisers, but significantly ($p<0.1$) more exercisers (84%) stated that diet, insulin and exercise are important constituents to obtain good diabetes management than did non-exercisers (70.8%). The remaining 29.11% of exercisers and 15.3% of non-exercisers need to be educated on the principles of obtaining good diabetes management.

In Figure 4.2.9 the respondents were questioned on their dietary practices for the past 7 days (week). A significant overall ($p<0.001$) majority stated they always (27%) or usually (38%) follow a balanced diet. The remaining respondents stated that they sometimes (23%), rarely (7%), or never (5%) follow a balance diet. These 35% who very seldom follow a diet should be educated on the benefits of a good, balanced diet. In comparing exercisers and non-exercisers there was a significant ($p<0.1$) difference between the two groups. It is evident that exercisers follow a fairly controlled diet more frequently as compared to non-exercisers. This may indicate that exercisers are more sensitive to the need for following a balanced diet than non-exercisers.

**FIGURE 4.2.9: BALANCED DIETARY PRACTICES (ITEM 64)**

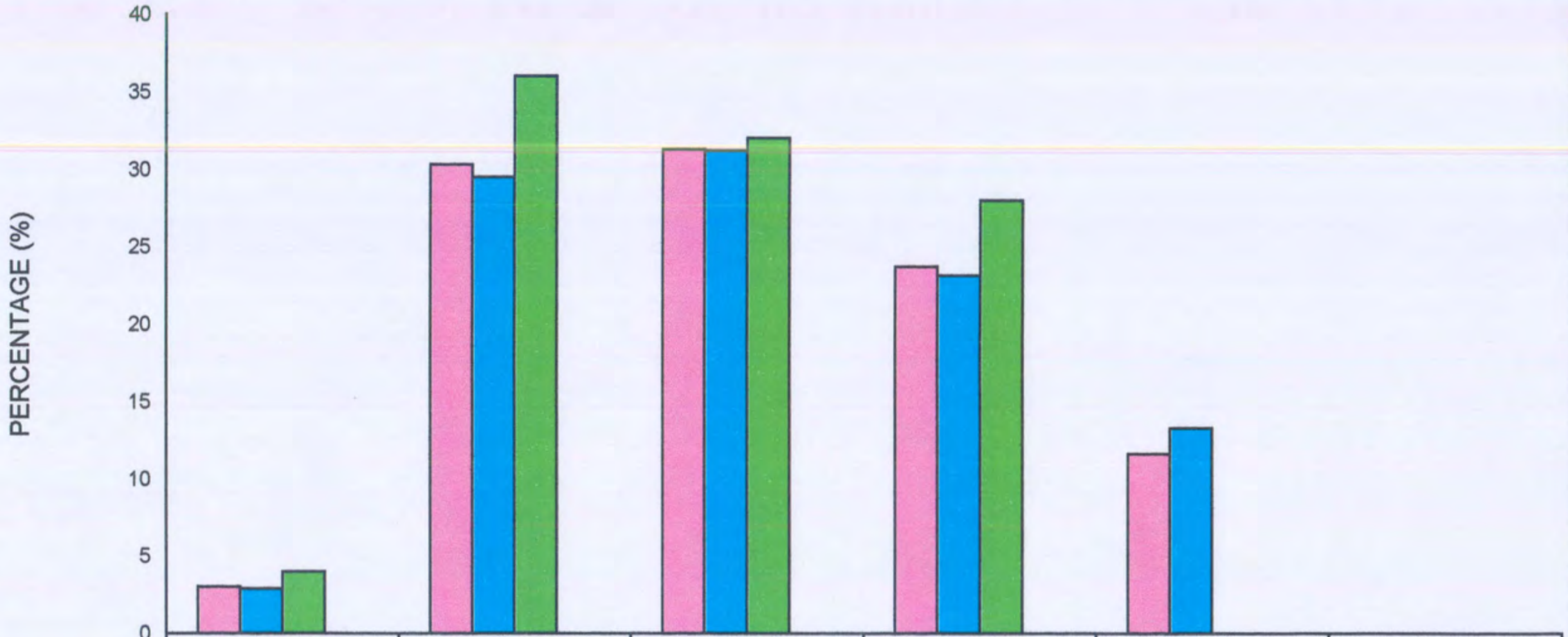



| | ALWAYS | USUALLY | SOMETIMES | RARELY | NEVER | Significance |
|---|---|---|---|---|---|---|
| OVERALL | 27,3 | 38,4 | 22,7 | 6,6 | 5,1 | p<0.001 |
| EXERCISERS (E) | 30,64 | 39,88 | 17,92 | 6,94 | 4,62 | p<0.001 |
| NON-EXERCISERS (NE) | 4 | 28 | 56 | 4 | 8 | p<0.001 |
| E vs NE | p<0.1 | NS | NS | NS | NS | |

In probing the fibre intake of respondents for the past 7 days (Figure 4.2.10), the significant ($p<0.001$) overall majority (61%) stated that their meals consisted of 25% to 50% fibre, whilst 24% stated that 75% of their meals consisted of fibre and the remaining 12% stated that 100% of their meal consisted of fibre. The recommended amounts of dietary fibre constitute about 20g per 1000 kcal (Pickup & Williams, 1991). One's dietary fibre content should thus constitute about 25% to 50% of a meal. The 39% that fell out of the recommended ratio need to be educated on what percentage of their meals should constitute of fibre. In comparing the exercisers to the non-exercisers, a similar trend was observed but yielded no significant difference ($p>0.1$) between the groups.

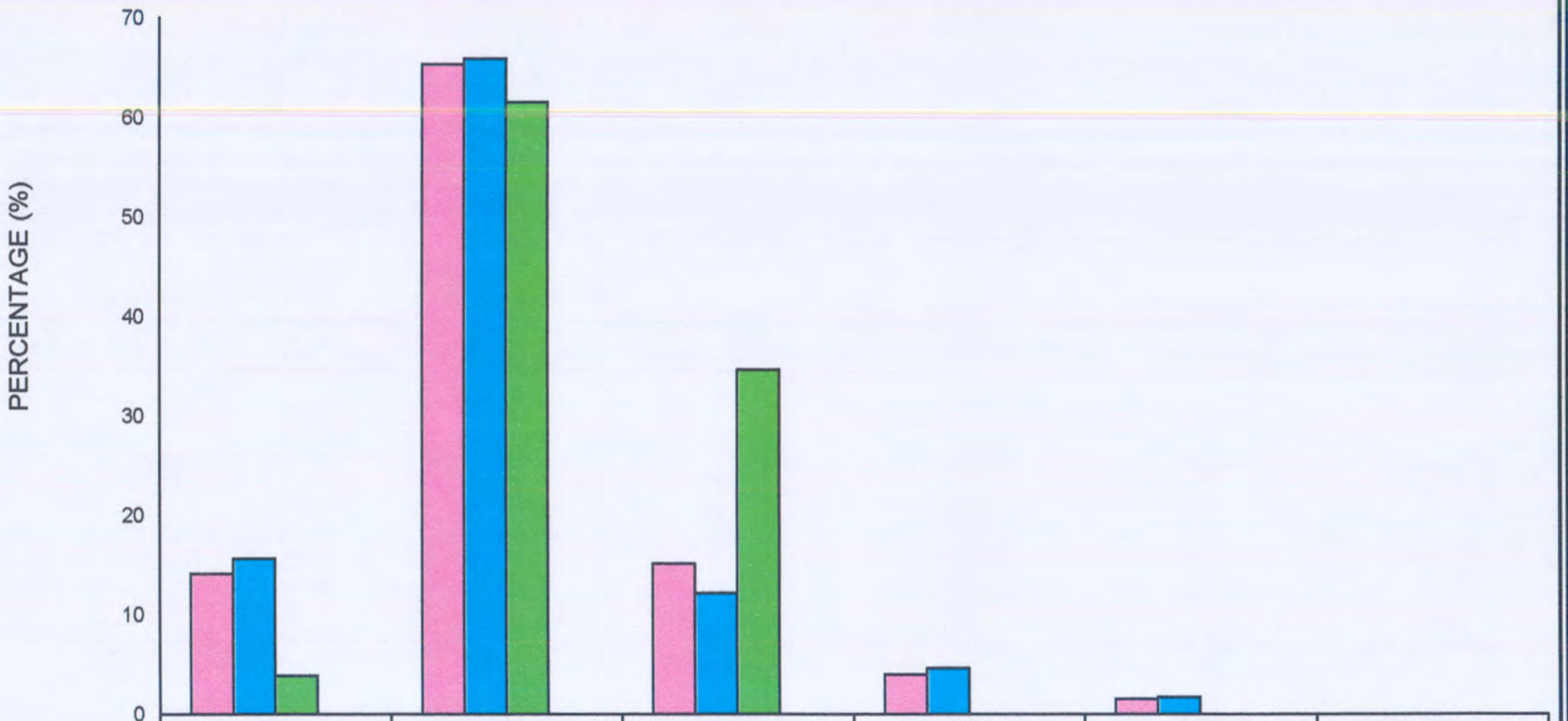
In Figure 4.2.11 the respondents fat intake for the past 7 days was also documented which indicated a significant ($p<0.001$) overall majority (65%) having the correct proportion of fat (25%) in their daily meals. The remaining 35% that fell in other categories need to be educated on the correct proportion of fat their meals should constitute. It is recommended that ones diet should consist of 25% of total fat content (Pickup & Williams, 1991). The comparison between exercisers and non-exercisers yielded in a significant ($p<0.1$) difference, it is evident that the majority of exercisers typically have a much lower fat intake (25% of meals) than non-exercisers where a fairly large proportion (35%) tend to eat meal with a 50% fat content.

## FIGURE 4.2.10: VOLUME OF DIETARY FIBRE INTAKE (ITEM 65)



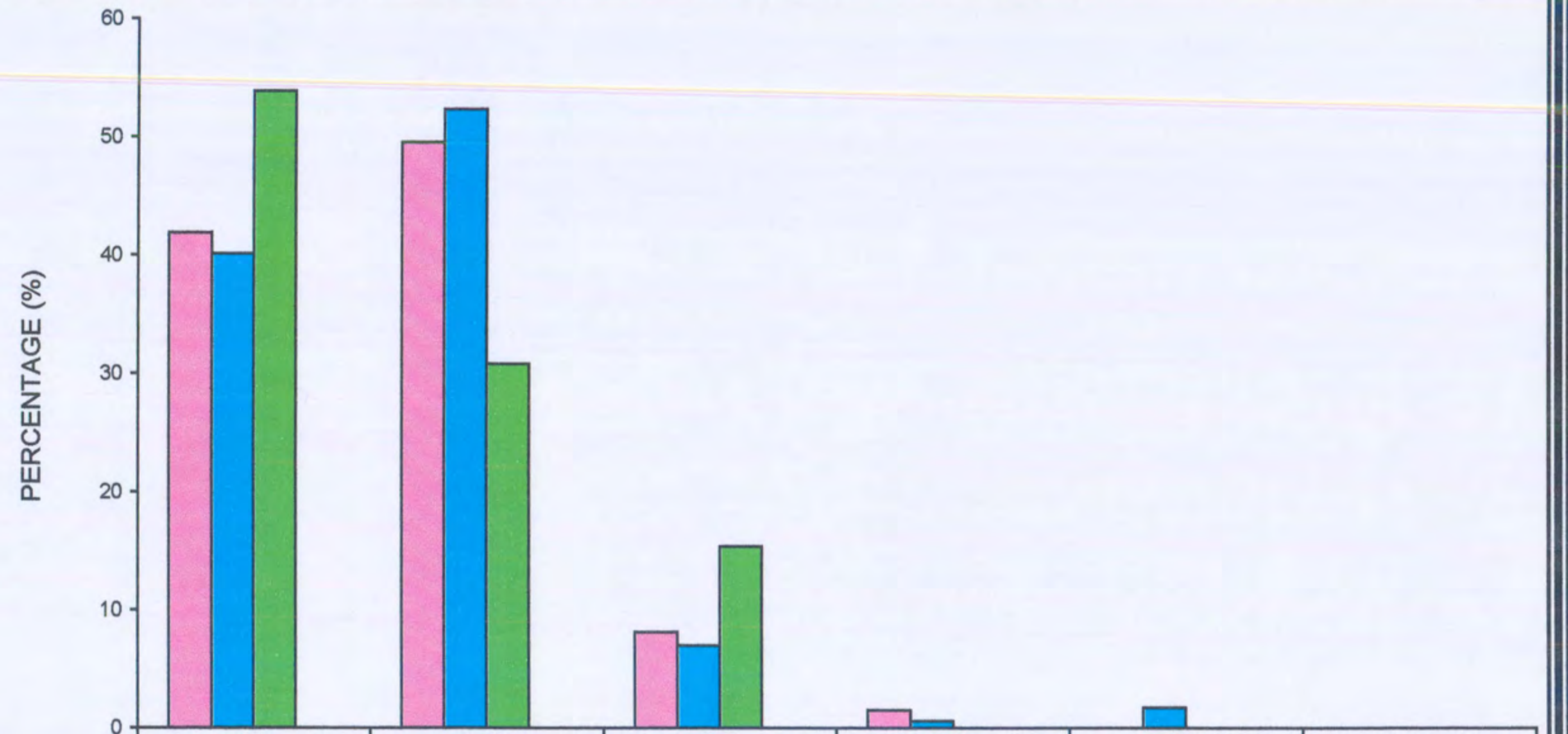

| | 0% | 25% | 50% | 75% | 100% | Significance |
|---|---|---|---|---|---|---|
| OVERALL | 3 | 30.3 | 31.3 | 23.7 | 11.6 | p<0.001 |
| EXERCISERS (E) | 2.89 | 29.48 | 31.21 | 23.12 | 13.29 | p<0.001 |
| NON-EXERCISERS (NE) | 4 | 36 | 32 | 28 | 0 | p<0.001 |
| E vs NE | NS | NS | NS | NS | NS | |

## FIGURE 4.2.11: VOLUME OF DIETARY FAT INTAKE (ITEM 66)




| | 0% | 25% | 50% | 75% | 100% | Significance |
|---|---|---|---|---|---|---|
| OVERALL | 14.1 | 65.3 | 15.1 | 4 | 1.5 | p<0.001 |
| EXERCISERS (E) | 15.61 | 65.9 | 12.14 | 4.62 | 1.73 | p<0.001 |
| NON-EXERCISERS (NE) | 3.85 | 61.54 | 34.62 | 0 | 0 | p<0.001 |
| E vs NE | NS | NS | p<0.1 | NS | NS | |

## FIGURE 4.2.12: VOLUME OF DIETARY REFINED CARBOHYDRATE INTAKE (ITEM 67)




| | 0% | 25% | 50% | 75% | 100% | Significance |
|---|---|---|---|---|---|---|
| OVERALL | 41.9 | 49.5 | 8.1 | 1.5 | 0 | p<0.001 |
| EXERCISERS (E) | 40.12 | 52.33 | 6.98 | 0.58 | 1.73 | p<0.001 |
| NON-EXERCISERS (NE) | 53.85 | 30.77 | 15.38 | 0 | 0 | p<0.001 |
| E vs NE | NS | NS | NS | NS | NS | |

In probing the respondents refined carbohydrate intake for 7 days (Figure 4.2.12) it was noted that a significant ($p<0.001$) overall majority (91%) of the respondent's meals consisted of the correct proportion of refined carbohydrate (i.e. between 0% to 25%). Eight percent stated that refined carbohydrate comprised 50% of their diet and 1.5% stated a 75% contribution. The non-conforming (9.5%) should be educated so that they decrease their refined carbohydrate intake. The comparison between exercisers and non-exercisers with regards to the refined carbohydrate intake yielded no significant difference ($p>0.1$) although more non-exercisers tended to include a higher (50%) refined carbohydrate in their diet.

## 4.3 EXERCISE ROUTINE

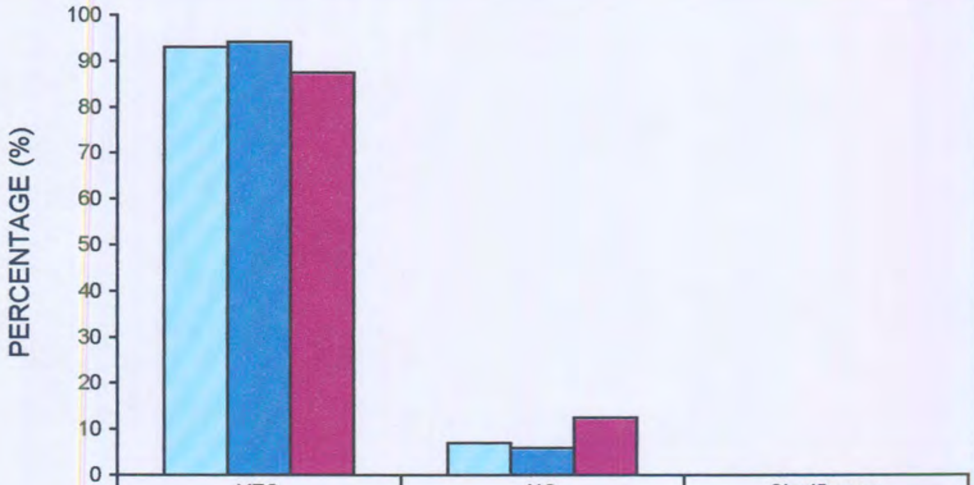
The results pertaining to the exercise routine of the respondents are discussed following presentation in tabular and graphic form in Table 4.3.1 and Figures 4.3.1-4.3.17 respectively.

### TABLE 4.3.1: ATTITUDE TOWARDS EXERCISE (ITEM 13)

| ATTITUDE | OVERALL | | EXERCISERS | | NON-EXERCISERS | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| Very positive | 74 | 37.4 | 70 | 40.7 | 4 | 15.38 |
| Positive | 90 | 45.5 | 81 | 47.09 | 9 | 34.62 |
| Indifferent | 26 | 13.1 | 16 | 9.30 | 10 | 38.46 |
| Negative | 8 | 4.0 | 5 | 2.91 | 3 | 11.54 |
| p<0.001 | | | p<0.1 | | | |

Physical exercise has been recommended as an important component of diabetic treatment (Colberg, 2001). In probing the respondent's attitude towards exercise (Table 4.3.1), the significant ($p<0.001$) overall majority (85%) had either a positive (40%) or very positive attitude (37%) towards exercise. In comparing exercisers to non-exercises, a significant difference ($p<0.1$) was observed. It was evident that those who exercised are more positive about exercising while those who don't exercise were more indifferent towards exercise.

**FIGURE 4.3.1: OPINIONS ABOUT EXERCISE AND DIABETIC CONTROL (ITEM 49)**




| | YES | NO | Significance |
|---|---|---|---|
| OVERALL | 93 | 7 | p<0.001 |
| EXERCISERS | 94.12 | 5.88 | p<0.001 |
| NON-EXERCISERS | 87.5 | 12.5 | p<0.001 |

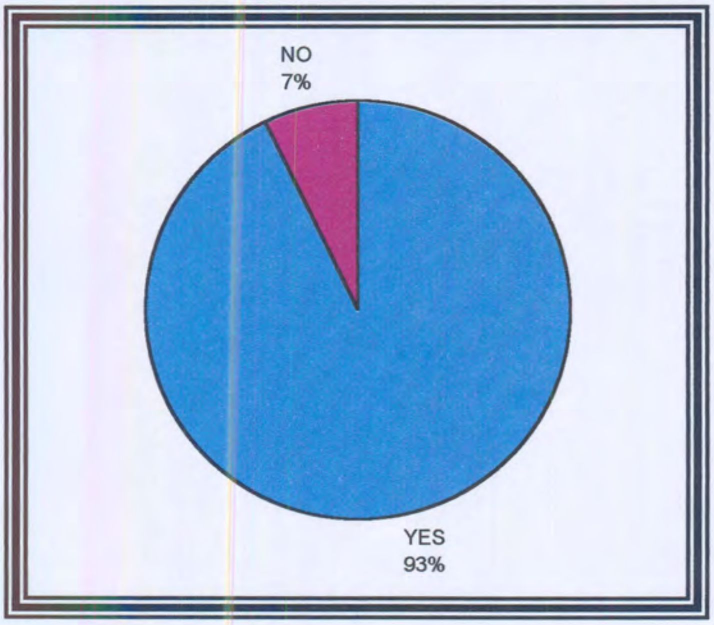
Respondents were asked as to whether they believed, exercise could help control diabetes. In Figure 4.3.1, a significant ($p<0.001$) overall majority (93%) agreed that exercise could help control diabetes whilst the other 7% stated otherwise. In comparing the response between exercisers and non-exercisers in this regard, the same trend was found, with no significant difference ($p>0.1$) between the groups.

**PERCEIVED EXERCISE-RELATED CONTROL MECHANISMS (ITEM 50)**

Those respondents who were of the opinion that exercise could help diabetics stated the following: exercise can reduce sugar levels; decrease body fat; decrease insulin dosages; helps utilize excess sugar for energy; helps with circulation thus preventing neuropathy and exercise lowers blood glucose levels. All of these answers are correct in helping to control diabetes.

From the minority (6%) that stated exercise does not help control diabetes, the reasoning was: exercise has no effect on ones blood glucose level; exercise caused hyperglycemia as well as hypoglycemia; it does not normalize glucose levels and exercise does not decrease body weight.

**FIGURE 4.3.2: OPINION ON THE EFFICACY OF EXERCISE (ITEM 32)**

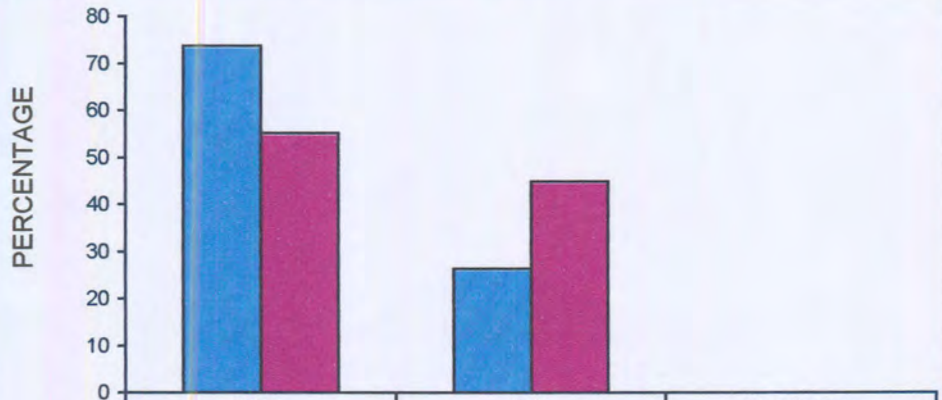



Exercise is undoubtedly beneficial to a person who has diabetes. The respondent's opinion was attained in this regard based on their experience of the benefits of exercise/sport (Figure 4.3.2). A significant ($p<0.001$) overall majority (93%) of the respondents stated exercise/sport is beneficial whilst the remaining 7% stated that exercise was not beneficial.

**BENEFITS OF EXERCISE (ITEM 33-35)**

The 93% of respondents that stated exercise was beneficial explained their reasoning, in the following ways: decreased weight; decreased sugar levels; increased self esteem; kept you in good health; relaxing; delays complications; have more energy to do tasks; able to concentrate better; less insulin is required; improves blood circulation; improves cardiac functioning; gain more self confidence; reduces blood pressure; relieves stress; tones ones muscles; sleep well; and mentally alert.

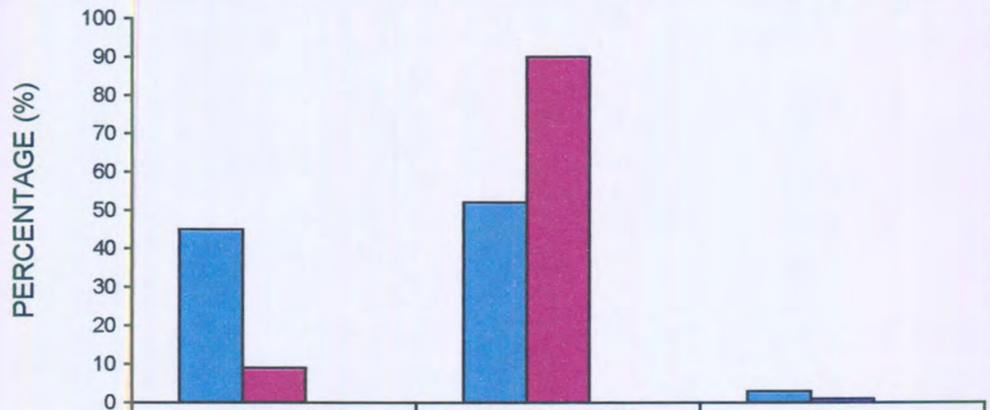
**FIGURE 4.3.3: PARTICIPATION IN EXERCISE/SPORT BEFORE AND AFTER DIAGNOSIS (ITEM 14 & 19)**




| | YES | NO | Significance |
|---|---|---|---|
| BEFORE | 73.72 | 26.28 | p<0.001 |
| AFTER | 55.17 | 44.83 | p<0.001 |

Participation in exercise/sport is a very important factor when dealing with diabetes, the researcher gathered information on the respondents participation in sport/exercise before being diagnosed as a diabetic and participation after being diagnosed as a diabetic (Figure 4.3.3). Before diagnosis, 74% of respondents were involved in exercise/sport and 26% were inactive, after diagnosis the number of participants in exercise/sport decreased to 55% and inactivity increased to 45%. There was a significant ($p<0.1$) difference between participation before diagnosis and after being diagnosed as a diabetic. Epidemiological surveys indicate that people with and without diabetes are equally likely to exercise. However more than 50% of diabetics are not meeting accepted physical activity goals, and should be able to exercise according to their capabilities, physical limitations and personal interest (Ford & Hermann, 1995).

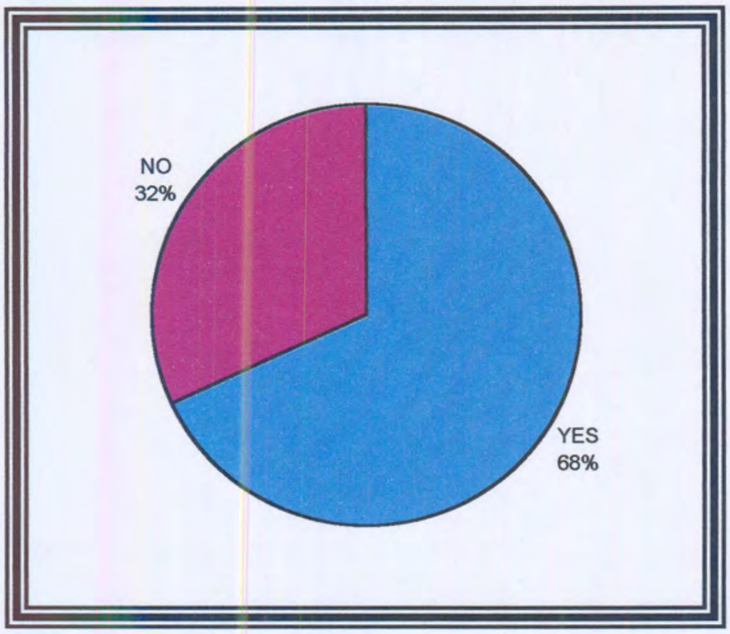
**FIGURE 4.3.4: PRE AND POST DIAGNOSIS EXERCISE CATEGORIZATION (ITEM 15 & 20)**




| | COMPETITIVE | RECREATIONAL | BOTH |
|---|---|---|---|
| PRE | 45 | 52 | 3 |
| POST | 9 | 90 | 1 |
| Significance | p<0.001 | p<0.001 | |

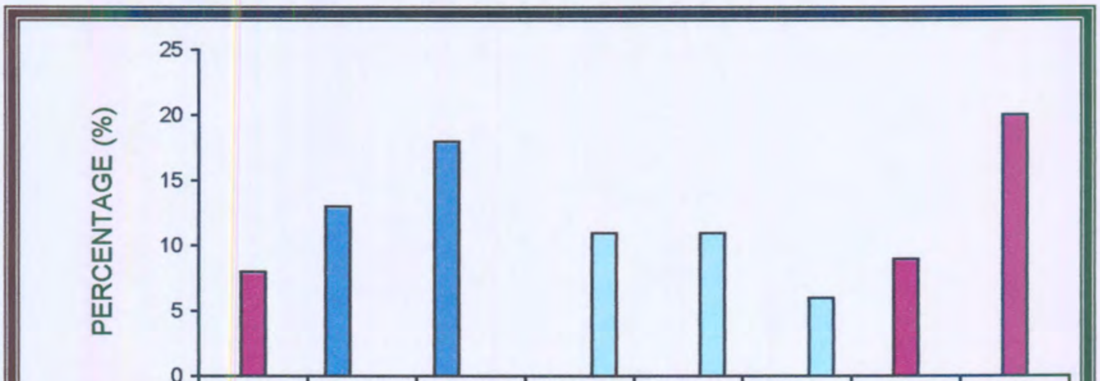
In probing the categorization of exercise practices among exercisers before and after diagnosis (Figure 4.3.4), 45% of the exercisers were involved in a competitive basis, 52% on a recreational basis, and 3% in both. After diagnosis, it was observed that only 9% competed on a competitive basis and the significant ($p<0.001$) majority (82%) competed on a recreational basis. The data reflects that there was significant increase in participation in recreational exercise/sport after being diagnosed, and a decrease in participation on a competitive basis.

**FIGURE 4.3.5: CURRENT PARTICIPATION IN EXERCISE/SPORT (ITEM: 19)**




In probing current exercise participation profiles it has been observed that there was a decrease in participation in sport after being diagnosed as a diabetic (Figure 4.3.5). A significant ($p<0.001$) majority (68%) of respondents were active exercisers as compared to the 32% non-exercisers.

**FIGURE 4.3.6: CLASSIFICATION OF EXERCISE ACTIVITIES (ITEM: 16-18)**




| | Racket | Water | Athletics | Leisure | Bat | Dance | Gym | Ball |
|---|---|---|---|---|---|---|---|---|
| AEROBIC | | 13 | 18 | | | | | |
| ANAEROBIC | 8 | | | | | | 9 | 20 |
| BOTH | | | | 11 | 11 | 6 | | |

Exercise can be classified into two predominant and interactive metabolic categories: aerobic and anaerobic. As seen in Figure 4.3.6 respondents who are physically active before being diagnosed as being diabetic were requested to state at least three exercises that they participated in. The respondents were given a choice of eight exercises, their responses were grouped into either aerobic or anaerobic. From the data provided it is evident that respondents preferred athletic (18%) and ball type activities (20%) as compared to the other sport. Insulin dependent diabetics can engage in any type of exercise, provided that they are aware of potential hypoglycemia, hyperglycemia and dehydration during the activity,. Actual problems may arise if the diabetic has diabetic-related complications (Colberg, 2001).

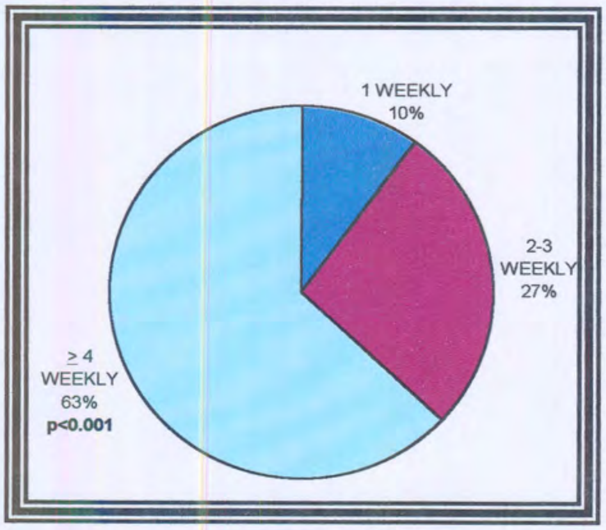
Running and jogging are stress endurance, which are aerobic activities. The main fuel used by the body is fat and carbohydrate, with carbohydrate use (blood glucose and glycogen), increasing with running intensity. Exercise intensity will affect the release of glucose raising hormone with more intense running resulting in possible increases in blood sugar levels. Similarly water sport e.g. swimming is mainly aerobic, especially when swimming long distances. Longer endurance swimming is aerobic in nature, utilizing a mixture fats and carbohydrate, however, shorter sprints are mainly anaerobic using phosphagens and lactic acid. Racket sport (e.g. tennis, squash), and weight training are anaerobic in nature. Weight training and gymnastics involve short, powerful repetitions of a specific movement to utilize mainly anaerobic energy sources (stored phosphagens and muscle glycogen via the lactic acid system). Racket sport involves quick, powerful moves such as hitting or throwing the ball and moving into position. These activities are therefore classified as anaerobic activities.

Bat sport, dance, and ball sport, are classified as both aerobic and anaerobic activities. All of these sports involve a combination of stop-and-start movements, e.g. soccer power moves such as throwing and kicking which is anaerobic and long runs which is aerobic. Bat sport e.g. cricket and hockey, depending on the position played, involves stop and start movements and longer sustained runs, involving both aerobic and anaerobic systems. These sports involve significant use of both muscle glycogen and blood sugar. With dance there's a combination of aerobic and anaerobic movement. Depending on the intensity and duration, dancing will have a big effect on blood sugar responses.

## TYPES OF EXERCISE/SPORT PARTICIPATED IN AFTER DIAGNOSIS (ITEM 21-23)

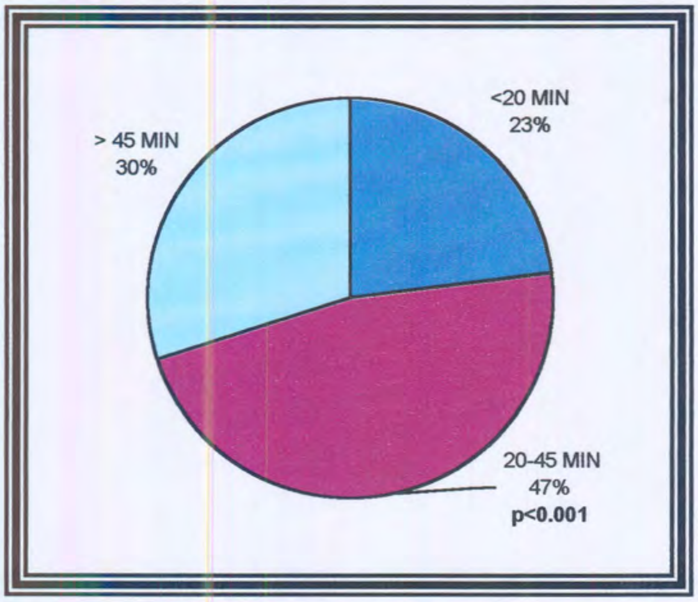
Those respondents that were exercising (69%) after being diagnosed as a diabetic were requested to list at least three types of sport they participated in. Similar to Figure 4.3.6 exercises were classified into two categories aerobic and anaerobic. Most of the respondents participate in similar sport such as racket sport, water sport, athletics and leisure activities, bat sport, dance, weights and ball sport. Resistance training has been shown to be essential to prevent loss of muscle tissue over time. Having more muscle will increase your basal metabolic rate and daily caloric expenditure, thus improving insulin sensitivity and preventing some fat weight gain.

## FIGURE 4.3.7: FREQUENCY OF EXERCISE SESSIONS (ITEM 28)



The frequency of exercise sessions was also probed (Figure 4.3.7). Ten percent of the respondents stated that they participated in exercise/sport once a week, 27% participated 2-3 times a week, and a significant ($p<0.001$) majority (63%) of the respondents participated four and more times a week. The American College of Sport Medicine (2000) recommends exercising a minimum of three to five days per week, engaging in resistance-type training as well as flexibility training a minimum of 2-3 days a week.

**FIGURE 4.3.8: DURATION OF EXERCISE SESSION (ITEM: 27)**



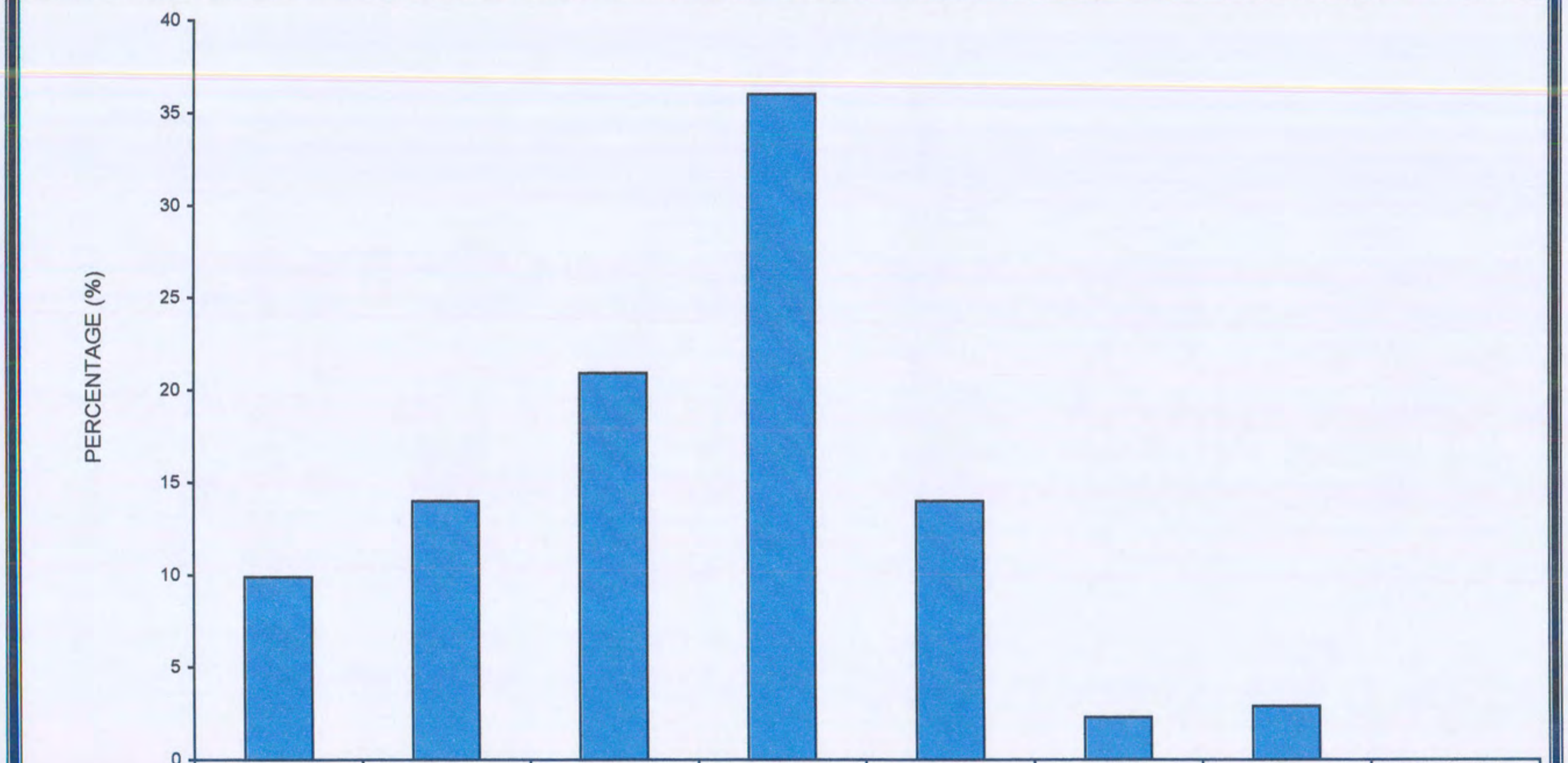

In probing the respondents duration of each exercise session Figure (4.3.8), a significant ($p<0.001$) majority 47% of respondents trained between 20-45 minutes, 23% of the respondents trained less than 20 minutes, and 30% trained more than 45 minutes. The other 23% of respondents who did not exercise adequately need to be educated to increase their duration of their exercise session to last at least 20 to 60 minutes of continuous aerobic activity to sufficiently improve your fitness levels (American College of Sports Medicine, 2000). You also achieve a greater total caloric expenditure by exercising over a longer duration at a lower, more sustainable intensity.

In Figure 4.3.9 below, the symbols used to represents estimated exercise intensity according to Borg's Rating of perceived exertion (Borg, 1998) are as follows:

| | |
|---|---|
| EL: extremely light | (7x10=±70bpm) |
| VL: very light | (9x10=±90bpm) |
| FL: fairly light | (11x10=±110bpm) |
| SH: somewhat hard | (13x10=±130bpm) |
| H: hard | (15x10=±150bpm) |
| VH: very hard | (17x10=±170bpm) |
| EH: extremely hard | (19x10=±190bpm) |

The choice of exercise intensity should reflect diabetic training goals (i.e. greater caloric expenditure versus maximal increases in endurance performance or $VO_2max$). In analyzing perceived intensity of their exercise, it is noted that 9.9% of the respondents felt the exercise sessions to be extremely light, 14% experienced exercise sessions as very light, 21% as fairly light, 36% as somewhat hard, 14% as hard, 2.3% as very hard, and 2.9% as extremely hard. There was a significant ($p<0.001$) difference between the variables.

**FIGURE 4.3.9 INTENSITY OF EXERCISE SESSIONS (ITEM: 29)**




| | EL | VL | FL | SH | H | VH | EH | Significance |
|---|---|---|---|---|---|---|---|---|
| PERCENTAGE | 9.9 | 14 | 20.9 | 36 | 14 | 2.3 | 2.9 | p<0.001 |

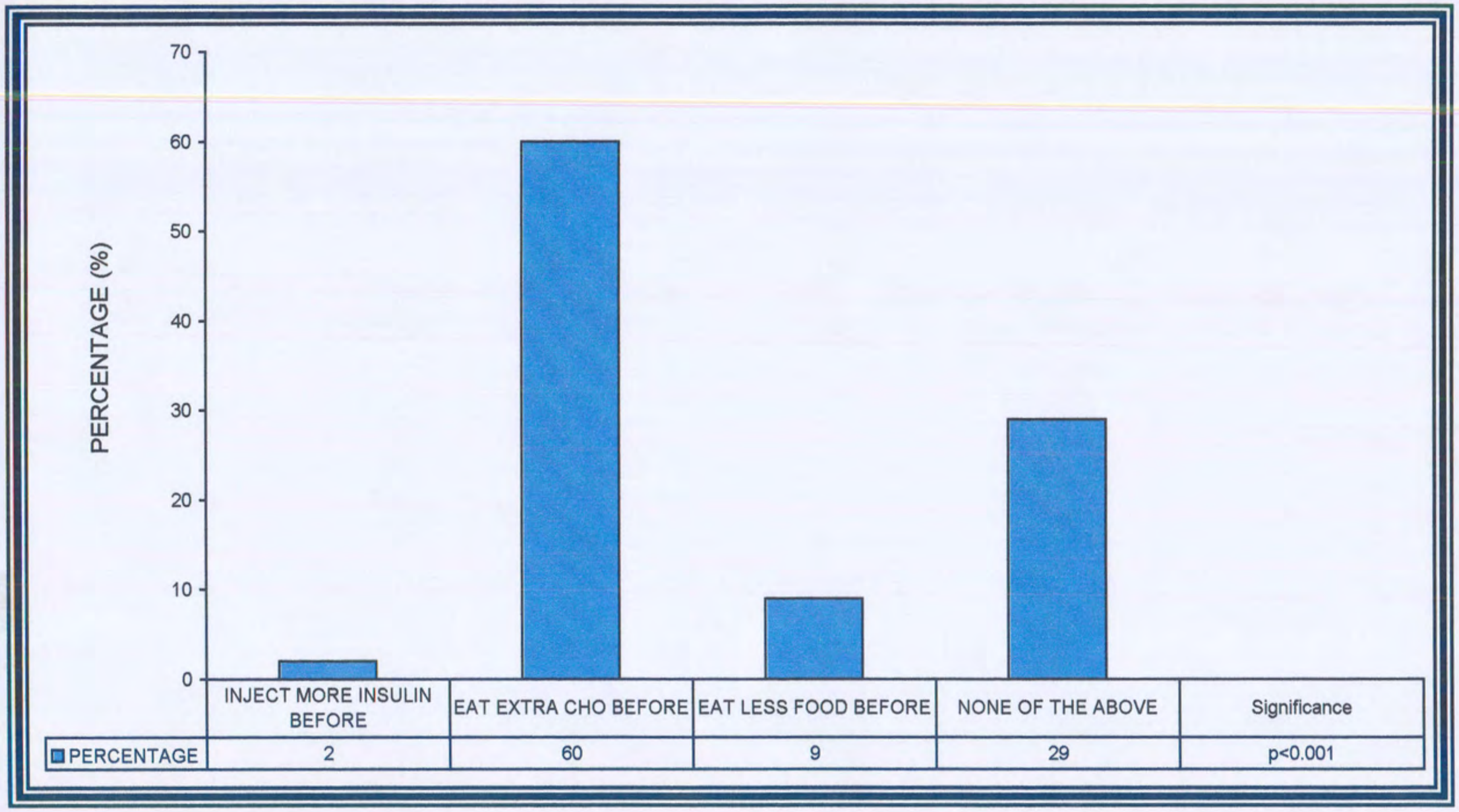
**RATING OF PERCEIVED EXERTION (RPE) SCALES X 10 = ± HEART RATE**

| ORIGINAL SCALE | |
|---|---|
| 6 | |
| 7 | Very, Very Light |
| 8 | |
| 9 | Very light |
| 10 | |
| 11 | Fairly light |
| 12 | |
| 13 | Somewhat hard |
| 14 | |
| 15 | Hard |
| 16 | |
| 17 | Very hard |
| 18 | |
| 19 | |
| 20 | Very hard |

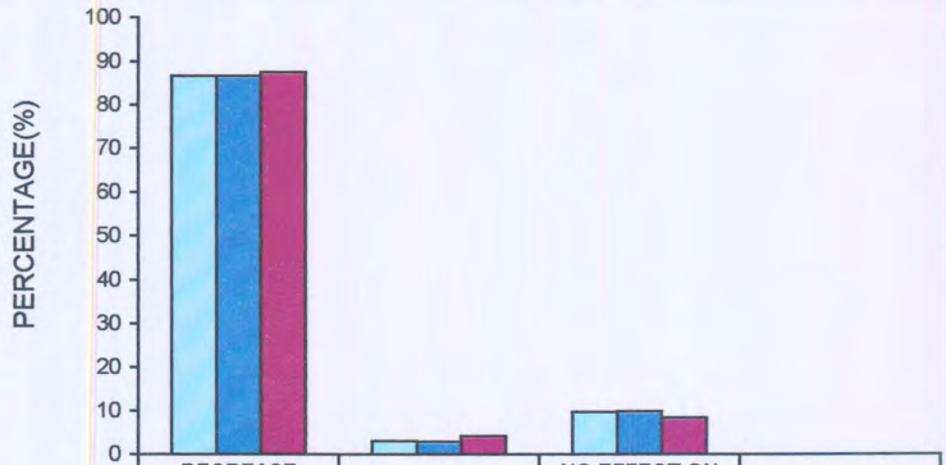
In Figure 4.3.9, the significant (p<0.001) majority (57%) of respondents perceived their intensity of exercise to range between fairly light and somewhat hard, corresponding with heart rate of between 110-130bpm which is slightly lower than recommended. The recommended range of RPE for optimal fitness improvement is 12 to 16 ("somewhat hard" to "hard") on the category (original) scale with 20 being the very hardest level.

In determining the knowledge of exercisers regarding related normoglycemic precautions (Figure 4.3.10), a significant (p<0.001) majority (60%) stated the correct response (eat extra carbohydrate before exercising to prevent hypoglycemia during exercise). The remaining 40% of these respondents need to be educated on the correct normoglycemic management strategies that should be adhered too before a vigorous workout.

**FIGURE 4.3.10: KNOWLEDGE ON EXERCISE AND NORMOGLYCEMIC PRECAUTIONS (ITEM 31)**



## FIGURE 4.3.11: OPINIONS ON GLYCEMIC RESPONSE TO EXERCISE (ITEM 72)

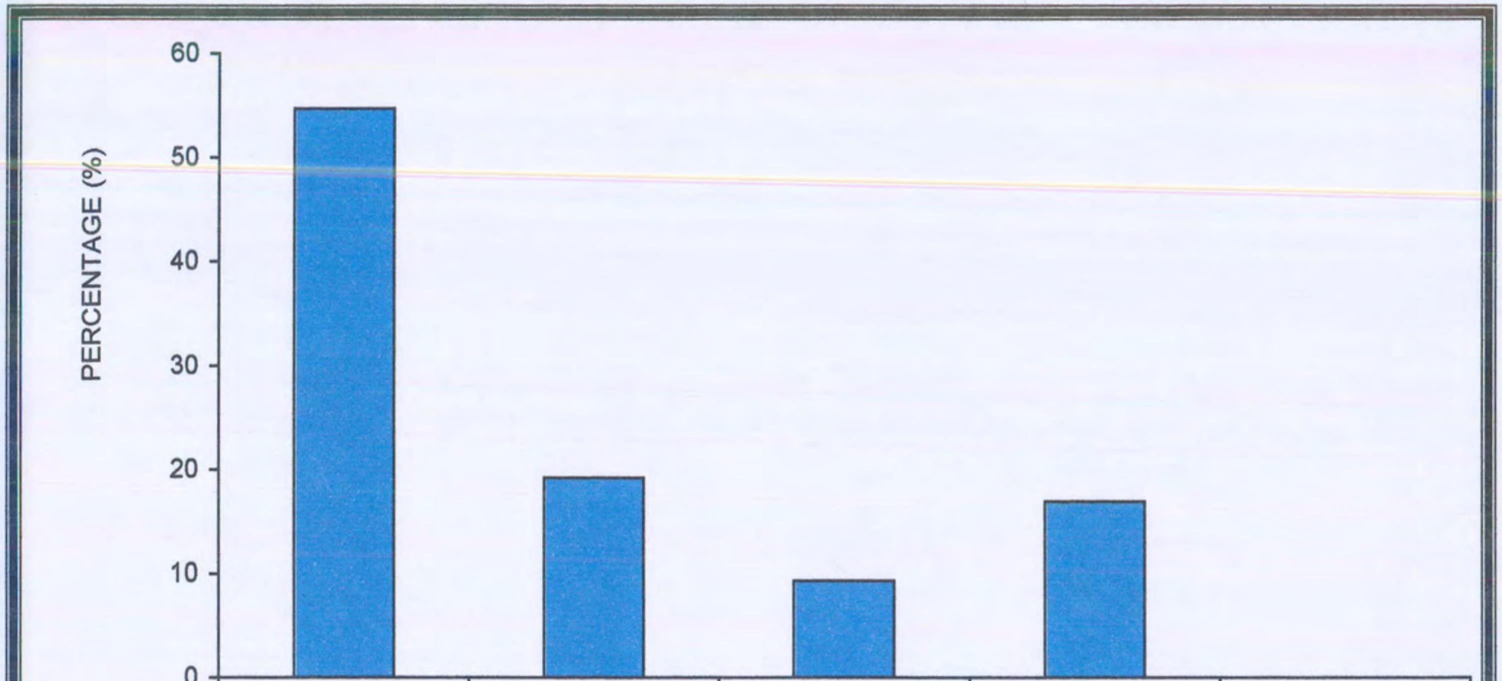



| | DECREASE BLOOD GLUCOSE LEVELS | INCREASE BLOOD GLUCOSE LEVELS | NO EFFECT ON BLOOD GLUCOSE LEVELS | Significane |
|---|---|---|---|---|
| OVERALL | 86.7 | 3.1 | 9.7 | p<0.001 |
| EXERCISERS | 86.63 | 2.91 | 9.88 | p<0.001 |
| NONEXERCISERS | 87.5 | 4.17 | 8.33 | P<0.001 |

Regular physical activity definitely improves blood glucose control by increasing the body's sensitivity to insulin. In gathering information on the respondents perceived glycemic response to exercise (Figure 4.3.11), a significant ($p<0.001$) majority (87%) stated that exercise decreased glucose levels. Three percent stated that exercise increased glucose levels and 10% stated that it has no effect on glucose levels. In comparing exercisers to non-exercisers the same response was seen with no difference ($p>0.1$) between the groups.

Exercising respondents were asked how they felt after exercising with regards to their state of mind. A significant ($p<0.001$) majority (54.7%) stated that they felt relaxed, 19% felt they were alert, 9.3% felt restless and 17% felt fatigued (Figure 4.3.12). The improved alertness factor could be attributed to the normoglycemia that the respondents felt during exercising

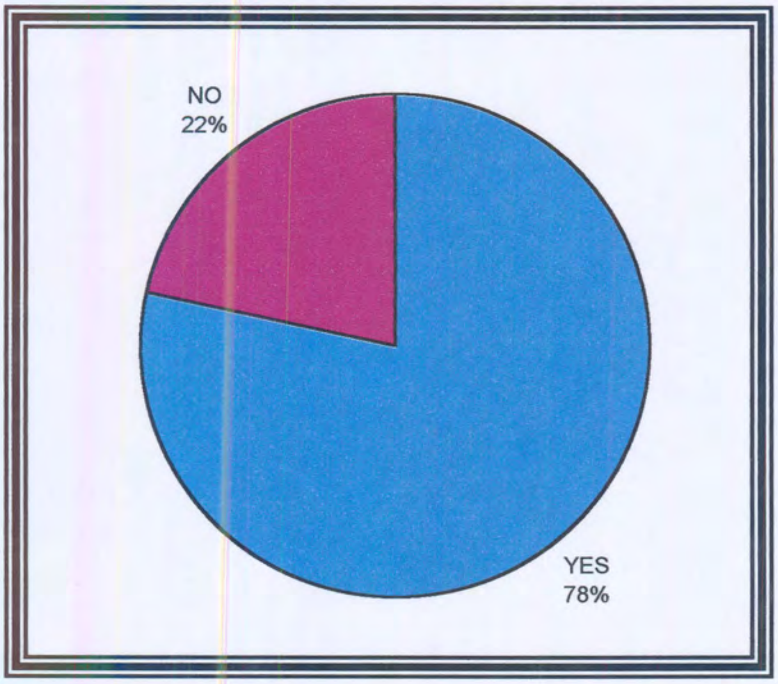
**FIGURE 4.3.12: EFFECT OF EXERCISE ON STATE OF MIND (ITEM 30)**




| | RELAXED | ALERT | RESTLESS | FATIQUED | Significance |
|---|---|---|---|---|---|
| PERCENTAGE | 54.7 | 19.2 | 9.3 | 16.9 | p<0.001 |

## NON-EXERCISERS

### FIGURE 4.3.13: WILLINGNESS TO PARTICIPATE IN SPORT (ITEM 25)




In probing the response of inactivity (Figure 4.3.13), a significant ($p<0.001$) majority (78%) stated that they would like to start exercising whilst the remaining 22% stated otherwise.

### INACTIVITY AFTER BEING DIAGNOSED DIABETIC (ITEM 24)

Respondents that stated that they were inactive were also questioned on their inactivity, the reasoning follows: time constraint; embarrassed of being overweight; no excess to facilities; cardiac problem; general dislike towards exercise; pain in her joints; expensive to join a health club; exercise induces asthma; afraid of hypoglycemia or hyperglycemia; and was not sure what precautions to take.

## ANTECEDENTS TO NON-PARTICIPATION (ITEM 26)

The 22% of respondents that stated that they are unwilling to be active were asked to substantiate their answer, their response was quantified into different categories, and the responses follows: time constraint; no access to sporting/exercise facilities; don't know what exercise to do; painful to exercise; old age; feel ill after exercising; generally dislike exercise; exercise induced asthma.

## NON-BENEFITS OF EXERCISE (ITEM 36-38)

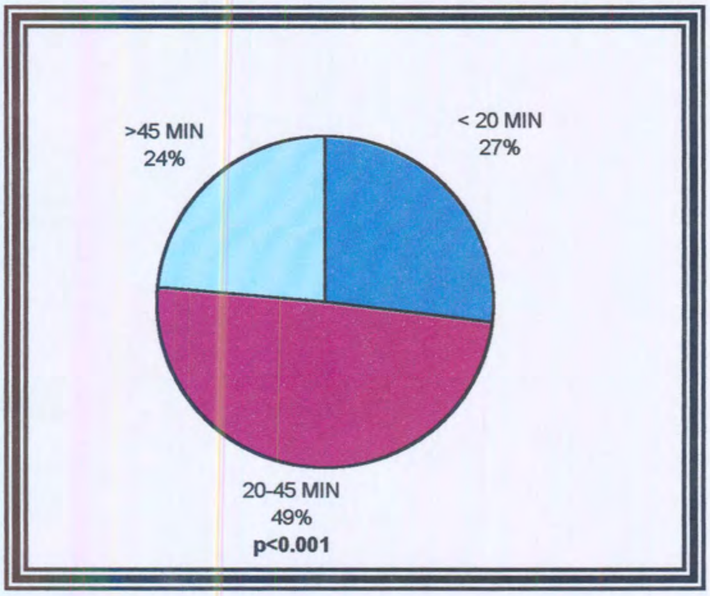
The 7% of respondents that stated exercise was non-beneficial, also explained their negativity: they get very tired after exercising; exercise increases blood glucose levels; experience pains after exercising; although they exercise they don't lose weight; no muscle bulk occurs even when exercised; heart cannot take on the strain exerted during exercise; gives the respondents headaches; limbs get swollen.

## LEISURE

## TYPES OF LEISURE ACTIVITIES (ITEM 39-42)

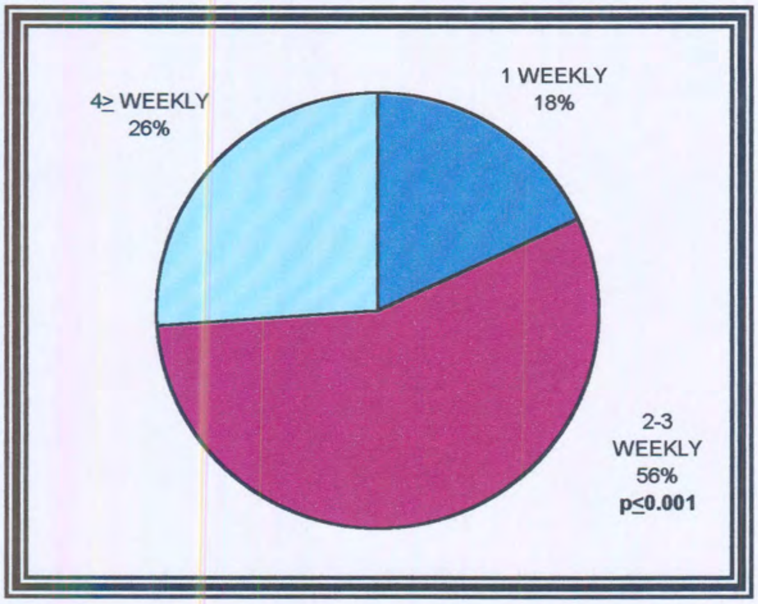
The leisure activities participated in can also be classified as recreational sport art or hobbies. Out of the thirty-two responses, these activities were classified into five categories: domestic work; yard word; hobbies; outdoor activities; assistant; visual entertainment.

**FIGURE 4.3.14: DURATION OF LEISURE SESSIONS (ITEM 42)**



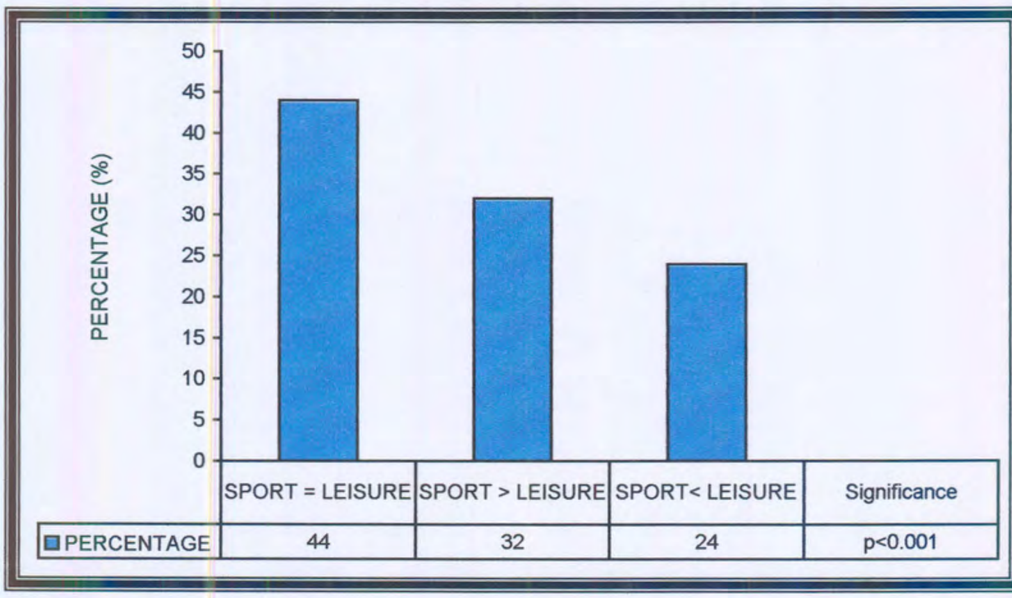

In probing the respondents duration of leisure sessions (Figure 4.3.14), the significant ($p<0.001$) majority (49%) participated in leisure activities between 20-45 minutes, 24% of the participated for more than 45 minutes and 27% participated less than 20 minutes.

**FIGURE 4.3.15: FREQUENCY OF LEISURE ACTIVITIES (ITEM: 43)**



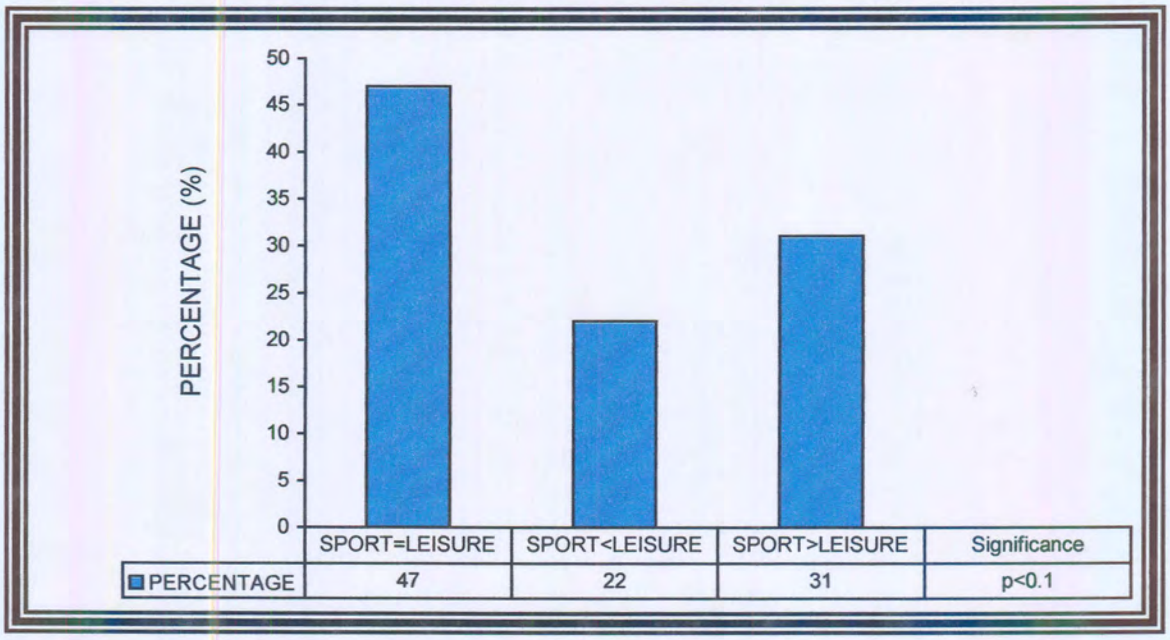
Frequencies of leisure sessions were also probed (Figure 4.3.15). Eighteen percent of the respondents stated that they participated in these leisure activities once a week, a significant ($p<0.001$) majority 56% participated in these activities 2-3 times a week and 26% participated in leisure activities 4 and more times a week.

**FIGURE 4.3.16: COMPARISON BETWEEN DURATION OF LEISURE AND SPORT SESSIONS (27 & 42)**




In comparing duration of exercise/sport to leisure (Figure 4.3.16), it was statistically deduced that 44% of the respondents spent equal time in exercise and leisure, 24% of the respondents participated in more leisure (>45min) and less sport (<20 min or between 20-45 min), 32% participated in less leisure (<20 min) or between 20-45 min) and more sport (20-45 min or >45 min). There was a significant ($p \leq 0.1$) difference between variables.

**FIGURE 4.3.17: FREQUENCY BETWEEN SPORT AND LEISURE SESSIONS (ITEM 28 & 43)**




In comparing the frequency of exercise to leisure sessions (Figure 4.3.17), 47% of the respondents equalized the frequency of exercise/sport and leisure sessions, 22% participated more in leisure sessions than in sport sessions and 31% participated in more sport than in leisure activities. There was a significant ($p<0.1$) difference with more respondents equalizing their exercise and leisure sessions or participating in more exercise than leisure sessions.

# CHAPTER 5

## CONCLUSION AND RECOMMENDATION

Although physical exercise has been long advocated in the management of diabetes mellitus, only recently has this relationship been scientifically scrutinized. Current studies have not clearly delineated the ability of physical training to improve glycemic control in individuals with IDDM (Wasserman and Zinman, 1994; Cantu, 1987). Regular exercise does not negatively affect long-term glucose control, and should be encouraged in people with IDDM (Wasserman and Zinman, 1994). The purpose of this study was to gain insight into the exercise practices, in conjunction with dietary habits and medication routine of insulin dependent diabetic. The 200 respondents were classified into exercisers and non-exercises.

In attempting to achieve near-nomoglycemia, education about prevailing glycemic levels are important. This has become possible with a wide variety of self monitoring blood glucose equipment that is available which allow glucose levels to be measured (Matthews *et al.*, 1987). Majority of the respondents where knowledgeable as to the normal blood glucose ranges.

Good dietary habits are also necessary in achieving normoglycemia, and the majority of respondents were aware of this fact. With regard to meal type and meal composition the majority of the respondents were aware of the meal types and what their meals should comprise, however, they did not comply to the prescribed quantity of meal compositions.

It was noted that both exercisers and non-exercisers were positive about exercising, but those who exercised were more positive than those who did not. Those respondents that were inactive were willing to start exercising. With regards to exercise duration and frequency, the majority of the exercise sessions lasted for a duration of 20-45 minutes at a frequency of 4 and more times a week, at an intensity eliciting an appropriate heart rate of between 110-130 beats per minute, corresponding with and RPE of 11-13.

Diabetic should be educated and encouraged during counseling on the importance of exercising and the implications it has for a diabetic. With regards to the data in the study, respondents need to be educated on all the different facets of diabetes, especially on the frequency, intensity and duration of exercising.

## 5.1 EXERCISE RECOMMENDATIONS FOR IDDM

The following are basic recommendations about exercise for the type I diabetic. Before diabetics undertake or change their exercise routines, they should consult their physicians.

Type of Exercise

Aerobic exercise is usually considered most suitable for insulin dependent diabetics. Activities such as walking, swimming, and cycling, if done at the correct intensity and duration, are aerobic activity. These activities help lower blood glucose and may reduce the risk of CVD. They involve less risk for vascular damage than do high-intensity anaerobic activities. This is important for those with long-standing diabetes and/or vascular complications such as retinopathy.

Intensity of Exercise

The exercise intensity should be between 50-80% of $VO_2max$. Younger diabetics with a shorter history of diabetes and no complications can exercise at a higher intensity (70-80% of $VO_2max$), however the risk of hypoglycemia is increased at higher intensities. Insulin dependent diabetics who have had diabetes for longer time or diabetics with vascular disease should exercise at lower intensities (50-65% $VO_2max$). To reduce the risk of exacerbating vascular complications, systolic blood pressure during exercise should no exceed 180-200 mm Hg in those with vascular complications. Diabetics with autonomic neuropathy may not be able to use heart rate to determine exercise intensity because of poor cardiovascular control. Ratings of perceived exertion may be used as alternatives (American College of Sport Medicine, 2000).

Duration of Exercise

The duration of exercise should be 20-40 min. This recommendation is based on studies of normal individuals showing that aerobic exercise for less than 20 min is of little cardiovascular benefit. Exercise done for longer than 40 min increases the risk of hypoglycemia (American College of Sport Medicine, 2000).

Frequency of Exercise

The recommended frequency of exercise ranges from 4-7 days per week. Seven days a week is suggested because it makes insulin adjustment and food planning more regimented and easier to control.

Time of Day for Exercise

The time of day that exercise is performed should be considered by the insulin dependent diabetic because of the need for precise timing of insulin action and food consumptions. Exercise may be performed in the morning after a small snack and before the morning insulin injection (Schneider and Kanj, 1986). This may reduce the risk of exercise-induced hypoglycemia and would have the greatest impact on maintaining stable blood sugar throughout the day. Exercise in the evening is not recommended because of the possible occurrence of delayed hypoglycemia when sleeping.

The above stated recommendations can be achieved by diabetes education. After successful completion of this research an educational module could be developed to educate/enlighten diabetics on the benefits of exercise as well as enlighten physicians and allied health professionals on diabetic's perception on the benefits of exercise in IDDM patients.

## 5.2 RECOMENDATIONS FOR FURTHER RESEARCH

From investigation it was evident that people with IDDM exercised more before diagnosis than after diagnosis, which proved to be a very interesting and important finding. Exercise is viewed as one of the primary treatments however when probed to question the reasoning behind the decrease in exercise after diagnosis, many diabetics attributed exercise decrease to time constraint and fear of hypoglycemia, a decrease in exercise can also be attributed to the poor education and advice from the patients' medical caregivers.

Research has been extensively undertaken in various countries and merely adapted to South African context. However it is necessary to undertake research in the South African context as our lifestyle varies vastly. Whilst undertaking this study it has become clear that certain area of exercise and diabetes have not been adequately studied and thus need further investigation. The areas include:

1) Late evening exercise is often associated with hypoglycemia, thus research has to be undertaken to investigate how hypoglycemia can be prevented with late evening exercising.
2) Many diabetics are ignorant to diabetes management, they often do not understand the implication diet and medication and exercise have on their blood glucose levels. This area also needs research to indicate clinically the inter-relationship of these three components.
3) To investigate the positive effect exercise has on diabetes complications or whether exercise tends to prolong diabetes complications.