PHYSICAL ACTIVITY AS INTERVENTION IN URBAN BLACK FEMALES WITH TYPE 2 DIABETES MELLITUS

Agatha Johanna van Rooijen

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DECLARATION

I, Agatha Johanna van Rooijen, declare that this thesis is my own work. It is being submitted for the degree of Doctor of Philosophy in the University of Pretoria, Pretoria. It has not been submitted before for any other degree or examination at this or any other university.

A van Rooijen

AJ VAN ROOIJEN

12 day of November, 2003.

PUBLICATIONS AND PRESENTATIONS ARISING FROM THIS STUDY

PUBLICATIONS

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Van Rooijen AJ, Rheeder P, Eales CJ, Becker PJ. Type 2 Diabetes Mellitus: Knowledge, Attitude, Physical Activity and Exercise. The National Congress of the South African Society of Physiotherapy, Rustenburg, South Africa: 2001.

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ABSTRACT

Type 2 Diabetes Mellitus (Type 2 DM) is present in the populations of almost all the countries in the world and is a significant disease burden in most developed countries. Evidence suggests that populations in Africa develop Type 2 DM at an increasing rate as they reject their traditional lifestyles. Furthermore, newly released figures by the Medical Research Council of South Africa indicate that diabetes is the 10th most common cause for total life years lost in females in South Africa. Exercise is a low cost, non-pharmacological intervention that has been shown to be effective in metabolic control. Exercise is still vastly under-utilised in the management of Type 2 DM, especially in urban black females with Type 2 DM.

This study was designed to determine the effectiveness of an exercise intervention to decrease haemoglobin A_{1c} (HbA_{1c}) over a period of 12 weeks in Type 2 DM black female subjects, aged 40 to 65 years. This study consisted of three phases. Data captured in the first two phases were utilised to plan the exercise intervention. Questionnaires and focus groups were used in the first two phases of the study. The final phase of the study consisted of a randomised controlled trial. For this phase 157 female subjects, who were recruited at the Mamelodi hospital diabetes outpatient clinic, were randomised to either an experimental or a control group.

It was found that the subjects had little knowledge about their disease and that they lead a sedentary lifestyle. Subjects felt that Type 2 DM had a negative impact on their lives. Their attitudes about Type 2 DM showed a dependence on health professionals and they disagreed with the attitude that they should be involved in decision-making about their health care. The results of the focus groups indicated that patients viewed walking and household chores as suitable exercise for them. Personal barriers to exercise were lack of knowledge, tiredness and health-related stress.

Subjects expected that exercise would increase the functional capabilities, increase their knowledge and improve their well being.
These findings were used to plan the exercise intervention, which consisted of a home-based exercise programme and fortnightly exercise sessions at the Mamelodi hospital. Subjects also had to complete a diary of their physical activities at home.

An analysis of co-variance (ANCOVA) was used to compare the experimental and control groups with respect to change in HbA_{1c}, and the secondary outcomes such as walking distance and quality of life outcomes. It was found that the exercise intervention was no more efficacious ($p=0.05$) than a supervised self-relaxation training intervention to decrease HbA_{1c}, over a period of 12 weeks. The exercise group was however able to walk a significantly further distance ($p<0.01$) than the control group after the 12-week intervention. While not significantly different between groups ($p=0.80$), the positive well-being improved significantly within both groups ($p<0.01$).

It is possible to improve blood glucose control by means other than medication in urban black female patients with Type 2 DM. The patients are willing to change their sedentary lifestyle to a more active one, but several environmental and personal barriers impact negatively on their attempts to do so. The role of the health care worker is to identify these barriers and to accompany the patient on the road to a healthier lifestyle. However, this population of women may need more assistance and support initially to take self-responsibility for their diabetes self-management eventually.

ABSTRAK

Tipe 2 Diabetes Mellitus (Tipe 2 DM) kom voor in volke in bykans al die lande van die wêreld en dra by tot 'n betekenisvolle siektelas in meeste van die ontwikkelende lande. Wetenskaplike bewyse dui daarop dat Tipe 2 DM toeneem, namate populasies in Afrika westerse gebruike aanneem. Nuwe syfers wat deur die Suid- Afrikaanse Mediese Navorsingsraad vrygestel is, dui daarop dat diabetes die 10de mees algemene oorsaak van dood onder vroue in Suid-Afrika is. Oefening is 'n bekostigbare, nie-farmakologiese intervensie wat effektief is om bloedglukose te beheer. Oefening word egter nie algemeen in die beheer van diabetes in veral stedelike swart vroue gebruik nie.

Die studie is ontwerp om die effektiwiteit van 'n oefeningsintervensie in die verlaging van hemoglobien A_{1c} (HbA_{1c}) vlakke, oor 'n periode van 12 weke, in 'n groep stedelike swart vroue tussen die ouderdomme 40 en 65 jaar te toets.

Die studie het uit drie fases bestaan. Die inligting wat in die eerste twee studies verkry is, is gebruik om die oefeningsintervensie te beplan. Vraelyste en fokusgroeponderhoude is in die eerste twee fases gebruik. Die laaste fase van die studie het 'n gerandomiseerde, kliniese proef behels. Vir die laaste fase is 157 vroulike proefpersone ewekansig in onderskeidelik 'n eksperimentele- en kontrole groep verdeel.

Daar is bevind dat die proefpersone min kennis oor hulle siekte gehad het en dat hulle hoofsaaklik 'n onaktiewe lewenstyl handhaaf. Proefpersone was ook van mening dat diabetes 'n negatiewe impak op hulle lewens het. Die proefpersone het nie saamgestem dat hulle betrokke in besluitneming oor hulle gesondheid sorg behoort te wees nie. Die resultate van die fokusgroepe het daarop gedui dat die proefpersone huishoudelik aktiwiteite en stap as geskikte tipes oefening beskou.

Gebrek aan kennis, moegheid en gesondheidverwante spanning is geïdentifiseer as persoonlike hindernisse tot deelname aan oefening.

Uitkomsverwagtinge van die proefpersone was dat oefening hulle funksionele werkverrigting, kennis en algemene welstand sou verbeter. Die oefeningsintervensie het bestaan uit tuisoefeninge en oefeningsklasse, elke twee weke by die Mamelodi hospital.

Die verskille in uitkomste tussen die eksperimentele en kontrole groepe met betrekking tot HbA_{1c} en die sekondêre uitkomste soos die loopafstand en kwaliteit van lewe uitkomste, is deur middel van 'n analise van ko-variansie bepaal (ANCOVA). Die resultate het getoon dat fisiese oefening nie meer effektief ($p=0.05$) as onderrig in self-ontspanningstegnieke was nie. Die eksperimentele groep kon egter betekenisvol verder loop ($p<0.01$) na die oefeningsintervensie. Die positiewe welsyn van die proefpersone in die twee groepe het nie betekenisvol verskil ($p=0.80$) na die intervensie nie, maar het wel betekenisvol verbeter in elke groep ($p<0.01$).

Dit is dus moontlik om stedelike swart vroue met Tipe 2 DM se bloedsuiker te kontroleer op ander metodes as deur die gebruik van medikasie. Die proefpersone was bereid om hulle onaktiewe lewenstyl te verander na 'n meer aktiewe een, maar is gekortwiek deur 'n aantal omgewings- en persoonlike hindernisse. Die rol van die gesondheidwerker is om die pasiënt op die pad na 'n gesonder lewenstyl te begelei. Dit blyk egter dat hierdie populasie vroue meer hulp en ondersteuning nodig sal hê om verantwoordelikheid vir hulle eie gesondheidsorg te aanvaar.

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LIST OF ABBREVIATIONS

Type 2 DM	Type 2 Diabetes Mellitus
HbA_{1c}	Haemoglobin A_{1c}
BMI	Body mass index
NHANES	National Health and Nutrition Examination Survey
WHO	World Health Organisation
SD	Standard deviation
BP	Blood pressure
DKNC	Diabetes Knowledge Scale
DAS-III	Revised Diabetes Attitude Scale-III
Pos	Positive
Neg	Negative
R	Correlation coefficient
HQOL	Health-related quality of life
B-cells	Beta cells
Mmol	Millimol
$[K^+]$	potassium

CHAPTER 1

INTRODUCTION

STATEMENT OF THE PROBLEM

Type 2 DM Mellitus (Type 2 DM) is present in the populations of almost all the countries in the world and is a significant disease burden in most developed countries.[1] Evidence suggests that populations in Africa develop Type 2 DM at an increasing rate as they reject their traditional lifestyles.[2] Studies in Durban, the greater Cape Town and Mangaung areas in the 1990's report prevalence rates for Africans of between 3 and 8%.[3] The NHANES I study indicated that the life expectancy was eight years lower for adults with diabetes in the age group 55-64 years.[4] Furthermore, newly released figures by the Medical Research Council of South Africa indicate that diabetes is the tenth most common cause for total life years lost in females in South Africa.[5]

Type 2 DM is a non-communicable disease characterised by disorders of insulin action and insulin secretion. The disease occurs primarily in adults. The diagnosis is usually made after the age of 40 years, although indications are that age of onset is decreasing, with diagnosis now being made in children and adolescents.[6] It is a chronic illness that can have a profound influence on all aspects of life and can affect most organs of the body. The long-term effects of diabetes result from its vascular complications: the micro-vascular complications of retinopathy, neuropathy and nephropathy, and the macrovascular complications of cardiovascular, cerebrovascular and peripheral vascular diseases.[7]

Type 2 DM affects the emotions, way of life and thus quality of life of the individual with diabetes. Due to the high morbidity and mortality of the disease, Type 2 DM has been targeted as one of the chronic diseases in South Africa, which is in need of special attention, especially at primary health care level.[8]

One such community and primary care facility is the Mamelodi Hospital in Mamelodi, a suburb north-east of Pretoria in the Gauteng Province in South Africa. Mamelodi covers an area of 48.9km^2. The suburb is divided into nine sections and has a population of 256 118 people.[9] It is serviced by six primary care clinics.[10] The Mamelodi hospital serves most patients with Type 2 DM residing in the suburb.[11] The diabetes outpatient clinic at the Mamelodi hospital sees patients two days per week.

Type 2 DM patients, who, on a regular basis attend the outpatient diabetes clinic at Mamelodi Hospital, receive medication. They also receive education about their disease on an individual basis by the attending physician. Education is limited due to the large numbers of patients attending the clinic on any given day. A health educator visits the clinic every Thursday and gives education to the patients, waiting to see the doctor. Patients are advised to eat correctly and to increase their physical activity. These are the cornerstones of Type 2 DM management in South Africa. [8]

Physical activity, one of the cornerstones of diabetic treatment, is a low cost, non-pharmacological intervention that has been shown to be effective in metabolic control .[7] Solid evidence exists that exercise on its own can significantly enhance insulin sensitivity and glucose homeostasis in the absence of any change in body mass or composition.[12,13] Exercise has the following advantages; a reduction in medication, as well as of risk factors for diabetic complications such as hypertension and weight loss.[14,15]

It is also a means of giving positive health advice to patients, since most of the other recommendations to patients are difficult for patients to comply with, such as not to eat high-fat food, not to eat sugar and to consume smaller portions.[16] It is therefore an ideal intervention to use in the management of Type 2 DM in the South African population with its limited health resources. [8]

An empirical observation of the patients attending the diabetes outpatient clinic is that, despite the education and advice, many women with Type 2 DM are typically overweight, have high blood pressure, poor blood glucose control and lead sedentary lifestyles.

Therefore, the question may be asked: can increased physical activity become part of a lifestyle and contribute to improved haemoglobin A_{1c} (HbA_{1c}) levels of female diabetics in the urban black community of Mamelodi in South Africa?

SIGNIFICANCE OF THE PROBLEM

Despite the scientific evidence that physical inactivity plays a role in the development of Type 2 DM, these messages have not reached the public.[17] Physical activity is still vastly under-utilised in the management of diabetes. The majority of individuals remains sedentary or does too little exercise to achieve health benefits.[18]

Furthermore, the increasing costs of Type DM care directly influence the limited public health resources in South Africa. Diabetes-related complications contribute to an increase in direct economic costs for the treatment of the disease and indirect economic costs of morbidity, disability and premature mortality.[19] Primary prevention of the disease or effective management of the disease can, however, reduce the financial burden of diabetes. [13]

Physical activity offers a low cost intervention for the management of Type 2 DM, both as preventative measure and to control diabetes-related complications. Ongoing prospective studies have consistently provided evidence documenting the protective effects of activity for other chronic diseases. These included coronary heart disease, hypertension, and osteoporosis. [18,20] It also presents a way for patients to be actively involved in their own health care.[21]

Regular physical activity and exercise for health purposes is however, foreign to the traditions of the adult African people.[22] In an ethnographical survey of the black culture of South Africa, the words "exercise" or "physical activity" does not even appear. The only reference is to games children play and dancing.[23] Traditionally household tasks and gardening were done collectively: however, in urban environments women no longer take part in hard physical work, for example, working in the fields and the making of floors and/or plastering of walls. The urban black person therefore, still complies with some cultural habits and beliefs, but has a more sedentary lifestyle than their rural counterparts, and also follows a westernised diet.

Another important factor is that African people have a poor understanding of the concept of "chronic" disease. [22] Patients with Type 2 DM therefore, have to be educated about their disease and their role in the management thereof.[24]

JUSTIFICATION FOR THE RESEARCH

The patient with Type 2 DM is at risk of developing many complications related to their disease. Prevention and early screening for complications and early intervention are paramount for good diabetes care. Glycaemic control is fundamental to the management of diabetes. The goal is to achieve normal or near-normal glycaemia with an HbA_{1c} - goal of lower than 7%.[25] Lifestyle modification is recommended in all patients as part of the treatment of diabetes. They should follow a low cholesterol diet and be encouraged to exercise and to loose weight.[26]

The American Diabetes Association [25] recommends a regular physical activity programme, adapted for any complications (if present), for all patients with diabetes who are able to participate in such activities. Category A-evidence also shows that combined diet and physical activity interventions are effective in people with diabetes in producing weight loss. Increasing physical activity has beneficial effects on metabolic control over and above the effect on body mass. [7]

Physical activity has been shown to be effective in improving hypertension, decreasing anxiety and depression. It also enhances feelings of well-being and improves performance of work.[27]

The increasing prevalence and burden of Type 2 DM in South Africa compel health care providers to look at cost-effective ways to successfully manage the disease especially at primary care level.

There is therefore a need for research in the management of non-communicable diseases and their risk factors in the multicultural population of South Africa.[28]

A literature review revealed gaps in the level of knowledge concerning the effectiveness of physical activity in the control of hyperglycaemia in the South African context, and especially with regard to the urban black Type 2 DM patients. Because of the increasing prevalence and burden of the disease, it was decided to address the gap in our knowledge with regard to the effect of exercise on the HbA_{1c} levels of black female diabetics residing in the suburb of Mamelodi.

THE PURPOSE OF THE STUDY

To establish the effectiveness of an exercise intervention on the change in baseline adjusted mean HbA_{1c} between an exercise and relaxation group after 12 weeks.

AIMS OF THE STUDY

The study was conducted in three phases. The data obtained in the first two phases were used to plan and implement the final phase, which was a randomised-controlled trial.

FIRST PHASE

The aim of this study was to obtain baseline data from female Type 2 DM patients on:

- General health status.
- Demographics.
- Knowledge of and attitudes towards diabetes and exercise.
- Current physical activity levels.

SECOND PHASE

The aims of this study were to:

- Investigate the personal and environmental barriers to doing exercise amongst black females with Type 2 DM residing in Mamelodi.
- Investigate the participants' knowledge and perceptions of exercise and the kind of exercise they wished to do.
- Establish the outcome expectations of performing physical activity in this sample of subjects.

FINAL PHASE

The aim of this phase was to establish the efficacy of an exercise intervention to decrease HbA_{1c} over a period of 12 weeks, in Type 2 DM black female subjects, aged 40 to 65 years.

Secondary outcomes were body mass index, walking distance, health-related quality of life and subjective experience of the subjects.

HYPOTHESIS

An exercise intervention will decrease the HbA_{1c} by 1% given a SD of 2.23% with α=0.05 and β=0.10 in a sample of 144 female Type 2 DM patients, aged 40-65 years.

THE TYPE OF STUDY THAT WAS DONE

As previously mentioned, the study was conducted in three phases.

FIRST PHASE

Quantitative data were obtained:

- Demographic data were obtained by means of a questionnaire.
- Clinical data to establish the present health status were obtained by general examination of the patients for body mass index, blood pressure and HbA_{1c}-level.
- The Diabetes Knowledge Form C (DKNC) scale was used to measure the knowledge of the sample group.[29]
- The Modified Baecke questionnaire on physical activity for older adults was used to measure the present physical activity status of the sample group.[30]
- The attitudes of the sample were investigated by means of the Revised Diabetes Attitude Scale-III (DAS III).[31]

SECOND PHASE

Demographic and qualitative data were obtained. Demographic data were obtained by means of a questionnaire.

The phenomenological approach by means of focus group interviews was used to:

- Investigate the participants' personal and environmental barriers to doing exercise.

- Investigate the participants' knowledge and perceptions of exercise and the kind of exercise they wanted to do.
- Establish the outcome expectations of performing physical activity in this sample of subjects.[32]

FINAL PHASE

A single blind, randomised controlled clinical trial design was used for the final phase of the study. The two groups only differed with respect to exercise prescribed.

Subjects, who arrived for the baseline test, were randomised into either an exercise group or a relaxation group by means of block randomisation by computer.[33] (http://www.randomisation.com)

DEFINITIONS

Key concepts around which the study was built are defined in Appendix A. The terms were defined according to the meaning that will be attached to them for the purposes of this study.

OUTLINE OF THE THESIS

CHAPTER 2

The literature that has been reviewed is presented.

CHAPTER 3

In this chapter the study conducted in the first phase of the research is presented. The research question asked was: " What is the knowledge of, attitudes towards their disease and current physical activity levels of urban female patients with Type 2 DM residing in Mamelodi?

CHAPTER 4

The methodology and results of the study of personal and environmental barriers to performing physical activity, as well as the outcome expectations of the study population are presented in this chapter. This was the second phase of the research. The question addressed was: "What are the personal and environmental barriers to and outcome expectations of performing physical activity of urban black female patients with Type 2 DM in Mamelodi?"

CHAPTER 5

The research question for the final and third phase of the research was: "What is the effectiveness of a twelve week exercise intervention to decrease the HbA_{1c} in a sample of black female Type 2 DM patients residing in Mamelodi?" Data on the secondary outcomes of this study, namely walking distance, body mass index, health-related quality of life and subjective experience of the subjects are also presented in this chapter.

CHAPTER 6

The thesis is concluded with chapter six. New knowledge obtained from the three phases of the study will be highlighted. The value of the findings of the research and limitations of the study will also be discussed.

CHAPTER 7

Recommendations for future research in the field of exercise for Type 2 DM are made.

CHAPTER 2

LITERATURE OVERVIEW

INTRODUCTION

Type 2 DM Mellitus (Type 2 DM) is a rapidly increasing, complex chronic and costly disease. It is difficult to prevent, although lifestyle changes, such as, healthy eating habits and increased physical activity, may delay its onset. The disease has many social consequences. It affects the emotions, way of lifestyle and the financial situation and therefore the quality of life of the individual with diabetes.

Furthermore, Type 2 DM is associated with dysfunction and failure of various organs, especially the cardiovascular system. Essential hypertension is associated with diabetes and prevalence thereof can be as high as 60% in Type 2 diabetics.[34] The disease has serious long-term complications; the development of which is unpredictable in individual patients. Retinopathy (visual disturbances), neuropathy (neuritis, etc.), angiopathy (atherosclerosis, vascular occlusion) and nephropathy are the most common.[35]

Current available therapies will not cure diabetes, but will delay or prevent the onset of complications. While several studies have investigated exercise interventions for African-American women with Type 2 DM, the data on exercise interventions for South African black women are limited.

This literature review therefore, aims to investigate all the relevant information necessary to plan an exercise intervention for black female patients with Type 2 DM in the South African context.

This literature review is limited to the study of Type 2 DM and related complications. Due to the many publications available in the field, only recent randomised controlled trials and prospective observational epidemiological studies, where physical activity was used as an intervention and which included women in the sample, are included. Studies including only men were reviewed to a limited extent. Furthermore, studies with participants younger than 30 and older than 65 years were excluded.

A brief overview of the aetiology and the epidemiology of Type 2 DM will be followed by a discussion of the possible risk and causal factors of the disease. The review also aims to examine the evidence that is currently available in the field of preventative diabetes care, with a critical focus on physical activity and exercise. Recent interventions regarding glycaemic control by means of multifactorial interventions are discussed. The role of exercise and physical activity in diabetes care is evaluated.

Keywords used for the literature search were: Type 2 DM mellitus; exercise; haemoglobin A_{1c}; physical activity; Africa; South Africa; health-related quality of life; knowledge; attitudes; health beliefs and cultural aspects.

Information sources that were used for this review consisted of journal articles, books, conference proceedings and other reports. Internet, CD-ROM and online databases: Medline, Sabinet and African Health Anthology were also visited. The literature review was limited to English and Afrikaans sources, dating from 1970 to 2003.

The first objective of this literature review is to investigate the aetiology and epidemiology of Type 2 DM. The role of physical activity and/or exercise in the prevention and control of hyperglycaemia is examined. General guidelines for exercise training in diabetes and hypertension are reviewed, followed by a review of ways to change exercise behaviours.

Cultural aspects of patients with diabetes are investigated. Finally a short overview on the influence of diabetes care on quality of life outcomes is provided. In order to understand the role of exercise in diabetes, the disease itself must be understood.

PATHOGENESIS OF TYPE 2 DM

Type 2 DM is the most prevalent form of diabetes and was previously referred to as non-insulin-dependent diabetes or adult-onset diabetes. Type 2 DM develops gradually and mostly later in life. It affects all races, but some more than others. [36]

The specific aetiology of Type 2 DM is not known, but auto-immune destruction of β-cells does not occur. [36] It is characterised by disorders of insulin action and insulin secretion.[37] Insulin is synthesised by the β cells, the predominant cells of the Islets of Langerhans. Insulin receptors are located within the cell membrane. Insulin affects the carbohydrate, fat and protein metabolism. The principle stimulus for insulin secretion is a rise in the plasma glucose concentration above 4.5 millimol per litre.[38]

Hyperinsulinism and impaired glucose tolerance (IGT) precede the development of Type 2 DM. [37] Hyperinsulinism indicates insulin resistance, which is defined as an inappropriately high level of insulin, which is required to maintain metabolic homeostasis.[39]

Insulin resistance shows familial aggregation and is associated with both obesity and physical inactivity. It precedes the development of IGT in many populations. As insulin resistance worsens, glucose tolerance deteriorates and IGT eventually occurs. The insulin level is increased in response to increasing intracellular insulin resistance. The circulating glucose levels increase, which results in further increases in insulin levels. [37,38]

Type 2 DM develops when the β-cells fail to sense and respond normally to hyperglycaemia. When the β-cells no longer maintain a sufficiently high rate of insulin secretion to offset the insulin resistance, increased hepatic glucose output occurs. This is a direct result of insulin deficiency. Fasting hyperglycaemia develops as a result and Type 2 DM ensues. [37,38]

Complications of Type 2 DM primarily affect the vascular system and lead to coronary heart disease, renal disease and failure, retinopathy and blindness. Other complications are peripheral vascular disease, neuropathy and amputation. [35,37,38]

These complications contribute to an increase in direct economic costs for treatment of the disease and indirect economic costs of morbidity, disability and premature mortality. [19] The increasing cost of diabetes care directly influences the limited public health resources in South Africa. Primary prevention of the disease or effective management of the disease can, however, reduce the burden of diabetes. [13] It is therefore important to know the prevalence and incidence of the disease in South Africa.

EPIDEMIOLOGY OF TYPE 2 DM

The incidence data on Type 2 DM are scarce and therefore, prevalence data must be used to describe the occurrence of the disease in human populations. The diversity in the development of diabetes between populations and the high number of undiagnosed cases makes it difficult to estimate the total number of persons living with the disease. [2]

PREVALENCE

King et al [1] estimated that between 1995 and 2025 there will be a 27% increase in the worldwide prevalence of adult diabetes in developed countries. For the developing countries, this percentage will be 48%.

It is furthermore, estimated that 75% of all people with diabetes will be in the developing countries by 2025. For sub-Saharan Africa the greatest numbers and the greatest prevalence increase are in the age groups 20 to 44 and 45 to 65 years respectively.

It is estimated that 588 000 urban people in South Africa will have diabetes of whom 282 000 will be female. These figures are, however, based on many extrapolations world-wide due to lack of suitable survey data, especially in the sub-Saharan African countries and more specifically South Africa.

PREVALENCE IN SOUTH AFRICA

To date few epidemiological studies based on World Health Organisation (WHO) criteria and methodology have been carried out in Africa. Therefore evidence for the prevalence of diabetes is sparse.[40,41]

A recent 10-year prospective population study on the incidence of Type 2 DM in South African Indians has shown an increased incidence of the disease.[42] However data on the African population is scarce and dates back to the 1990's with reported prevalence rates of 5% to 8%.[3] Motala,[43] is of the opinion that the moderate–to-high prevalence of impaired glucose tolerance, especially in those populations with a low prevalence of Type 2 DM, is a possible indicator of the early stage of a diabetes epidemic.

PREVALENCE IN WOMEN

Omar et al [3] furthermore, reported that it would appear that increases in body mass index and obesity constitute important risk factors in the emergence of diabetes among black women. Skene and co-workers [44] conducted an epidemiological study of 299 black patients attending the Garankuwa Diabetic Clinic to establish a management baseline and identify specific problem areas. Their results revealed female predominance in diabetes, problems with control of overweight patients, a high incidence of hypertension and a low percentage of patients being controlled by diet only.

Levitt et al[45] also investigated the prevalence of Type 2 DM and its risk factors in a South African working class peri-urban community. The sample consisted of 974 participants of whom 56% was women and 27.9% of the women fell into the age group 45 to 64 years.

They reported that the total energy expenditure was lower at all ages in the women compared to the men, with the highest prevalence of low activity levels occurring between the ages of 15 to 24 years and after the age of 55 years. The prevalence of Type 2 DM was 8.1% in the women, with a higher prevalence amongst the more inactive women. Type 2 DM also occurred more frequently in women with prior gestational diabetes mellitus. [40,41]

RISK FACTORS

Incidence studies also provide important data for identifying risk factors and possible causes for the disease. Our current understanding is therefore, that Type 2 DM probably results from an interaction of genetic and environmental factors.

While a genetic link is most likely a forerunner to the disease a number of environmental factors and lifestyle behaviours, including obesity, lack of physical activity and diet also influence the development of the disease. [2,13]

Increased obesity and reduced physical activity contribute to insulin resistance, which appears to be a critical component in the pathogenesis of Type 2 DM.[37] Cross-sectional studies in several ethnic groups have shown that the prevalence of diabetes in physically-inactive individuals are two to three times higher than among physically-active people in the same population.[46] The frequency of the disease however varies in different ethnic groups. [35]

FAMILY HISTORY

Positive evidence for a family history of Type 2 DM in first-degree relatives is always an indication that at least 50% of relatives will inherit the genetic predisposition to diabetes.[13] The frequency, ranging from 50 to 90%, is however, much higher in identical twins than in non-identical twins, siblings and first-degree relatives. [2]

Evidence of genetic factors in South Africa is scarce. Omar and Asmal [47] reported a positive family history in less than 10% of subjects in South Africa in 1983. The past 20 years have seen marked social change in the country, which may influence these factors considerably. [40]

According to the American Diabetes Association[48] the incidence of Type 2 DM in children and adolescents has increased dramatically in the last decade and this increase is linked to lifestyle choices related to modernisation. The increase in obesity among children is presumably related to physical inactivity. Girls become less active than boys, and indications are that obese children and adolescents have a high risk of becoming obese adults, where obesity is related to coronary heart disease, hypertension and diabetes.[49] However, no recent comparable figures are available for South Africa.

ENVIRONMENTAL FACTORS

Both Zimmet [50] and Songer [2] have reported that the development of Type 2 DM is influenced substantially by environmental factors and the degree of modernisation. High unemployment, poverty, poor education, illiteracy, lack of housing, poor sanitation and rapid urbanisation in South Africa contribute to the prevalence of Type 2 DM in South Africa.[51] These factors can contribute to a decrease in physical activity and a change in eating patterns, which have been shown to be forerunners for the development of the disease.[2,13] People, who are better educated, are more physically active.[52]

WESTERNISATION

The traditional lifestyle is abandoned for a more westernised lifestyle. The risk of developing Type 2 DM is further associated with age, hypertension, hyperlipidemia, lack of physical activity, dietary habits and smoking. [40,41] Hypertension is common in black diabetics, especially in obese female patients.[53] People become obese, because the traditional diet is being replaced by a more westernised "junk food" intake, so-called "Coca-colonisation".[54] Urban, black women no longer take part in hard physical work, for example working the fields or plastering of walls. [23]

From this literature review it is clear that Type 2 DM is prevalent under the South African black female population. The disease results from the interaction of genetic and environmental factors. There will be an increase in the number of women with Type 2 DM in future. These women are usually older, hypertensive and mostly obese and physically inactive.

Environmental factors and lifestyle behaviours, lack of physical activity and obesity influence the progress of the disease in this population. It is also clear that increased obesity and reduced physical activity both promote the development of insulin resistance and therefore the development of Type 2 DM.

From the literature reviewed so far, it can be concluded that Type 2 DM is a chronic disease that requires continuing medical care and also patient self-management, as well as education to prevent diabetes-related complications. Diabetes care is complex and involves many factors, which should be addressed to manage the disease successfully. Fundamental to the medical management of Type 2 DM is good blood glucose control. [25]

THE IMPORTANCE OF BLOOD GLUCOSE CONTROL

Prospective randomised clinical trials such as the Diabetes Control and Complications trial [55] and the U.K. Prospective Diabetes Studies [56, 57] have shown that improved blood glucose control is associated with sustained decreased rates of retinopathy, nephropathy and neuropathy.

Furthermore, epidemiological studies showed that intensive blood glucose control could reduce cardiovascular disease. [56,57]

Blood glucose is also the only nutrient that normally can be used by the brain, retina and germinal epithelium of the gonads in sufficient quantities to supply these organs optimally with their required energy.[58] It is therefore, important to maintain the blood glucose at a sufficient high level to provide this necessary nutrition.

Too high blood glucose concentrations can cause considerable cellular dehydration and loss of glucose in the urine. This can deplete the body of its fluids and electrolytes. Long-term increases in blood glucose may cause damage to many tissues, especially blood vessels and lead to an increased risk for heart attack, stroke, end-stage renal disease and blindness. These acute and long-term complications affect health-related quality of life and life expectancy of people with diabetes.

Individuals with Type 2 DM face an increasing financial burden because of their long-term medical care needs. If the prevalence of the disease rises, the direct and indirect costs will also rise with serious consequences for the annual health budget of the country. Strategies focusing more on prevention of complications and public education could make better use of available resources.

The question arising from the review so far is, whether control of hyperglycaemia will limit morbidity and mortality in these patients?

Most recently the United Kingdom Prospective Diabetes Study [59] showed that each 1% increase in HbA_{1c}, averaged over 10 years of follow-up ($p<0.0001$), was associated with a 16% increase in myocardial infarction. There was a 25% reduction in microvascular endpoints and a 12% reduction of any diabetes-related endpoint in the group, who had an intensive glucose control policy. There was also a reduction of 21% of risk for retinopathy at 12 years. This is a very important finding, which must be translated to clinical care for diabetics. There is therefore, no doubt that good blood glucose control is essential in the management of the individual with Type 2 DM.

HOW SHOULD BLOOD GLUCOSE BE CONTROLLED?

Because of the large body of evidence on interventions to improve diabetes outcomes, the American Diabetes Association [25] compiled standards of medical care for Type 2 DM.

The Association states that glycaemic control by means of hypoglycaemic agents is fundamental to the management of diabetes, and that an HbA_{1c} of lower than 7.0% is recommended to reduce the microvascular and neuropathic complications of diabetes. Furthermore, self-monitoring of blood glucose, medical nutrition therapy and a regular physical activity programme, adapted to any complications that may have developed, are recommended for all patients with diabetes. Recommendations with regard to the prevention and management of the complications of Type 2 DM include blood pressure control, lipid management, use of aspirin therapy and cessation of smoking.

Diabetes management is therefore, based on four cornerstones of treatment: glycaemic control, education, medical nutrition therapy and physical activity. [25]

The Department of National Health (DoH) of South Africa also accepts this approach. However, it has not been implemented at all levels of health care in South Africa. Due to a lack of human and physical resources the approach has not been fully implemented at primary care level. [8]

The aims of the DoH are to create awareness of the disease in the community and among the health care professionals at primary care level and to provide adequate facilities for diagnosis, treatment and follow-up. Education of patients in self-care is an important aim of this programme. Although the goal is to deliver quality diabetes care in South Africa, it has to go hand in hand with other improvements such as socio-economic upliftment of the historically disadvantaged. [8]

Due to the progressive nature of the disease, hypoglycaemic or insulin therapy becomes necessary to control the blood glucose.

PHARMACOLOGICAL AGENTS

The Standards of Medical Care for patients with Diabetes Mellitus states that treatment regimens that reduce average HbA_{1c} to at least 7% are associated with fewer long-term microvascular and other complications. [25] Oral hypoglycaemic agents, medical nutrition therapy and physical activity are recommended to obtain this goal. Initial therapy is nearly always by means of diet, weight loss and exercise. Oral hypoglycaemic or insulin therapy is added later to achieve glycaemic control. Two important studies contributed evidence to the use of hypoglycaemic therapy in the management of Type 2 DM. The UKPDS [57] and Kumamoto [60] studies provided evidence to the importance of control of glycaemia by means of pharmacological interventions.

THE UNITED KINGDOM PROSPECTIVE DIABETES STUDY [57]

This study was conducted from 1977 to 1997 and was designed to investigate whether intensive (compared to conventional) control of blood glucose could lower the incidence of complications in newly diagnosed diabetics.

The study recruited 5102 individuals, of whom 3867 individuals were randomised to conventional treatment with diet alone or intensive treatment, either with sulphonylurea or insulin. Another 342 overweight individuals were randomised to metformin. The study was not blinded. The results of the study demonstrated that good glycaemic control of Type 2 DM would reduce morbidity. There was a 25% reduction in microvascular endpoints and a 12% reduction of any diabetes related endpoints in the group, which had an intensive glucose control policy.

In the sub-group treated with a tight blood pressure control policy, achieving a blood pressure of 144 over 82 mmHg, or less, diabetes-related deaths were reduced by 32% and diabetes related endpoints by 24%. In those subjects with blood pressures more than 150 mmHg and HbA_{1c} larger than 8%, a fivefold increase in risk for any diabetes-related endpoints, when compared to those whose blood pressure was lower than 130 mmHg and HbA_{1c} smaller than 6% was reported.

However, the intensive therapy was associated with significant increases in body mass and an increased risk of hypoglycaemia. Patients who had hypoglycaemic reactions reported a lower health-related quality of life. This study demonstrated beyond any reasonable doubt that good glycaemic control of Type 2 DM would reduce morbidity.

KUMAMOTO STUDY [60]

The results of the Kumamoto study were confirmed in a recent follow-up to an eight year-report by Shichiri M et al. [60] The study, which was also prospective and randomised, tested whether intensive glycaemic control could prevent or slow the worsening of microvascular diabetic complications in Type 2 DM subjects. The sample consisted of 110 patients: fifty-five subjects with no retinopathy and 55 subjects with 'simple' retinopathy. Both groups were randomised to treatment with insulin, which differed in frequency of injections and the types of insulin used.

The researchers concluded that treatment of blood glucose to near normal levels, lowered the risk and progression of the renal and retinal complications of diabetes.

Although the effectiveness of hypoglycaemic agents has been proven in the treatment of Type 2 DM, the cost of these agents places a large burden on the health budget of the country. Furthermore, other risk factors for diabetes-related complications, such as obesity, should also be treated.

MEDICAL NUTRITION THERAPY

The prevalence of obesity-related co morbid conditions in individuals with Type 2 DM and the increased mortality associated with obesity in the disease, make medical nutrition therapy (MNT) an integral component of diabetes management and education. [25]

Weight loss and increased physical activity decrease insulin resistance; improve glucose tolerance and glycaemic control. It furthermore, reduces the risk of cardiovascular disease. [14]

Obesity is also particularly prevalent among South African black women. [3] It has been shown that a weight loss of as little as 5% of body mass has resulted in improved metabolic control.[61] There is, however, some suggestion that people with diabetes find it harder to lose weight than non-diabetics do and that pharmacological therapy for diabetes may promote weight gain.[62]

META-ANALYSIS BY BROWN ET AL [63]

The authors of this article reviewed 89 studies involving 1800 subjects with Type 2 DM. They reviewed five different types of weight loss strategies and combinations thereof and found that dietary strategies alone produced the greatest weight loss.

The meta-analysis reviewed literature up to 1994. The data were limited to six (6) months post-intervention and the majority of the studies used a pre-test/post-test design instead of an experimental design.

It was focused on weight and glycated haemoglobin outcomes by means of a very low calorie diet, which may explain the large weight loss effects observed. Since 1994, there have been substantially more research studies on the roles of diet and exercise in achieving weight loss.

EXPERT PANEL ON IDENTIFICATION, EVALUATION AND TREATMENT OF OVERWEIGHT AND OBESITY IN ADULTS [64]

In 1998 this panel published clinical guidelines based on research from 1980 to 1997. They recommended a combination of a low-calorie diet and physical activity, since it produced greater weight loss than did either diet or physical activity in isolation.

The authors also reported that, while no one behaviour therapy seemed superior to any other in effects on weight loss, behaviour therapy in totality only provides additional benefits in achieving weight loss in the short term.

Since 1997, several studies have demonstrated the long-term effectiveness of weight loss and increased physical activity on diabetes prevention. These studies will be described under the heading: The use of exercise in the prevention of Type 2 DM.

Another cornerstone of the diabetes treatment regimen is increased physical activity and or exercise. Exercise is often prescribed along with diet and oral hypoglycaemic agents in the management of Type 2 DM. There is also strong evidence that regular physical exercise protects high-risk populations against the development of the disease. Whether exercise is used as a preventative or a therapeutic intervention, its effectiveness must be taken into consideration.

EXERCISE

"Exercise tends to lower the blood sugar in the diabetic in whose body there is an adequate supply of insulin whether this be of endogenous or exogenous origin. This effect is so striking and so beneficial that exercise along with diet and insulin is now accorded a definite and prominent place in the everyday treatment of diabetes".[65]

PHYSIOLOGY OF EXERCISE IN TYPE 2 DM

Regular exercise was recognised as an important part of the treatment of diabetes as early as the 18th century.[66] After the discovery of insulin, exercise was strongly recommended as a cornerstone in the treatment of diabetes, because it decreased insulin requirements.[67]

Benefits of regular exercise for patients with Type 2 DM included lower blood glucose concentrations during and after exercise, lower basal and postprandial insulin concentrations and improved insulin sensitivity.[68] Other documented benefits of regular exercise are reduction in cardiovascular risk factors, improvement in mild to moderate hypertension and increased energy expenditure. Exercise also results in improved lipid profile and lower glycosylated haemoglobin levels. More general benefits are: increased muscle strength and flexibility, improved joint mobility and sense of well-being, as well as enhanced health-related quality of life. [68]

EXERCISE IMPROVES MUSCLE GLUCOSE TRANSPORT

Exercise can have both short and long term effects on insulin action. An acute session of exercise improves muscle glucose transport, which reverses rapidly after exercise is stopped.[69] This is then replaced by a marked increase in the sensitivity of muscle glucose transport and glycogen synthesis to insulin.[70]

Mayer-Davies et al[71] showed a significant association between moderate- and vigorous-intensity physical activity and insulin sensitivity among individuals with and without Type 2 DM.

Duncan et al [39] investigated the effect of aerobic exercise, without concomitant weight loss on insulin sensitivity. They reported that regular aerobic exercise improves insulin sensitivity, independent of changes in body mass index. Repeated bouts of exercise, of sufficient intensity and duration, lower muscle glycogen stores and therefore the blood glucose level.

EXERCISE CONTRIBUTES TO CENTRAL FAT LOSS

Furthermore, exercise may prevent, delay or correct the development of physiological changes that occur with a sedentary lifestyle. [69] An increase in abdominal fat accumulation is linked to insulin resistance.[72] Exercise can contribute to loss of fat from the central regions, and should therefore, contribute significantly to decreasing insulin resistance related to excess body fat through improved insulin action.

EXERCISE DEVELOPS MUSCLE MASS

Although loss of fat has been found to have a significant effect on insulin action, there is also evidence that loss of muscle mass is highly associated with the development of insulin resistance. [69]

Skeletal muscle is the largest mass of insulin-sensitive tissue in the body and therefore, reduction in muscle mass can reduce the effectiveness of insulin to clear glucose from the circulation. [38] After the age of 50 years a steady decline in muscle mass occurs in individuals who are not physically active. [69] Therefore, strength training is important to increase muscle mass and thereby the available glucose storage area.[73]

EXERCISE IMPROVES SKELETAL MUSCLE BLOOD FLOW

Insulin has been shown to cause vasodilatation in skeletal muscle and to increase limb blood flow.[74] This increased limb blood flow correlates positively with total body glucose uptake and accounts for 50% of the increased limb glucose uptake under hyperinsulinaemic conditions.[75] Aerobic exercise training increases skeletal muscle blood flow and therefore, glucose uptake.

Dela et al[76] trained individuals with Type 2 DM for 10 weeks and reported a significant improvement in limb glucose clearance. This was found under both sub maximal and maximal insulin-stimulating concentrations.

EXERCISE INCREASES INSULIN RECEPTORS

Insulin action is initiated through hormone binding to cell surface insulin receptors. Insulin-sensitive tissues such as muscle tissue have an overabundance of these insulin receptors. [69]

A reduced number of insulin receptors have been observed in blood cells from obese and individuals with Type 2 DM.[77] An increase in insulin receptor numbers has been documented in studies on rats, but not in humans.[78] It is, however, possible that exercise can increase the number of insulin receptors and therefore, insulin responsiveness. [69]

EXERCISE INCREASES GLUT4 PROTEIN LEVELS

Aerobic exercise training has been shown to increase GLUT4 protein levels in the skeletal muscles of individuals with Type 2 DM.[79] GLUT4 isoform is a glucose transporter, which is located intracellularly and which is translocated to the sarcolemma by the action of insulin.

Glucose transport is the penetration of glucose through the plasma membrane. The increased GLUT4 levels correlate significantly with improvements in insulin-stimulated glucose transport and limb glucose uptake. [69]

EXERCISE INCREASES PHOSPHORYLATION OF GLUCOSE

Once the glucose is inside the cell, it is rapidly phosphorylated by hexokinase to form glucose-6-phosphate (G-6-P). In the skeletal muscle this is rapidly converted to glycogen or oxidised.[80] Insulin-stimulated glucose oxidation and storage is impaired in individuals with Type 2 DM.[81]

The enzymes responsible for the phosphorylation, storage and oxidation of glucose are increased after exercise training. Therefore, an increase in the capacity of muscle to transport and dispose of glucose takes place after exercise training. [69]

EXERCISE INCREASES TYPE IIa MUSCLE FIBRES

Skeletal muscle is composed of Type I (slow twitch) and Type II (fast twitch) fibres. Type I fibres have a high oxidative, low glycolytic capacity and high capillary density. Type II fibres can be further classified as Type IIa and Type IIb fibres. Type IIa fibres have metabolic characteristics that are between that of Type I and IIb fibres. Type IIb fibres have a low oxidative, high glycolytic capacity and low capillary density. [69]

Type I fibres have a higher insulin sensitivity and responsiveness than Type IIb fibres. Individuals with Type 2 DM have more Type IIb muscle fibres.[82] Hickey et al[83] reported that individuals with Type 2 DM and obesity had a lower percentage of Type I muscle fibres than merely obese or non-obese groups. The insulin-stimulated glucose transport was significantly lower in the obese groups.

Aerobic training cannot increase Type I fibres, but can increase Type IIa muscle fibres and reduce the percentage of Type IIb fibres.[84] Therefore, an increase in Type IIa fibres can result in an increase in numbers of the muscle insulin receptors and GLUT4 protein levels. This in turn can result in increased muscle insulin sensitivity and responsiveness. [69]

EXERCISE INCREASES MUSCLE CAPILLARY DENSITY

It has also been shown that aerobic exercise can increase muscle capillary density, which will enhance diffusion of glucose from the capillary lumen to the muscle cell membrane and therefore, insulin action and glucose uptake.[85]

EXERCISE MAY DECREASES ADIPOCYTE SIZE

Adipocyte hypertrophy accompanies the development of obesity. [69] The inability of insulin to effectively regulate plasma free fatty acids (FFA) concentration appears to be due to a diminished insulin suppression of fatty acid release from the adipose tissue.[86]

Insulin-stimulated glucose transport and oxidation is inversely related to the size of the adipocyte.[87] Increased circulating FFA can lead to increased gluconeogenesis and hepatic glucose output. It can also result in inhibition of insulin-stimulated muscle glucose uptake.[88] It is possible that exercise can cause a reduction in adipocyte size and therefore improve plasma glucose control. [69]

CONCLUSION

Beneficial effects of exercise training occur at both the systemic and cellular levels. However, exercise benefits appear to subside rapidly when training is stopped. Studies have shown that the beneficial effects of exercise wane within three to 10 days and therefore, training must take place on a regular basis.[89]

Furthermore, exercise training; involving the large muscle groups may have the best effect on insulin resistance. [69] Exercise reduces the need for medication, as well as reduces risk factors for diabetic complications such as hypertension and weight loss. [14,89]

It also represents positive health advice to patients, since most of the other recommendations to patients, are in the nature of negative advice, such as not to eat high-fat food and to consume smaller portions. [15] Foster et al [16] also say the following: " Since people are infamous for ignoring negative advice the value of using a positive recommendation, that may indirectly lead the patient to discontinue bad behaviours, can hardly be overstated."

Willey and Singh [15] agree with this viewpoint as they are of the opinion that, prescribed diet is often perceived as negative and difficult by patients. Diabetics especially find it hard to change eating habits, which have been established over a lifetime. Solid evidence exists that exercise alone is able to significantly enhance insulin sensitivity and glucose homeostasis in the absence of any change in body mass or composition. [13,16] Exercise is therefore, an effective non-pharmacological therapy and it is relatively inexpensive.

The physiological role of exercise in the treatment of diabetes has been established in this review. What then, is the evidence for the therapeutic use of exercise in the prevention of the disease?

THE USE OF EXERCISE IN THE PREVENTION OF TYPE 2 DM

CROSS-SECTIONAL STUDIES

Several studies support the concept that physical activity contributes to the prevention of Type DM. The strongest predisposing factor for Type 2 DM is obesity, which is linked to a sedentary lifestyle. However, physical inactivity increases the risk of diabetes independent of obesity. [17]

A number of cross-sectional studies found that the prevalence of diabetes was higher among sedentary individuals than among their more active counterparts. This was independent of age and body mass index.[90,91] Such studies must be interpreted with caution, because it is difficult to establish cause and effect in cross-sectional studies. Many variables in addition to physical activity, including modifications in diet and other lifestyle factors, undergo change in these studies. Indirect evidence for the positive effect of exercise is also provided by descriptive comparisons of the prevalence of Type 2 DM in active and inactive urban populations by Zimmet et al.[92]

Studies by Manson [93] and Perry [94] showed that the degree of protection against diabetes was the same, irrespective as to whether exercise was of a vigorous or a moderate intensity. There are however, discrepancies in terms of the relationship between the risk of Type 2 DM and the frequency and intensity of physical activity in these studies. The effect of physical activity on individuals at either high or low risk of Type 2 DM is also not clear in these studies. Furthermore, the subjects in the studies were mainly male.

In 2001 Kriska et al [95] published the results of a cross-sectional survey to determine the prevalence of Type 2 DM and its associated risk factors in the Sandy Lake native community. They found that both physical activity and fitness were significantly associated with fasting insulin concentrations in men. It was however, not the case with the women in the sample. They postulated that women were engaging in lower-intensity activities like walking, childcare and housework, which are relatively more difficult to assess and less reproducible. Of importance is the observation of the authors that women were less willing or able than the men to maximise their effort on the sub maximal step test, used to estimate cardiovascular fitness.

EPIDEMIOLOGICAL EVIDENCE

Cohort studies show that physical activity is related to the incidence of Type 2 DM. Kriska et al[96] reviewed a large number of epidemiological studies on the effect of changes in diet and decreased physical activity on the prevalence of Type 2 DM. They reported that changes in diet and physical inactivity were frequently associated with increased prevalence of the disease. These changes involved increased consumption of processed foods.

Helmrich and associates [97] conducted a study among 5990 University of Pennsylvania alumni and assessed the incidence of diabetes over nearly 100 000 person-years of follow-up. They reported that age-adjusted risk for the development of diabetes decreased by 6% for each 500-kcal increase in weekly leisure time and physical activity energy expenditure. This protective effect was higher in obese subjects. In addition, the protective effect of physical activity was strongest in persons at the highest risk for diabetes. [98]

Manson and colleagues [99,100] have conducted three prospective studies on the association between physical activity and the development of Type 2 DM. In 1991 Manson and co-workers [99,101,102] prospectively examined the association between the frequency of vigorous physical activity and the subsequent incidence of clinical diabetes in a cohort of 87 253 women over an eight-year period in the Nurses' Health study. They reported a reduced incidence of Type 2 DM among women who exercised regularly compared to their sedentary peers (after adjustment for age and body mass index). Physical activity was however only assessed by means of questionnaires and not physically tested.

The authors then examined the effect of participation in vigorous exercise on the risk for the development of diabetes in 21 271 US male physicians.[93] Their results showed that vigorous exercise performed five or more times per week reduced the relative risk to 0.58 compared to 0.77 for vigorous exercise performed once per week.

Hu et al [99] sought to clarify the role of moderate-intensity activity, such as walking, on the risk of developing Type 2 DM. More than 70 000 females from the Nurses' Health Study, who did not have diabetes or other illnesses at baseline, were considered. Risk of Type 2 DM by quintile of metabolic equivalent score, based on time spent per week on each of eight common physical activities, was calculated.

Follow-up results over eight years and more than 500 000 person-years of the Nurses' Health study in 1999 [99] indicated that the relative risks of developing Type 2 DM decreased progressively as activity patterns increased. The most active group demonstrated a 50% reduction in risk, compared to the least active group. A similar pattern for reduction in diabetes incidence was observed among women who did not perform vigorous activity. Faster than usual walking pace was independently associated with decreased risk in this group of women.

More recently, Hu and associates [101] reported on their results from the 16-year follow-up of the Nurses' Health Study in 2001. They found excess body fat to be the single, most important determinant of Type 2 DM. They also reported that a combination of a healthy diet and regular exercise was associated with a 24% reduction in the risk of diabetes.

Hu and co-workers [102] used data from the Nurses' Health Study to determine whether, physical activity decreased risk for cardiovascular disease among diabetic women. Of the 5125 female nurses with diabetes, followed up from 1980 to 1992, 323 new cases of cardiovascular disease were documented. After adjusting for age and other risk factors, it was found that faster than usual walking pace was independently associated with lower risk for cardiovascular disease.

The results of these studies indicate the presence of a dose-response effect of physical activity in the prevention of Type 2 DM.[103]

The findings of these studies also support the hypothesis that Type 2 DM can be prevented by increasing physical activity. [17]

The apparent benefits of regular physical activity have been documented in several ethnic groups. [104] Kriska and co-workers, [46] also reported the potential impact of increased physical activity on diabetes risk in women in studies with Pima Indians. The prevalence of diabetes was reduced by 32%, compared with those subjects reporting less activity.

James and associates [105] conducted the Pitt County Study and examined the role of physical activity in the incidence of diabetes in African-Americans. The risk for developing diabetes was reduced by 65% in subjects participating in moderate physical activity, after adjusting for age, sex, body mass index (BMI) and waist/hip ratio.

RANDOMISED CONTROLLED STUDIES

The first large-scale diabetes prevention study to include physical activity, as part of their intervention, was a six-year feasibility study conducted in Malmö, Sweden.[106] Men with impaired glucose tolerance (IGT) were non-randomly assigned to either an exercise training or control group. Exercise training consisted of two 60-minute exercise sessions per week, including walking, jogging and other recreational sporting activities. A weight loss of 2.3% to 3.7% over six years, normalised glucose tolerance in more than 50% of subjects with IGT. It also resulted in remission in more than 50% of individuals with Type 2 DM.

The Da Qing study conducted in China by Pan and associates [107] is considered to be the first randomised controlled trial to examine the effects of increased physical activity in the prevention of Type 2 DM. The results of this 6-year study showed that the diet, exercise and diet-plus-exercise interventions were associated with 31%, 46% and 42% reductions in the risk for developing diabetes respectively.

The findings of this study are important, because it provided the first direct evidence that an increase in physical activity decreases the risk for the development of diabetes.

In 1997 McNabb [108] and associates tested the effectiveness of the PATHWAYS weight loss programme designed for obese African-American women at risk for diabetes. The programme consisted of 14 sessions of weekly one and a half-hour group instruction conducted in churches. Participants were instructed to begin an at home exercise programme, generally consisting of recreational walking. The participants lost an average of 5% of their body weight. No detail about the exercise part of the programme is however provided.

Other intervention studies have also contributed to the evidence that changing diet and/or exercise behaviours may reduce the risk of developing diabetes in individuals with impaired glucose tolerance. The Diabetes Prevention Program (DPP) [109] was a randomised clinical trial comparing the safety and efficacy of intensive lifestyle change, metformin and placebo, in the prevention of Type 2 DM in individuals with IGT. The DPP followed up 3 234 ethnically diverse participants at high risk for diabetes from 27 centres. Subjects randomly assigned to the lifestyle intervention had goals of losing at least 7% of their body weight and of increasing physical activity to at last 150 minutes per week over three to six years. A mean weight loss of 7% after one year of the intervention was achieved. The weight loss of 5% was maintained for three years. Since commencement of the DPP, other randomised control trials reported on the positive effects from lifestyle interventions.

The last-mentioned results confirmed the results of a pilot study on Pima Indians.[110] Of importance in this study was that the authors showed that diabetes interventions must address cultural values and overcome numerous personal barriers such as transportation, need for childcare and other factors to overcome poor compliance with the interventions.

The results of the Finnish Diabetes Prevention study, [111] where a lifestyle intervention designed to produce weight loss was used, improved diet and physical activity in 522 overweight subjects.

After one year 86% of subjects, reported exercising more than four hours per week and after two years the intervention group has lost an average of 3.5 kg. The risk of diabetes was reduced by 58% after a follow-up of 3.2 years.

Wing et al[112] reported that modest weight loss, achieved through diet changes and increases in physical activity, could reduce the incidence of diabetes.

The results of the Cross-cultural Activity Participation Study by Irwin and co-workers [113] showed that 30 minutes of a moderate physical activity, such as brisk walking, was associated with a 6.6% reduction in fasting insulin levels. This was obtained independent of ethnicity, age and educational level in their sample group. This was an important finding since these results are applicable to women who are not used to, or do not regularly perform vigorous physical activity.

After these studies, the 3.2 years follow-up of the Finnish Diabetes prevention study showed that the modification of lifestyle reduced the incidence of Type 2 DM by 58% in middle-aged, overweight participants.[114]

Also in 2003, Gaede and co-workers [115] reported on their eight-year follow-up of 80 patients. Of these patients, 80 were randomly assigned to receive conventional treatment according to national guidelines and 80 patients who received intensive treatment. The intensive treatment included a stepwise implementation of behaviour modification and pharmacological therapy. Cardiovascular and microvascular events were reduced by 50% in the intensive treatment group.

A study by Tanasescu et al [116] reported that walking was associated with reduced risk of mortality.

They also reported that walking pace was inversely associated with cardiovascular disease, fatal cardiovascular disease and total mortality, independent of the walking hours. Marked decreases in risk were associated with walking or similar modest levels of physical activity. Although the study only included 2803 men with Type 2 DM, its strengths include the prospective design, size and consideration of lifestyle changes by repeated measurements every two years.

In conclusion: the literature review on the use of exercise in the prevention of Type 2 DM showed that body mass and physical activity outcomes achieved in these diabetes prevention studies, were positive. It however, appears to be largely a function of goal setting, tailored treatment and the intensity of follow-up of these goals.[117]

The reviewed studies clearly suggest that an increase in physical activity prevents or at least delays the development of Type 2 DM in adults. It also seems that a dose-response effect of increasing physical activity, with a resultant decrease in the risk for Type 2 DM, exists.

Of importance is the evidence that moderate exercise, such as walking also decreases the risk for diabetes. This finding supports the recommendation by the Centres for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM); [18,118] stating that adults should accumulate at least 30 minutes of moderate intensity physical activity on most, if not all, days of the week.

The preventative effect of exercise is also most important in overweight individuals. The effects of exercise on other risk factors, such as obesity and cardiovascular risk factors should also be considered, since Wei et al [119] showed that physical inactivity, independently predicted all-cause mortality in men with Type 2 DM. The protective effect of cardiovascular fitness was furthermore, highlighted in normal and overweight men. [116]

Dunn and co-workers [120] showed that lifestyle physical activity counselling was as effective as structured exercise programmes in improving cardiovascular risk factors after six months in sedentary men and women.

The physiological role of exercise in the patient with Type 2 DM has been established. Evidence for the role of exercise in the prevention of diabetes, as well as the prevention or delay of other risk factors for the disease, has been demonstrated. The focus of the literature study now moves to the role of physical activity in the treatment of Type 2 DM.

THE ROLE OF EXERCISE IN THE TREATMENT OF TYPE 2 DM

Physical activity has been considered to be one of the three cornerstones in the management of diabetes for many years. [66] Physical activity is also recommended by the American Diabetes Association, since it may have beneficial effects on metabolic risk factors for the development of diabetes-related complications.[121] The fact that physical activity is a low cost, non-pharmacological therapy is also of importance, especially in a country with limited health resources. [51]

CONTROL OF HYPERGLYCAEMIA

The major management goals of Type 2 DM are to reduce hyperglycaemia and body fat. [12] Chronic hyperglycaemia leads to long-term complications such as coronary heart disease, renal disease and failure, retinopathy and blindness. Other complications are peripheral vascular disease and neuropathy. [37,38]

Boule and co-workers [12] reviewed the literature up to December 2000, on the effects of exercise on glycaemic control. They limited their review to exercise interventions lasting at least 8 weeks, since the HbA_{1c} reflects average, blood glucose concentration from the previous eight to 12 weeks. The results of 14 trials, comprising a total of 504 participants with a mean age of 55 (SD=7.2) years, were analysed. Fifty percent of these participants were women.

In 11 studies the HbA_{1c} was significantly (-0.66%) lower in the exercise groups compared to the control groups. When diet and exercise were combined, the effect on HbA_{1c} was similar to the effect of exercise alone (-0.76%). Subgroup analyses, comparing aerobic or resistance training groups with the control group, revealed no significant difference. They showed that high intensity activity and low-intensity exercise had comparable beneficial effects on insulin sensitivity.

The results showed that exercise should be viewed as beneficial and that exercise does not need to reduce body weight to have a beneficial impact on glycaemic control. The reduction in HbA_{1c} is close to the difference between conventional and intensive glucose-lowering therapy as described in the UK Prospective Diabetes Study (UKPDS).[57]

In the UKPDS described elsewhere, subjects who were randomised to intensive glycaemic control with metformin, had HbA_{1c}-levels 0.6% lower than the subjects who received the conventional treatment. However, it seems that in older patients, with long-standing diabetes, insulin and oral hypoglycaemic agents are the major determinants of blood glucose control.[122]

WEIGHT LOSS

Intra-abdominal obesity is associated with insulin –resistance Type 2 DM, hypertension, dyslipidaemia and cardiovascular disease. [72] The metabolic syndrome is a cluster of these abnormalities. Hypertriglyceridaemia, low HDL -, altered LDL cholesterol and elevated free fatty acids (FFA) are strong risk factors for cardiovascular disease.[123,124]

A meta-analysis by Dattilo and Kris-Etherton [125] has shown that a weight loss of 1 kg decreases serum cholesterol by 1%, triglycerides by 1.9% and fasting plasma glucose values by 3.6mg/dL. This improvement is in the range of many oral hypoglycaemic agents.

Exercise contributes to reduction in intra-abdominal obesity[126,127] and frequently counteracts weight gain observed after diet-induced weight loss.[128] Appropriate physical activity to control blood lipid is recommended by the Expert Panel of Detection, Evaluation and Treatment of High Blood Cholesterol in Adults.[129] Furthermore, skeletal muscle uses its own stores of glycogen, triglycerides and free fatty acids, derived from the breakdown of adipose tissue triglycerides and glucose released from the liver. [124]

CONTROL OF BLOOD PRESSURE

Essential hypertension is a part of the metabolic syndrome and has a prevalence as high as 60% in persons with Type 2 DM.[14] Hypertension accelerates the rate of progression of diabetic renal disease.[130] Although glucose control is essential for the prevention of microvascular disease, intensive blood pressure control is also needed to reduce cardiovascular events.[131] Lowering blood pressure reduces the risk for stroke, diabetes-related deaths, heart failure, microvascular disease and retinopathy up to 56%.[132]

Exercise training appears to reduce blood pressure to some degree and is recommended by the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure.[133]

In a meta-analysis of 54 randomised, controlled trials by Whelton and associates, [134] an overall reduction in mean blood pressure of 3.9/2.6 mmHg across all initial blood pressure levels, independent of body weight and race was reported. These results support results of another meta-analysis of 16 studies by Kelley and co-workers.[135] In these studies walking as intervention was examined in normo- and hypertensive persons after an average of 25 weeks. A decrease of 3/2 mmHG was documented.

PREVENTION OF CARDIOVASCULAR DISEASE

Insulin resistance syndrome is an important risk factor for premature coronary disease, particularly with associated hypertension, hyperinsulinaemia, central obesity and overlap of metabolic abnormalities. The risk factors for coronary heart disease in Type 2 DM are increased LDL cholesterol, decreased HDL cholesterol, hypertension, hyperglycaemia and smoking. [56]

Having Type 2 DM increases the risk of cardiovascular disease two - to - four fold.[136] Cardiovascular disease is the most costly complication of Type 2 DM.[137] Poor aerobic fitness is associated with many of the cardiovascular risk factors. It is likely that the beneficial effects of physical activity on cardiovascular risk, is related to improvements in insulin sensitivity. [124] Cardiorespiratory fitness furthermore, reduces the rate of cardiovascular morbidity and mortality independent of weight obesity.[138]

The University Group Diabetes Program [139], the Kumamoto Study [60] and the Veterans Affairs Cooperative Study [140] did not show significant beneficial effects of improved glycaemic control on macrovascular disease. The UKPDS [57] reported a borderline significant reduction in the number of myocardial infarctions with intensive blood glucose control, but significantly fewer diabetes-related deaths and strokes with tight blood pressure control.

Gaede and associates [141] did a randomised trial of stepwise intensive treatment or standard treatment of risk factors in a sample of patients with microalbuminuria. They reported a decrease in the progression to nephropathy and progression to retinopathy. They concluded that further studies were necessary to establish the effect of intensified multifactorial treatment on macrovascular complications and mortality.

In the eight-year follow-up report of the above-mentioned study, Gaede et al [115] reported a 50% reduction in cardiovascular and microvascular events in the exercise group.

From this literature review, one can conclude that exercise is widely recognised as an important component of the management of Type 2 DM. It plays an important role in restoring health and preventing disease. The benefits of exercise for the diabetic patient have been well researched and described in a number of studies.

It can also be concluded that appropriate physical activity and dietary intake are fundamental to good glycaemic control, blood pressure and blood lipid control. These are however, difficult to achieve in practice. Regular physical activity and a meal plan are needed to control glycaemia, lipid levels and hypertension.[142]

Exercise and diet are associated with more weight loss and less use of hypoglycaemic agents than diet alone.[143] Exercise therefore, enhances short-term weight loss when combined with dietary modification and is one of the best predictors of long-term maintenance of weight loss.[144]

However, adherence to exercise in overweight adults is not good.[145] Regular exercise requires more time and effort than modifications to diet and taking medication. Patients often perceive exercise as a significant and difficult change in their lifestyle.[146]

Therefore, the next question to be addressed in this literature review is: "What is the most effective way to use exercise in the management of Type 2 DM patients?" Several clinical trials, using a variety of methods, have been published. The most recent ones will be reviewed in the next section.

EVIDENCE FOR EFFECTIVE PHYSICAL ACTIVITY INTERVENTIONS

EXERCISE IN A SUPERVISED LABORATORY SETTING

In 1997 Dunstan and co-workers[147] demonstrated that reducing fat in the diet, by including one fishmeal daily, reduced serum triglycerides and increased HDL_2 in dylipidemic Type 2 DM patients. They found that a concomitant programme of moderate exercise prevented increases in HbA_{1c} associated with fish diets. Their programme consisted of stationary cycling on a bicycle ergometer at 50-55% of the baseline Vo_{2max}, three times per week in a supervised laboratory setting for eight weeks.

Irwin and co-workers [126] examined the effects of exercise on total and intra-abdominal body fat overall. They also looked at the level of exercise in this randomised controlled trial over a period of one year. The intervention included a three-month exercise programme consisting of at least 45 minutes of moderate intensity exercise, five days per week, for one year. Participants started with a target of 40% of maximal heart rate, which was increased to 60-75% by week eight of the programme. The exercise facilities available were treadmills and stationary cycles. Women in the control group attended weekly 45-minute stretching sessions for one year. They reported significant between-group differences in baseline to 12-month changes in body weight, total body fat and intra- and subcutaneous body fat. They concluded that overweight women should be encouraged to participate in moderate exercise to reduce obesity and to prevent chronic disease. However, participants in their study were highly educated and only 4% were African-American women.

COMMUNITY-BASED WALKING PROGRAMMES

Wing and co-workers [148] investigated the effect of exercise in a behavioural weight control programme in obese Type 2 diabetics, aged 30 to 65 years. This was conducted over a six month (25 subjects) and one year (30 subjects) interventions.

The interventions consisted of diet plus moderate exercise, compared to diet plus placebo. They also compared diet plus walking to diet alone. They reported no between-group difference in HbA_{1c} in either study. However, the one-year intervention demonstrated statistical significant reduction in weight in the diet and exercise group.

Walker et al [149] examined the effects of regular walking on cardiovascular risk factors and body composition in normo-glycaemic women compared to women with Type 2 DM. The walking programme consisted of self-paced walks of at least 60 minutes duration, at least five times per week. Statistically significant reductions in upper body fat and HbA_{1c} (-0.59%) were found in the participants with Type 2 DM after the 12-week walking programme. Total cholesterol concentrations also fell significantly. There was however, no change in the concentration of HDL cholesterol. They concluded that walking was a form of moderate exercise that can be performed safely by older women and with positive effects on fitness and lipid profile.

Jakicic and associates [150] compared the effects of intermittent exercise to traditional continuous exercise on weight loss. They also examined the adherence and fitness in their sample of 148 sedentary, overweight women. Subjects were randomly assigned to three groups and were prescribed a similar volume of home-based exercise. The three groups differed in the way exercise was prescribed. The exercise varied in terms of the number of exercise sessions per week, duration and availability of home exercise equipment. Subjects were instructed to choose a mode of exercise similar to brisk walking. They reported that the use of short bouts of exercise, performed multiple times throughout the day, may not increase long-term exercise adherence, but could be used as an option for incorporating exercise into one's lifestyle.

Brown et al [151] determined the effects of a culturally competent diabetes-self-management intervention in Mexican Americans with Type 2 DM. The Starr County Border Health Initiative was an intensive instructional and support group intervention with 52 contact hours over 12 months.

The authors showed that statistically significant changes were achieved in diabetes knowledge, fasting blood glucose and HbA_{1c}. Numerous barriers to participating in exercise were identified. These were complications from diabetes, co morbid conditions, and history of sedentary lifestyle and decreased mobility associated with ageing. Environmental barriers were lack of access to exercise facilities and cultural factors, such as the inappropriateness of women walking alone in their neighbourhoods.

Keyserling and co-workers [152] investigated, whether a culturally appropriate clinic- and community-based intervention for African-American women with Type 2 DM, would increase moderate-intensity physical activity in the New Leaf programme.

Their intervention consisted of two to three hours of individual counselling, four and half-hours of group sessions and two hours of telephone contact. The intervention was associated with a statistically significant increase in physical activity energy expenditure.

However, participants in all groups gained weight. Furthermore, there were minimal changes in HbA_{1c}, and in total and HDL cholesterol. The intervention required a lot of human resources, which is a problem in a country like South Africa with a stressed health budget.

Goldhaber-Fiebert and associates [153] determined the effect of a community-based, group-centred public health intervention on glycaemic control and associated cardiovascular risk factors in Type 2 DM patients in rural Costa Rica. Their lifestyle intervention included 11 weekly nutrition classes over a period of 12 weeks. Participants in the intervention group were invited to participate in 60-minute walking groups, three times per week. Although the walking time was kept constant, participants were encouraged to increase their pace and distance during that time. Both weight and HbA_{1c} decreased significantly in the intervention group after 12 weeks.

In the same year, Di Loreto and co-workers [146] validated a counselling strategy to promote the adoption and maintenance of physical activity by Type 2 DM patients. Their programme was based on the conclusions of the report by the US Department of Health and Human Services, regarding the efficacy of interventions to promote physical activity in adults.[154] They compared two groups over a period of two years. The control group received usual care and the intervention group received usual care and an additional 30 minutes of structured counselling, recommending physical activity. Subjects discussed with the participants were motivation, self-efficacy, pleasure, support, comprehension, lack of impediments and keeping a daily diary of physical activity. Participants were followed-up by means of monthly telephone calls and three-monthly appointments at the outpatient clinic.

Significant increased energy expenditure in the intervention group through voluntary physical activity was documented. Their results are relevant in clinical practice, because it showed that an unselected population of Type 2 diabetics was successfully motivated to increase their energy expenditure and that this was still the case at the two-year follow-up. They also demonstrated reduced BMI and HbA_{1c}. These findings significantly correlated the amount of voluntary physical activity.

Lauzon et al[155] investigated whether a physical activity intervention for individuals with Type 2 DM could be successfully implemented in geographically diverse diabetes education centres. Their programme incorporated the use of a pedometer, group meetings, individual goal setting, self-monitoring and feedback. Increased levels of physical activity and improved health outcomes were reported.

However, Brown et al[156] reported that the initial increased step counts due to the use of a pedometer in their study, returned to baseline at 16 weeks, indicating that patients did not adhere to the programme in the long term.

RESISTANCE TRAINING

Dunstan and co-workers[157] used high-intensity resistance training to improve glycaemic control. In their six-month trial, 16 subjects were randomly assigned to either a high-intensity progressive resistance training plus moderate weight loss group, or a moderate weight loss group plus control programme. The control programme consisted of 30 minutes of flexibility exercise and stationary cycling with no workload for five minutes. They reported a significant reduction in HbA_{1c} (-0.8% at six months) in the experimental group. They concluded that a supervised progressive high-intensity resistance-training programme, performed three days / week and over a period of six months was safe and well tolerated by older patients with Type 2 DM. It was also effective in improving muscle strength. However, in the author's opinion such a programme can only be conducted under direct supervision and is therefore, not suitable for community-based exercise training.

Recently, Willey and co-workers [15] also reported on the feasibility of progressive resistance training compared to aerobic exercise. They compared the two types of exercise, because of the concomitant cardiovascular, arthritic and other diseases patients with Type DM may have. According to the authors, muscle wasting due to ageing and physical inactivity, exacerbated problems of peripheral glucose uptake. Progressive resistance training increased muscle mass, strength and endurance. It furthermore, had positive effects on bone density, osteoarthritic symptoms and mobility impairment.

CONCLUSION

Weight loss is central to the management of obese Type 2 diabetics. [14,72] However, long-term energy restriction as the sole means of improving glycaemic control, is difficult to maintain and only modest in its effect. [61,158] Therefore, diet must be augmented by hypoglycaemic medication due to the progressive nature of the disease. [56]

Prescribed diets are often perceived as negative and difficult by patients, who have to change eating habits established over a lifetime. [158] Repeated, unsuccessful attempts to loose weight can lead to tissue loss and decreased metabolic rate, worsening the energy balance equation.[159]

Due to this problem exercise prescriptions the for management of Type 2 DM have been included in Positions Statements by organisations such as the American College of Sports Medicine [20], and the American Diabetes Association. [25] Solid evidence also exists that exercise alone, in the absence of any change in body mass or composition, can significantly enhance insulin sensitivity and glucose homeostasis. [12,114]

Aerobic exercise, such as walking, enhances insulin sensitivity in Type 2 DM. [149] This is due to adaptive changes in skeletal muscle including increased GLUT4 transported proteins on muscle fibres [79], increased muscle glycogen storage [73] and the cumulative effects of acute exercise bouts. [149]

Long-term aerobic exercise for obese individuals coupled with a weight-reduction diet, enhances insulin sensitivity more than only dieting.[160]

Evidence from the reviewed studies indicates that physical activity contributes to weight loss and improvements in glycaemic control. Furthermore, moderate intensity exercise has the same effect as structured vigorous exercise, but it is more acceptable to overweight women and therefore, adherence to moderate intensity exercise is better. Walking is a suitable moderate intensity exercise, which has a positive effect on weight loss and glycaemic control. However, successful programmes report intensive contact with patients and also supervised exercise. It was also shown that short bouts of exercise, multiple times per day, was a good way to incorporate exercise into the lifestyle of previously sedentary individuals. [150]

Evidence for the importance of exercise in the prevention and treatment of Type 2 DM has been established in the literature review up to this point.

It is clear that exercise is beneficial for the diabetic patient on several levels and that it should be included in the daily management of the disease. Patients should be clinically assessed to safely incorporate exercise in the diabetes treatment regimen.

EXERCISE TESTING

AMERICAN DIABETES ASSOCIATION (ADA)[25]

The American Diabetes Association recommends a detailed medical evaluation with appropriate diagnostic studies. [25,124] Patients should be screened for the presence of macro- and microvascular complications that may be exacerbated by exercise.

It is stated that a graded exercise test may be helpful if a patient is at high risk for underlying cardiovascular disease. However, when participating in low-to-moderate-intensity forms of physical activity such as walking, the physician could use clinical judgement in deciding, whether to recommend an exercise test. Patients with known coronary artery disease should undergo a supervised evaluation of the ischaemic response to exercise. [124]

META-ANALYSIS BY STEWART [34]

Stewart [34], carried out an extensive meta-analysis of exercise training and the cardiovascular consequences of Type 2 DM and hypertension. She is of the opinion that the exercise guidelines of the American College of Sports Medicine, [27] are safe and effective for exercise testing of Type 2 DM and hypertension patients.

AMERICAN COLLEGE OF SPORTS MEDICINE (ACSM)[27]

The ACSM [27] recommends that health professionals should decide about the level of screening according to the health status of the patient. Moderate risk patients are women of 55 years and older, who meet the threshold for two or more risk factors.

The risk factors are family history, cigarette smoking, hypertension, hypercholesterolemia, impaired fasting glucose, obesity and a sedentary lifestyle. Exercise testing is therefore, not essential for moderate risk persons participating in moderate intensity exercise. However, it should not be viewed as inappropriate.

The measurement of health-related physical fitness is, however necessary for the prescription of exercise programmes. This is necessary in order to provide baseline and follow-up data to evaluate progress by participants. It can also be used to educate and motivate participants by setting reasonable and attainable fitness goals. Care should be taken to administer the physical fitness test in a safe, quiet and private environment.

Participants should wear comfortable, loose-fitting clothing. Anxiety should be minimised by explaining the test procedures.

Cardio respiratory fitness is measured by means of maximal and sub maximal exercise testing. The decision to use a maximal or sub maximal exercise test depends on the reasons for the test, the type of subject tested and the availability of appropriate equipment and staff.

MAXIMAL EXERCISE TESTING

While maximal exercise tests offer increased sensitivity in the diagnosis of asymptomatic ischaemia, it is not a feasible method of assessing cardio respiratory endurance at a community hospital. The reasons for this are the expensiveness of the test involved and lack of equipment. Treadmill exercise testing may also be intimidating for sedentary subjects, who are not used to exercise and where the rate of exercise is not under the subject's control. Lowther et al[161] expressed the opinion that fitness assessments are intrinsically motivating if the participant does well, implying that it can be de-motivating for sedentary individuals and can lead to avoidance of all physical activity.

SUB MAXIMAL EXERCISE TESTING

While not as precise as maximal exercise testing, sub maximal exercise testing provides a reasonably accurate reflection of a participant's fitness. The test can be conducted at a lower cost and reduced risk. It also requires less time and effort on the part of the subject. [27]

Since expensive testing equipment is not available at the Mamelodi Community Hospital, a mode of testing which would be suitable at community level is a field test. This test consists of walking a certain distance in a given time.

An example of such a test is the six-minute walk test.[162] The test is simple, inexpensive, safe and highly acceptable to patients. It corresponds more closely to the demands of everyday activity than does cycle ergo meter exercise testing. The results are reproducible and correlate with conventional measures of functional status and exercise capacity.[163] In this way a large number of subjects can be tested at any one time. Little equipment is needed and it is easy to administer.

The disadvantages of the test are that the subject's level of motivation and pacing ability can have a profound impact on the test results. [159] Exclusion criteria for the test are factors such as arthritis, claudication of the legs and angina, thus limiting its use. Psychiatric disease preventing reliable performance of the walking test is also an exclusion criterion. [27]

The Six-minute walking test is conducted in an enclosed corridor on a course, which of 33 metres in length. Subjects are instructed to walk from end to end, covering as much ground as possible during the allotted time. The supervisor faces the subject and encourages the subject with phrases such as "You're doing well" or "keep up the good work". At the end of the test the supervisor calls out "Stop" and the distance walked is recorded. [162]

Supporting the use of sub maximal exercise testing, Foster et al [16] is of the opinion that exercise prescription becomes more of an empirical process without an exercise test. The cost and delay in securing exercise tests and the overwhelming advantage of exercising allow clinicians to make use of adjunctive techniques, without direct information regarding maximal exercise response.

RATING OF PERCEIVED EXERTION SCALE

Although significantly less specific, it is also possible to perform a reasonably accurate exercise prescription without a maximal exercise test, using the Rating of Perceived Exertion (RPE) scale.[164]
This is a valuable and reliable indicator in monitoring an individual's exercise tolerance. [16,27] The exerciser is allowed to subjectively rate his or her feelings during exercise, taking into account personal fitness level, environmental conditions and general fatigue levels.

The greatest value of the RPE scale is that it provides exercisers of all fitness levels with guidelines that are easily understood. A cardio respiratory training effect and the threshold for blood lactate are achieved at a rating of "somewhat hard" which is more or less a rating of 12-16 on the category scale. [27]

Colberg and co-workers[165] examined the use of RPE to prescribe exercise intensity for diabetic individuals. They reported a highly linear relationship between RPE and the percent Vo_2 reserve (% VO_2R), providing support for its continued use by diabetic patients in clinical settings, in cases where maximal or peak heart rate is not easily measured.

A wide variety of exercise testing was reported in clinical trials reviewed in this chapter. Tests ranged from medical screening only, sub maximal and maximal exercise testing.

EXERCISE PRESCRIPTION

AMERICAN DIABETES ASSOCIATION (ADA) [124]

According to ADA middle-aged and older individuals should be encouraged to be physically active. Long-term programmes of regular physical activity are feasible for uncomplicated Type 2 DM patients. Studies showing the best adherence, have used an initial period of supervision, followed by relatively informal home physical activity programmes with frequent follow-up assessments. [124]

ADA recommends a warm-up period of five to 10 minutes of aerobic activity, such as walking at a low intensity level. Another five to 10 minutes of gentle stretching of the muscle groups used during warm-up, should follow this.

The Association also provides guidelines for exercise for patients with diabetes-related complications. Signs and symptoms such as intermittent claudication and cold feet, decreased or absent pedal pulses, atrophy of subcutaneous tissues and hair loss, diagnose peripheral arterial disease. Grade I intermittent claudication can be treated with a supervised physical activity programme. [124]

Patients with active prolific diabetic retinopathy should avoid anaerobic exercise and physical activity that involves straining, jarring or Valsalva-like manoeuvres. No data exist on the intensity and type of exercise for patients who have had laser or surgical procedures for diabetic retinopathy.

Low to moderate intensity physical activity is allowed for patients with nephropathy. These patients' blood pressures should however be carefully controlled.

Peripheral neuropathy may result in loss of protective sensation in the feet and therefore, weight-bearing exercise should be limited and is contraindicated for such patients.

Willey and associates [15] are of the opinion that progressive resistance training (PRT) is an effective alternative for individuals with peripheral vascular disease, since many exercises can be performed seated in chairs with no pressure on the feet.

Patients with autonomic neuropathy may have limited physical activity capacity and may develop hypertension or hypotension after vigorous physical activity. These patients also have difficulty with thermoregulation and they should be advised about adequate hydration and to avoid physical activity in hot or cold environments. [25]

Additional exercise precautions are, the use of good exercise shoes or cotton socks to keep the feet dry and to minimise trauma to the feet. Proper hydration prior to and during physical activity is recommended. Care should be taken to exercise in a safe environment with adequate light and airflow or air-conditioning.

AMERICAN COLLEGE OF SPORTS MEDICINE [27]

The American College of Sports Medicine [27] states that regular participation in moderate-intensity physical activity (3-6 METs) is associated with health benefits, even when aerobic fitness remains unchanged. The Centres for Disease Control and Prevention and the ACSM therefore. recommend accumulation of 30 minutes or more of moderate-intensity physical activity on most, preferably all days of the week. [118]

A further recommendation is that an exercise programme should consist of a wide variety of exercises, involving the major muscle groups. The programme should also increase the likelihood that its effects may be transferred to activities at work and at home.

Five components apply when developing exercise prescriptions for persons of all ages and fitness levels, regardless of the presence or absence of risk factors and disease. These factors are mode, intensity, duration, frequency and progression of physical activity. [118]

The ACSM prescribes five to 10 minutes of low-intensity, callisthenics-type and stretching exercises followed by five to 10 minutes of progressive aerobic activity to prepare the muscles, tendons, ligaments and joints for the endurance phase. The endurance phase develops cardio respiratory fitness and consists of 20 to 60 minutes of aerobic activity. The lower the intensity, the longer the duration of this phase should be. Exercises should involve large muscle groups in a dynamic rhythmic way.

Furthermore, individual preferences and personal goals must be considered to improve the likelihood of adherence to the programme.[27]

The most common methods of setting the intensity of exercise to improve or maintain cardio respiratory fitness are the use of heart rate and the rating of perceived exertion. [159] According to the ACSM, rating of perceived exertion is a valuable aid in prescribing exercise for an individual who experiences heart rate palpation and for people without watches.

The appropriate exercise intensity for an individual will be one that is safe, is compatible with a long-term active lifestyle for that individual and achieves the desired energy expenditure. The American College of Sports Medicine [27] also recommends a carbohydrate-rich snack before and after exercise. They furthermore suggest that exercise should be performed with a partner, who has knowledge regarding the signs and symptoms of hypoglycaemia.

SOME OTHER AUTHORS

Stewart [34] recommends 30 to 45 minutes of aerobic exercise at 55% to 79% of maximum heart rate for those with multiple risk factors and no exercise testing.

She furthermore, recommends that resistance training should consist of eight to 10 exercises at 30% to 50% of one-repetition maximum and a minimum set of 12 to 15 repetitions. Resistance training should last about 20 minutes for one set each, for eight to 10 exercises. The endurance phase should be followed by a cool-down period of five to 10 minutes, similar to the warm-up period, to bring down the heart rate and to stretch muscles.

Stewart [34] is also of the opinion that patients, using insulin should be encouraged to exercise and be given instructions about blood glucose monitoring, insulin dosing and supplementary foods.

When determining the level of exercise intensity, the subject's level of fitness and physical activity should be kept in mind. Samaras et al[166] suggest small increases in physical activity and encourage safe physical activity of any kind, rather than unrealistic exercise regimens.

Progression of the exercise programme will depend on the subject's functional capacity, medical and health status, age and the individual's preferences and goals. The initial goal for sedentary individuals may be not to attain the recommended 30 minutes of moderate physical activity per day, on preferably all days of the week, but to progress to this goal during the first weeks of the training programme. [18,159]

The meta-analysis performed by Boule and associates [12] included studies of exercise interventions in Type 2 diabetics up to December 2000.

They reported that exercise interventions typically prescribed three workouts per week, each lasting a mean of 53 minutes (including warm-up and cool-down) for 18 weeks. The intensity of the aerobic exercise was moderate and typically consisted of walking or cycling. Resistance training was composed of two to three sets ranging from 10 to 20 repetitions, which was progressively increased. Comparing aerobic or resistance training to the control group revealed no significant differences.

The ACSM [159] and the American Heart Association [167] recommend supervised resistance training for its favourable effects on muscular strength and endurance, cardiovascular function, metabolism, coronary risk factors and psychosocial well being.

Willey and associates [15] support the above recommendation, suggesting that progressive resistance training is feasible in older obese Type 2 diabetics. They are of the opinion that the translation of aerobic exercise recommendations into appropriate activity regimens for these persons is challenging and often impossible to implement.

Foster et al [16] report that the addition of resistance training to the programmes of long-term, aerobic trained patients can significantly improve their ability to complete activities of daily living.

More recently published studies also reported exercise interventions according to the guidelines of the ACSM and ADA. [95,109,113,114,146,147,151,152]

In spite of careful testing and planning, exercise programmes dropout rates, ranging from nine to 87% are reported. This fact highlights the problem of poor adherence to exercise programmes.[159] Dropout rates are generally the highest in the first three months, increasing to approximately 50% within one year. [27]

Factors contributing to the high dropout rate are the facts that exercise is voluntary and time-consuming.

It may therefore, compete with other valued interests and responsibilities of daily life [27] Psychosocial variables, including perception of the program, personal convenience factors and family lifestyle components appear to present the major impediment to adherence to exercise programmes.[168]

The question arising is: how to improve exercise compliance and self-management in the diabetic?

DIABETES SELF- MANAGEMENT EDUCATION (DSME)

Diabetes self-management education (DSME) has been considered an important part of the clinical management of individuals with Type 2 DM since the 1930s.[169] The American Diabetes Association [25] recommends annual assessment and continuing education of self-management skills and knowledge for patients with Type 2 DM. The goals of self-management education are to optimise metabolic control, prevent acute and chronic complications and optimise quality of life, while keeping costs acceptable.[170]

Diabetes self-management therefore, requires ongoing commitment, skills and active change of lifestyle by the patient. It also reflects active patient engagement in making decisions about the management plan and carrying out the planned treatment behaviours and activities.[171] Knowledge and skills are needed to make the necessary behaviour changes [172,173]

Successful diabetes self-management will also mean that the patient accepts responsibility for her own health and execute the required health behaviour to improve her health.[172]

Eales and Stewart [172] define self-responsibility as the necessary action for an optimal health outcome and the moral duty of the patient to successfully execute the required health behaviour for improved health. In order to accept responsibility, the patient will need to have technical knowledge and skills of the required health behaviour.[173]

Poor adherence to medical advice, exercise or therapy is however, a significant problem in any lifestyle intervention programme. It is difficult for patients to accept self-responsibility and to change health behaviour. Intervention programmes are often complex, of long duration, inconvenient and require lifestyle alterations that are difficult for especially the older patient with long-established habits.[174] Acceptance of self-responsibility and behaviour change is also influenced by diversity in health beliefs, cultures, religions and traditions. It is an extended process and is based upon the understanding of certain psychological theories.

Various models of health behaviour help to explain why patient behave in certain ways

CONSUMER INFORMATION PROCESSING THEORY [175]

This theory explains the factors that influence the processing of knowledge and the effect of knowledge on health behaviour.[175] The patient needs knowledge to make the decision to change behaviour. The information should be clear and the patient must believe in it. Furthermore, the patient must be able to and have the time and energy to comprehend the information.

Knowledge can be provided on an individual basis or in small groups. Group and individual diabetes education is equally effective when a consistent curriculum is used, provided the group is not larger than eight persons.[176]

The patient may however, still lack the motivation, the skills and the support or the resources to make the necessary behaviour changes. [175] The Social Learning Theory and the Health Belief Model help us to understand what will enable the patient to change health behaviour. [172]

HEALTH BELIEF MODEL [177]

The model emphasises the fact that patient beliefs are seen as the fundamental driving force behind health-related behaviour.[177] The model furthermore, suggests that patients are more likely to comply with preventative action such as exercise, and correct diet if they believe that they are vulnerable to diabetes. They will also take action if they believe that there will be serious consequences if they do not take action.

THE SOCIAL COGNITIVE THEORY [178]

The Social Cognitive theory[178] provides insight into the interrelationships between patient beliefs, understanding, environment and behaviour. [27] The theory also emphasises the fact that, as most behaviours are learned, they can also be changed.

For this to happen, the patient must be an active participant in the learning and application of behaviour-changing skills. This process is however, influenced by a number of determinants. These are: personal characteristics of the patient, environmental influences and other associated behaviours.

The personal characteristics include cognitive factors, personality and demographic factors. Cognitive factors include knowledge, thoughts, attitudes and skills. [172] Environmental influences include social, cultural and economic factors.

Patients' beliefs that they can motivate themselves and regulate their own behaviour play a crucial role in their decision to exchange detrimental health habits for good behaviours.[179] Only patients who believe that they can succeed have high self-efficacy, which is the most important prerequisite for behaviour change. [27,172,179]

THE READINESS FOR CHANGE MODEL [180]

This model by Prochaska and DiClemente [180] was primarily developed for addictive behaviours and describes how patients undergo a process of change, in order to bring about more beneficial health behaviours.

It is based on the principle that people move through an orderly sequence of change at different paces. Some patients may stay longer at certain points or even regress. The stages of behaviour change include precontemplation, contemplation, preparation, action and maintenance of altered behaviour.

Precontemplation is the stage where individuals have no intention to change. Lack of knowledge may be a reason.

Individuals in the contemplation stage are thinking about change. They are more likely to retrieve information and pursue educational activities. However, they will not advance to the preparation stage unless the reasons hindering change decrease.

Patients in the preparation stage are ready to take immediate action to change their health behaviour. They believe that behaviour change will be beneficial to them, despite the costs.

In the action stage, individuals change behaviour. It is very important that they have the appropriate skills required for the new behaviour. They must have the autonomy to change their behaviour, as opposed to an external force determining the change. This stage can last for six months and requires a lot of physical and emotional energy from the patient.

Individuals in the maintenance stage successfully sustain behaviour for at least six months. These stages are cyclical and it may happen that a patient relapses into her old behaviour. It is important for the health professional to understand this and not to embarrass the patient who relapsed.

The patient should not be regarded a failure, but rather as someone who is learning and who should be facilitated through the process. [180,181]

THE THEORY OF REASONED ACTION [182]

The relations between beliefs, attitudes, intentions and behaviour are the emphasis of this theory.[182] The intention of an individual to change behaviour is determined by the individual's attitude and his subjective norm.

Attitude is determined by the patient's beliefs about the outcome of performing certain health behaviour. Attitude is also determined by the importance of the outcomes to the patient. The subjective norm of the patient is determined by her normative beliefs that other people, who he regards as important, approve or disapprove of the behaviour.

These theories and models are widely accepted and used by health care practitioners. A number of studies have made use of these theories and models in their lifestyle interventions. The most recent studies are discussed in the next section.

EFFICACY OF DIABETES SELF-MANAGEMENT EDUCATION ON GLYCAEMIC CONTROL

Norris et al [183] performed a systematic review of 72 randomised, controlled trials, published between January 1980 and December 1999. The authors investigated the effects of self-management on glycaemic control, lipids, physical activity weight and blood pressure. They reported that lifestyle interventions in a group setting were more effective to increase weight loss and to promote glycaemic control. Interventions, involving patient participation and collaboration had more positive effects on glycaemic control, weight loss and lipid profiles. Improvements in glycaemic control, knowledge and diet were however, more readily demonstrated than improvements in weight and physical activity levels. They concluded that a more holistic view of patient function, longevity and quality of life was necessary.

A meta-analysis to evaluate the efficacy of self-management education on glycaemic control performed by the same authors for the same period followed.[184] They concluded that self-management education improves glycaemic control with 0.76% at immediate follow-up, 0.26% by one to three months and 0.26% at more than four months follow-up. Furthermore, duration of contact between educator and patients was the only significant predictor of effect with 23.6 hours of contact time needed for each 1% decrease in HbA_{1c}.

Jones et al [185] compared diabetes "Treatment As Usual" (TAU) with" Pathways To Change" (PTC), and an intervention developed from the Transtheoretical Model of Change (TTM). They wanted to determine whether, the PTC intervention would result in greater readiness to change, increase in self-care and improved diabetes control. The sample consisted of 1029 patients with Type 1 or 2 DM and was conducted over a period of 12 months. The PTC intervention included stage-based personal feedback reports, self-help manuals and newsletters delivered by mail and personal counselling via telephone. The TAU involved regular family physician or endocrinology sessions as prescribed.

The authors reported that the PTC intervention was significantly better than TAU in helping individuals to move into action stages of critical diabetes self-care behaviours. While this study was effective in delivering interventions to a large number of people, it would be difficult to repeat in a black urban community. Reasons for this statement are the low level of education and illiteracy and other socio-economic factors such as lack of telephones and the availability of permanent addresses.

Egede[186] investigated the effectiveness of physician advice on hypertension-related lifestyle modification in 1906 on mainly black, less educated diabetics. He reported that patients with diabetes appeared to modify behaviour in response to the advice of physicians. The results however, suggested that patients with diabetes might be less likely to engage in exercise training than other lifestyle interventions, such as weight loss.

The way of measuring adherence to physician advice may have overestimated the true prevalence of behaviour change and adherence. The study also did not collect data on the frequency, duration, intensity and sustainability of exercise. Recall bias may also have influenced the findings.

Kirk and co-workers [187] evaluated the effect of exercise consultation on physical activity in people with Type 2 DM. The exercise consultation involved a 30-minute on-on-one discussion with a trained research assistant, based on the transtheoretical model. The aim of the consultation was to encourage patients to accumulate 30 minutes of moderate physical activity most days of the week. Support follow-up phone calls were given at one and three months after the consultation. The results demonstrated that exercise consultation was more effective in promoting physical activity than a standard exercise leaflet. The experimental group demonstrated a 0.31% decrease in HbA_{1c}. These findings demonstrate an inexpensive means to promote physical activity, which could be conducted by any member of the multidisciplinary diabetes care team.

Glascow and associates[188] have shown that problem solving is a key to successful long-term diabetes self-management in a sample of 279 women with Type 2 DM.

Hill-Briggs et al, [189] who investigated the relationship of problem solving to diabetes control, support this finding. They reported that higher problem solving scores were associated with better medication adherence, physical activity and nutrition, although not statistically significant.

The following studies, which have been discussed under the section of multifactorial interventions, also made use of counselling as an intervention.

Di Loreto et al [146] validated a counselling strategy to promote the adoption and maintenance of physical activity by Type 2 DM patients. Their counselling strategy was based the Report of the U.S. Department of Health and Human Services and Bandura's social cognitive theory.

Their finding, that the counselling strategy was effective in motivating approximately 70% of Type 2 diabetics to perform a regular aerobic exercise programme, is of clinical importance. However, the differences in socio-economic conditions, family support and lack of crime as an environmental barrier, may have favourably influenced the results of this Italian population.

Keyserling and associates [152] based their intervention of one year on behaviour change theory and reported that individual counselling, group sessions and telephone contact were associated with enhancement of physical activity expenditure.

Kinmonth[190] reported that approaches, guided by social psychology behavioural techniques and patient participation were generally associated with greater treatment adherence. These approaches also resulted in behaviour change, well being and improved health outcomes including blood glucose control and functional status in adults with Type 2 DM.

The findings of these studies support the principle of self-responsibility by the diabetes patient. It was however clear that helping individuals to move into the action stage of critical diabetes self-care behaviours, is costly in terms of time, physical and human resources.

Several barriers to health behaviour, which could complicate acceptance of self-responsibility, will be discussed in the next section.

BARRIERS TO DIABETES SELF-MANAGEMENT AND EXERCISE

The most frequently reported barriers in diabetes self-management are adherence to diet and exercise.[191] It appears that exercise is not unlike other health-related behaviours; typically half or less of those who initiate the new behaviour will continue, irrespective of initial health status or type of programme. [27,192]

Perceived health, lack of knowledge about their disease, level of education, perceived available time, access to facilities, family influences, peer influences and attitude toward physical activity are factors associated with no exercising according to Kerner et al [192] and other researchers. [27,146]

Stewart et al [193] reported that patients being treated for hypertension in the public health-care system in South Africa have poor knowledge about their disease. Patients often do not understand their disease; do not know what the complications of the disease are and how to look after themselves. This may also be true for Type 2 DM patients, since they visit the same public health-care clinics and most of the times receive treatment for both diabetes and hypertension.

Access to exercise facilities, lack of paved sidewalks and enclosed malls available for walking make it difficult for patients to exercise on a regular basis. Cultural factors also play a role such as the inappropriateness of women walking alone in the neighbourhoods. [63]

Psychosocial variables present the major impediment to exercise compliance, accounting for almost half of all dropouts in programmes. [194] Psychosocial variables include perception of the programme, personal convenience factors and family lifestyle components.

Bopape [195] reported that the needs of the diabetic, particularly dietary needs, were frequently subordinated for the sake of the family. They found it difficult and tiresome to cook different food for themselves, than for the rest of the family. That is why they sometimes eat food that is not healthy for them, as there may be no alternative meal to eat.

Stressful life situations, coping ability and social environment have been identified as psychosocial factors that are important determinants of health status, adaptation to illness and adherence to the diabetic regimen.[196]

Psychological stress is a generalised state of arousal occurring in response to stimuli, that exceeds one's coping capacities, such as undesirable life events and uncomfortable emotional experiences.[197]

Grant et al [198] suggested that a relationship exists between negative life events and changes in diabetic symptomatology. Stress and stress hormones have been shown to have a hyperglycaemic effect on Type 2 diabetics. Individuals with Type 2 DM may have altered adrenergic sensitivity in the pancreas, which could make them particularly sensitive to environmental stimulation.[199]

During psychological stress, associated sympathetic activation inhibits pancreatic insulin secretion and stimulates gluconeogenesis and glycogenolysis. Catecholamine release stimulates lipolysis, increases blood pressure and has numerous other systemic effects. Cortisol release causes insulin resistance, lipolysis and hepatic glucose production. It enhances glucose production by the liver and diminished cellular glucose uptake. In diabetic individuals, where glucose metabolism is compromised, chronic stress effects may therefore be problematic. [199]

It is unclear, whether psychosocial stress has an effect on the neuro-endocrine regulatory mechanisms that influence metabolic control. It is however, clear that stress can influence patients' adherence to diabetes management regimes and therefore, glucose control.[200]

Possible solutions for environmental barriers may be the use of community-based churches or centres to attract a broader group of and to ensure the safety of the participants. [108]

Kerner and Grossman [192] developed "Fitness Attitude -, Expectations of others-, Perceived Behavioural Control – and Intention to exercise" scales in order to identify those characteristics, that may cause the discontinuation of exercise. These scales have good content validity and good scale reliability, but have not been validated for use with diabetic patients.

Cultural factors have a major influence on the perceived barriers to self-management and adherence to exercise and other prescriptions.

TRANSCULTURAL HEALTH CARE

In the traditional African approach to illness management, a reason, usually a life-event of past occurrence, for the disease must be found. The treatment is then in trying to correct the offending cause. [201,22,202] Ancestors are believed to look after the interests of their descendants. They provide health and well being, but they can also be the cause of illness. [201] A diagnosis by a diviner, that an illness comes from the spirits, constitutes a reprimand and elicits feelings of guilt on the part of the patient. Reasons for interference by the ancestors may be neglect of the customs of the home and failure to accord due respect to seniors in the community. The belief in the ancestors therefore, provides an explanation of sickness and misfortune.

Modern medicine is quite separate from religion, while the traditional healer is open to a wide range of possible explanations, mostly mystical in western terms. Some African people therefore, believe that diabetes is a punishment from a vengeful god or ancestor. Successful treatment may be perceived as the giving of a sacrifice, prayer or even self-punishment. [22,202]

Bopape [195] examined the beliefs and attitudes of patients with Type 2 DM in the Northern Province of South Africa. She reported that 60% of patients in her sample did not know why they had diabetes and what the cause of it was. Others had strong religious beliefs that God controls personal health in ways that were positive: "God will help us deal with this problem or "Only God knows why we have this disease".

Bopape's report supports a finding by Sameul-Hodge et al, [203] who performed a qualitative study to identify culturally relevant psychosocial issues and social context variables, influencing lifestyle behaviours in a sample of African-American women. They documented that participants reported that God plays a central role in providing the strength to deal with daily challenges.

Bopape [195] also reported that some patients believed that diabetes is a foreign disease, that result from eating a western diet such as maize meal full of artificial ingredients. The majority of subjects (63%) in her study had a fatalistic view of the disease; that diabetes was a life-long disease and they were justly patiently waiting to die. According to the author, this fact may have influenced adherence to diabetes self-management by these patients.

De Villiers [202] reported that an African patient's own perception of the cause of the condition influences, her decision about which doctor to consult. She also stated that dual consultation of a western doctor and a traditional healer was quite common.

Hammond-Tooke [201] is of the opinion that, although urban blacks have easier access to western-type medical care, the number of indigenous healers in urban areas is also increasing. Even urbanised individuals are aware of the danger of neglecting the ancestral spirits and will take the necessary steps to seek their aid. Tshabalala and Gill support this opinion. [22] They reported that even well educated African people still adhere to traditional beliefs.

The degree of westernisation, level of education, socio-economic position and status of the individual also influence the decision. Other factors that influence the patient's decision on which practitioner to consul, are the influence of relatives, friends or employers and availability of money. [202]

Subjects do not report their visits to traditional healers to the health care professionals, because the traditional treatments are usually unsuccessful. [195]

Sometimes a patient would consult the traditional healer first, which is evident from small scratch marks on the body. The western doctor is then consulted, because the symptoms persist. The patient could also consult the traditional healer on discharge from hospital, either to determine the cause of the illness or to prevent its recurrence. [195,202] The last mentioned consultation is more associated with people with a chronic or terminal disease.

The traditional healer will inform the patient fully about her condition, without the patient telling anything about herself. The patient is therefore, mostly a passive participant in the consultation. From the perspective of the health professional, this behaviour is seen as shyness, lack of concern or submissiveness. [202]

Bopape [195] reported that 80% of patients in her study believe that only a health care professional and prescribed medication can control their disease. Patients may also withhold information from the health care professional, because they believe that the professional should be able to determine the cause and to provide a diagnosis without the help of the patient. If in the patient's view, the health professional's questions are irrelevant, he/she will withhold information.

Some form of diagnosis is therefore, essential to meet the expectations of the African patient, that she has been treated adequately. An African traditional healer will seek to understand why the patient became ill in the first place and the treatment administered, will address the perceived cause. This is usually done in addition to specific therapies to alleviate the signs and symptoms of the condition. [204,202]

Tshabalala and Gill [22] are of the opinion that the concept of a "chronic" disease is poorly understood by some cultures and that only acute symptoms are recognised. The finding by Bopape [195] that 95% of patients in her sample knew when their disease was getting better or worse, supports this opinion.

The power of beliefs and preconceptions related to diabetes must not be underestimated. These findings may influence the likelihood that a patient will comply with preventative action. [172] Tshabalala and Gill [22] emphasise the fact that health care professionals should be aware of the guilt, self-blame and confusion, which frequently haunt patients with diabetes. These beliefs of diabetic patients form the basis of their decisions regarding health care.

The conflict between cultural beliefs and the westernised health care system may also contribute to a poor health-related quality of life in diabetes patients.

HEALTH-RELATED QUALITY OF LIFE

Health-related quality of life is a multidimensional construct, encompassing aspects of psychological, social and physical well being. It reflects the patient's subjective evaluation of well being, rather than the health care professional's view. [205]

Type 2 DM is a chronic disease, which may influence the patient's general health and well being in a number of ways. Dietary restriction and the taking of daily medication may affect the patient's health-related quality of life (HQOL). [206]

Quality of life (QOL) may also be severely compromised in Type 2 diabetics, who develop diabetes-related complications. [206,207] The impact of diabetes varies considerably between individuals in both nature and extent. On average, impact is negative for all aspects of life and greatest for "freedom to eat as I wish". [208] There seems to be a relatively weak association between patients' objective health status and their subjective life quality as illustrated by low correlations between subjective well being and HbA1c. [205]

Women in the focus groups conducted by Sameul-Hodge and co-workers [203] reported a considerable amount of stress in their lives due to life-stage, multi-care giving and health. They also reported health-related stress in terms of worry about their disease and feeling tired and nervous.

Tiredness was attributed to multiple causes, including general life stress, physical overexertion and diabetes. The authors concluded that tiredness and the multi-caregiver role could influence self-management by the patient, who would rather rest than do physical activity.

Redekop and co-workers [206] determined the HQOL and treatment satisfaction in 1348 Dutch Type 2 DM patients with a mean age of 64.9 years. Fifty percent of the sample was women. Lower HQOL was reported in women and in patients with a longer duration of diabetes and obesity. Furthermore, the use of insulin and the presence of diabetes-related complications and obesity were associated with a lower HQOL.

Petterson [209] reported that well being and treatment satisfaction is lower in insulin-treated, than in non-insulin treated patients. They also found no correlation between HbA_{1c} and quality of live, indicating that quality of life and glycaemic control is independent outcomes. Treatment satisfaction of the patient depended on the physician's attitude toward the patient and the degree of communication. [206]

Snoek and Skinner [210] performed a literature review to establish whether psychological treatment in problematic diabetic patients is beneficial.
They found limited empirical studies demonstrating the effect of psychological counselling in complicated diabetes. They however, did recommend the integration of psychological services as part of diabetes care, to conduct controlled studies.

Stressful life situations, coping ability and the social environment contribute to a Type 2 DM patient's well being and adaptation to diabetes. [196]

RELAXATION TRAINING

Diabetes patients often report feelings of stress and not coping with their disease. [203] The way people experience and cope with stress, affects whether and how they seek medical care and social support. It also affects the way they will accept self-responsibility and practice positive health habits. [196]

The experience of stress is associated with the release of counter-regulatory hormones and energy mobilisation, often resulting in elevated glucose levels. [199] Stress can also influence diabetes control through effects on diet, exercise and other self-care behaviours. [211]

The Transactional Model of Stress and Coping [212] provides a framework for evaluating the processes of coping with stressful events. Primary appraisal is the patient's view about the significance of his/her illness. Minimised primary appraisals by patients may lower the motivation to adopt the recommended preventive health behaviours. When the patient perceives herself as responsible for the disease, it may generate guilt and depression.

Secondary appraisals are the patient's perceived ability to change the situation, to manage her emotional reactions and self-efficacy. Self-efficacy beliefs predict maintenance of exercise and diet regimens. [179] The outcomes of stress and coping processes are determined by a combination of the environmental factors, the patient's personal characteristics and appraisal of the situation and the coping strategies she employs.

Stress and stress hormones have been shown to have a hyperglycaemic effect on Type 2 diabetics. [199] Individuals with Type 2 DM may have altered adrenergic sensitivity in the pancreas, which could make them particularly sensitive to stressful environmental stimulation. No consistent relationship between stress levels and glucose control has been documented so far.

It is however, recognised that stress may disrupt glycaemic control directly through the effects of stress hormones and via deterioration of self-care behaviours. [210]

Relaxation therapy may be a non-pharmacological means to moderate the negative effects of stress-induced changes in counter-regulatory hormones on the metabolic control in some patients with Type 2 DM, according to Lane et al. [213]

Progressive muscular relaxation is one technique of relaxation training. The patient is instructed to progressively tense, and then relax alternative muscle groups. Suggestions for feeling and imagining the body relaxing are incorporated in between instructions to tense and then relax the next body part. [214]

Although the physiological basis of relaxation therapy is not well understood, it appears to involve a decrease in sympathetic and adrenal cortical activity. [215] Relaxation therapy may serve to prevent the adverse effects of stress-induced increases in sympathetic nervous system activity on the metabolic control of diabetics. [211]

Lane and co-workers [213] postulated that, subjects who had a more external locus of control were more likely to show improvements in glucose tolerance with relaxation, than would subjects with an internal locus of control. They furthermore, suggested that relaxation training should be used in anxious and neurotic patients.

Stress management training can improve glycaemic control in patients with Type 2 DM. [213] It typically includes progressive muscle relaxation, mental imagery, diaphragmatic breathing and instructions on how to modify behavioural responses to stress. [211]

Positive effects of stress management on blood glucose have been reported in several studies. [216,217,211]

Surwit and Feinglos [211] studied the acute effects of relaxation training on glucose tolerance in a population of Type 2 DM patients. They reported a significant improvement in glucose tolerance in the relaxation group. Decreases in plasma cortisol were also demonstrated.

Aikens and co-workers, [218] however, reported no consistent effects of relaxation training on glycaemia in Type 2 DM. Their findings were similar to those of Lane et al. [213]

In 2002, Surwit and co-workers, [211] reported a 0.5% improvement in HbA1c after 12 months. Their study examined the efficacy and feasibility of cost-effective outpatient group-stress management training. This improvement is of clinical importance, since it has been shown that improvements of <0.5% in HbA1c are associated with a significant reduction in risk of microvascular complications. [59]

There may be a particular subset of diabetes patients who benefit from stress management training. Two recent studies by Aikens [218] and McGrady, [216] have demonstrated that low-anxious and stress-unresponsive subjects improved more after stress management training than highly anxious patients.

SUMMARY

Type 2 DM is a complex and chronic disease, that requires continuing medical care. Glycaemic control is fundamental to the management of the disease. Although glucose control is essential for preventing microvascular disease, intensive blood pressure control is also needed to reduce cardio and cerebro vascular incidents in diabetic patients with hypertension.

The dangerous nature of Type 2 DM provides a rationale for searching for therapies, other than pharmacological measures, that may help reverse the hypertension and cardiovascular consequences of the disease.

Data on Type 2 DM in the African population and more specifically women, are scarce and date back to the 1990's. A rising body mass index, obesity and sedentary lifestyles among black women, may be possible indicators of an early stage of a diabetes epidemic. Data on the effect of modernisation, poor education and a sedentary lifestyle on urban black females with Type DM in South African are lacking.

Data on the prevention or delay of Type 2 DM in South Africa are non-existent. The lack of evidence places the emphasis of care on the control of the disease. Once an individual has established Type 2 DM, an increased risk of complications, compared to those without diabetes, exists. The control of glycaemia is therefore, important in the relief of symptoms and the prevention of microvascular disease.

The effectiveness of interventions, aimed at weight loss and increased physical activity to achieve control of diabetes and to prevent its complications, must be subjected to close scrutiny. The standard approach in prevention studies is a combination of weight loss and increased physical activity. The question, whether increased physical activity on its own, can prevent the incidence of Type 2 DM, still remains unanswered. A golden standard for assessing physical activity in this population of patients is lacking. This hampers the generalisation of results of prospective observational studies.

No studies on multifactorial approaches to diabetes care, including physical activity interventions, in South Africa could be identified. Treatment of Type 2 diabetics is still limited to mainly advice about diet, hypoglycaemia agents and education.

The physical activity mostly used in the reviewed studies, was walking. Duration varied from 20 to 60 minutes and the frequency was on average three times per week. The intensity was mostly moderate to brisk and in all studies; participants were encouraged to increase the intensity of walking. Studies with longer follow-up periods seem to demonstrate better results.

Furthermore, the contact between the participants and the health-care professionals seems to be an important factor in adherence to the programme.

While long-term intervention studies in Type 2 DM have demonstrated that intensive glycaemic control can significantly reduce microvascular complications, few long-term randomised controlled trials of behavioural interventions exist. Good evidence that lowering blood glucose as a means of lowering the risk for diabetic complications exist, however, evidence of the impact of physical activity on the long-term complications of diabetes is lacking. This may be attributed to the difficulty of measuring physical activity in free-living populations and the evaluation of intervention programmes where the goal is to measure change in physical activity.

Studies on the effects of physical training in Type 2 diabetics vary considerably in study design, control and the using of non-diabetic controls. Furthermore, there is a wide variation in study methodology, such as exercise testing and type, intensity and duration of exercise prescription in the published trials.

A lack of studies, that demonstrate long-term changes in health behaviour exist, although the study by Irwin and co-workers has contributed to evidence on the effect of regular exercise on body weight and body fat among overweight and obese menopausal women over 12 months.

The art of exercise prescription for Type 2 diabetics has not been mastered. This would include the successful integration of exercise sciences with behavioural techniques, that results in long-term programme compliance and attainment of the individual's goals. The reviewed studies are characterised by a wide variety of exercise test techniques. While the exercise prescriptions in recent exercise interventions vary widely, prescriptions were mostly done in accordance to the prescriptions of the American Diabetes Association and the American College of Sports Medicine's guidelines.

There seems to be no difference in the effectiveness of aerobic or progressive resistance training to decrease HbA_{1c}. Progressive resistance training may be more appropriate in older diabetic populations, because of clustering of conditions such as arthritis, cardiovascular disease, peripheral vascular disease, neuropathy and mobility impairment. Exercise should however be supervised.

On the other hand, aerobic exercise can be incorporated in daily activities and does not have to be supervised. Breaking exercise up into short 10-minute periods, several times a day, is as beneficial as long bouts of exercise in overweight women and can be used as an option for incorporating exercise into one's lifestyle.

The acceptability of the programme to the participant is very important and will determine the success of the intervention. Lifestyle physical activity is as effective as structured exercise, for improving fitness in adults and should be considered to increase participation.

The implementation of a physical activity programme has emotional and physical implications for diabetes patients. Changing of habits, established over a lifetime, such as eating habits and a sedentary lifestyle, is very difficult for the diabetic patient.

Health care professionals are furthermore, faced with the challenge of working with Type 2 diabetics and their families in their community, to change negative health-related behaviours such as a sedentary lifestyle to more positive health behaviours. In order to change long-established behaviours, the participants should take part in the decision making process about their management plan. They should accept responsibility for self-management of their disease.

Patients are generally resistant towards changing unhealthy lifestyle behaviours. Change comes slowly and it sometimes seems that very little is achieved. Information about the disease must be made available to diabetic patients. The patient must believe it and want it.

He/she must also have the time, energy and ability to comprehend this information. The patient must be an active participant in the learning process, for which support and resources must be available. Patients must be taught to identify and control appropriate preventative behaviours. Providing the patient with information about Type 2 DM must facilitate adherence to behaviour change. The patient should understand and believe that he/she can change the outcome of the disease and the importance of his/her health behaviour change.

The health professional should have insight in the patient's personal beliefs about the disease and the stage of behaviour change the patient is at. The health professional – patient relationship should be permeated with trust that the recommended behaviour change is to the patient's benefit. Cultural background influences the acceptance of self-responsibility by individuals with diabetes. The health professional should therefore, know a specific patient's cultural background to address self-management by the patient.

The literature review highlighted the importance of self-management by diabetics and the factors that could influence the outcomes. Little is known about the South African black woman's experience of this chronic disease, her knowledge about the disease and attitude towards the disease. Clinical observations have shown, that women attending the Diabetic Outpatient Clinic at the Mamelodi Community Hospital presented with poor glycaemic control, obesity, and hypertension and lead primarily sedentary lifestyles. While the patients were advised by the attending physicians to increase their physical activity levels, it did not happen.

For a diabetic to change health behaviour she must have knowledge to do so. The intention to change depends on the individual's attitude and beliefs that she can change. Against this background the first research question was postulated as described in Chapter 1 of the thesis. The study is described in the following chapter.

CHAPTER 3

BLACK FEMALE PATIENTS WITH TYPE 2 DM MELLITUS: KNOWLEDGE, ATTITUDES AND PHYSICAL ACTIVITY

INTRODUCTION

Type 2 DM Mellitus is a chronic disease that involves continuous self-care activities. These self-care activities must be followed on a daily basis, usually without direct supervision of a health care professional. [219] Attitudes and beliefs are a major component of health behaviour and adherence to the self-care regimen. Glasgow et al [191] found in a sample of 2000 participants that beliefs about treatment effectiveness to be a better predictor of self-management than perceived barriers to adherence.

According to the Social Cognitive Theory [179] adherence to the treatment regimen is influenced by knowledge, beliefs about one's ability to perform certain behaviours and the value of doing so, the skills to so and incentives for engaging in a particular behaviour.

The Theory of Reasoned Action [220] states that an individual's intention to adhere to the self-care regimen is determined by his/her attitude. Attitudes are determined by the individual's beliefs about the outcome of performing certain behaviour. Knowledge about patients' attitudes toward the disease and diabetes care is therefore necessary to understand their behaviour and to educate them. [221]

AIM OF PHASE ONE OF THE STUDY

The aim of this phase of the study was therefore to obtain baseline data from female Type 2 DM patients on their general health status, demographics, their knowledge of and attitudes towards diabetes and exercise, as well as their current physical activity levels.

METHOD

Ethical clearance for the study was obtained from the Ethics Committee of the Pretoria Academic Hospital (Number 116/99). The superintendent and matron of the Mamelodi Hospital also consented.

STUDY DESIGN

Demographic and quantitative data were captured by means of questionnaires.

SUBJECTS

The convenience sample comprised 93 female Type 2 diabetics between the ages of 36 and 70 years, attending the Diabetic Out-patient Clinic at the Mamelodi Community Hospital, east of Pretoria, in the Gauteng Province of South Africa, on a regular basis. The subjects were invited to participate from the waiting room of the Diabetes clinic (twice a week). The only exclusion criterion was mental incompetence. This research project was conducted simultaneously to a research project on the diabetic foot. Professor P Rheeder and team members conducted the last-mentioned project. Due to the relatively small number of men seen at the clinic, the study was restricted to women with Type 2 DM (diagnosed after the age of 30 years and insulin not used within the first year of diagnosis). Females were also chosen because it was thought that they would be more likely to keep research-related appointment visits than the men. This may have biased the sample.

Patients came for two visits, during which the interviews were conducted and the clinical data obtained. Patients were compensated for their transportation costs.

Data capturing started on the 27th of March 2000 and was completed on the 31st of July 2000. Four to six patients reported daily to the research venue at 08h00 on the morning of their appointments.

Each patient was welcomed, introduced to the research team members and asked the language of their preference. Informed consent was obtained from each patient after the aims, procedures and benefits of the study were explained to them. Subjects had an opportunity to ask questions before the consent form was signed, witnessed and each subject received a signed copy of her own consent form.

INSTRUMENTATION

Demographic, clinical, diabetes knowledge, diabetes attitude and physical activity data were captured.

The Diabetes Knowledge Form C (DKNC) scale was developed by Dunn and associates [29] and has been used in the elderly from a variety of ethnic backgrounds. The scale comprises of fifteen questions sampling knowledge in five broad categories. DKNC scores are expressed as raw scores out of 15, or as percentage of correct answers, with higher scores indicating better diabetes knowledge. The internal reliability (0.76) of the DKNC is moderate and acceptable for use with Type 2 DM –samples. [222] The scale was therefore regarded as valid.

The Modified Baecke questionnaire [30] on physical activity for older adults was developed to enable discrimination between physical active and inactive, elderly people living independently. It consists of scores for household and sporting activities and other physically active leisure time activities, for example gardening.

These scores, classified by an intensity code, together with data on the number of hours spent on the activity and the season of the year in which the activity was performed, resulted in a total activity score. In a study by Voorrips et al [30] the subjects at the upper end of the scale with an activity score higher than 17 were labelled the physically active group. Subjects at the lower end of the scale, with an activity score under 9, were labelled the "sedentary group". (Reliability = 0.89; Relative Validity = 0.72-0.78).

The Revised Diabetes Attitude Scale-III (DAS-III) [31] was used to assess the impact of diabetes education programmes on the attitudes of patients and to explore the relationship between attitudes and behaviour. It consists of five constructs, containing 35 Likert scale items (1, strongly agree; 2, agree; 3, neither agree nor disagree; 4, disagree; 5, strongly disagree). The scale was revised in order to simplify the wording of the original items and to eliminate technical terms and the reading level was lowered from 12th to the 10th grade. It was tested on a sample of 1202 patients, consisting of 65% female patients with a mean age of 50.7 years. The reliabilities for the five sub-scales ranged from 0.61 for the seriousness of Type 2 DM (3 items) to 0.71 for the need for special training (7 items). These reliabilities of the DAS-3 sub-scales are adequate for group comparisons.[31] All the scales were originally developed and validated in English.

RESEARCH PROCESS

ADMINISTRATION OF THE QUESTIONNAIRES

A trained multilingual interviewer was asked to freely translate the questionnaires into the idiom of the community. A second trained interviewer was asked to translate the questionnaires back into English. A pilot study was conducted during which the first interviewer asked the questions, while the second interviewer also completed the questionnaires. The completed questionnaires were then compared to see if the first interviewer interpreted the patients' answers correctly.

The same interviewer was used for the first 45 interviews, after which she was unavailable to continue with the work. A second trained multilingual interviewer was then used to complete the remaining 48 interviews. A trained observer, partaking in the diabetic foot project for the clinical data generally examined the patients and took the following measurements:

CLINICAL MEASUREMENTS

Height was determined to the nearest 0.1 cm using a measuring stick attached to the wall. Weight was determined to the nearest 0.1 kg standing barefoot in light clothing on a calibrated electronic scale (Tanita ®). These measurements were used to calculate the body mass index (BMI) for each subject.

The obtained BMI values were interpreted according to predicted BMI values as published by Manson et al [223] The predicted BMI values are demonstrated in Table 3.1.

TABLE 3.1

PREDICTED BODY MASS INDEX VALUES [223]

CLASSIFICATION	VALUE Kg/m^2
Normal	20-25
Pre-obese	25-29.9
Class I obese	30-34.9
Class II obese	35-39.9
Class III obese	≥40

Blood pressure measurements were taken in a sitting position using the right arm. A period of at least five minutes rest was allowed. A calibrated mercury Baumanometer was used to do the measurements.

Two measurements were taken at least one minute apart. If there was a discrepancy of more than 5 mmHg between readings, a third measurement was taken. The mean of the two closest measurements was used to determine mean blood pressure. (Reference values: Systolic blood pressure: optimal ≤ 130, acceptable 131-150, poor >150. Diastolic blood pressure: optimal ≤ 85, acceptable 86-90, poor >90). [224]

The HbA1c-value, (Beckman LX20®), which give an indication of the average blood glucose concentration over a six to eight week period and is a good monitoring test, was used. In the 88 patients who returned for their second visit 85 sets of blood samples were obtained. In two cases obesity precluded the investigators from obtaining sufficient blood samples. One sample was insufficient for analysis (Reference values: 4.5%-6.5%; acceptable < 2% points above normal; compromised > 2% points above normal).[225,226]

STATISTICAL ANALYSIS

Data were entered into a file on the Statistix -program on the computer, screened for missing values and range checked. Data were analysed using Statistix ®, StatSoft's Statistica® and Stata® software. Data were summarised with descriptive statistics, i.e. mean, SD, median, range, frequency and percentage. Pearson product-moment correlations were employed to assess relationships. Cronbach's alpha measured the reliability of the Revised Diabetes Attitude Scale-3 in this population. Alpha coefficients of > 0.70 was regarded as satisfactory, based on a recommendation by Nunnally.[227] A mean score was calculated for each sub-scale for each individual. Then the sample mean was calculated of the construct averages for the 93 subjects. The sub-scale scores were inter-correlated, using Pearson product-moment correlation.

RESULTS

The results are be presented in the following order:
Demographic, clinical, Diabetes knowledge scale, DAS-3 scale, Modified Baecke Scale and integrated results.
The demographics of this sample by age group, educational level, employment status and housing are provided in Table 3.2.

TABLE 3.2

DEMOGRAPHIC DATA

Demographics variables		N	%
Age	36-39	2	2
	40-49	13	14
	50-59	28	30
	60-69	48	52
	70	2	2
Educational level	None	16	17
	St 1-4	28	30
	St 5-7	34	37
	St 8-10	13	14
	Post St 10	2	2
Employment status	None	23	25
	Part-time	12	13
	Full-time	15	16
	Pensioner	43	46
Housing	Lives with partner	7	8
	Lives with family	81	87
	Lives alone	5	5

Eighty four percent of the sample group had schooling only up to Standard 7 (Grade 9). The sample consisted of 46% pensioners. The majority (87%) of the patients lived with their families at the time of the interviews. All the subjects in the sample were black females.

TABLE 3.3

CLINICAL DATA

Table 3.3 reflects the number of patients, mean, standard deviation, median and range for the clinical data of the sample.

Variable	N	Mean	SD	Median	Range
Age (years)	93	58.29	8.18	60.00	36-70
Weight (kg)	92	78.55	13.83	76.90	51.4-119.4
Height (cm)	92	156.71	5.74	156.20	144.5-173.3
BMI (kg/m^2)	92	31.96	5.14	31.51	20.88-45.61
Systolic BP (SBP) (mmHg)	93	149.94	25.59	147.00	96-205
Diastolic Blood Pressure (DBP) (mmHg)	93	89.09	11.09	90.00	60-120
HbA1c (%)	85	9.82	2.23	9.90	5.3-13.9

N = number of patients

SD = standard deviation

The sample can be classified as Class I obese. Mean score = 31.96 (31.51). Mean HbA1c- levels indicated that the sample group was in the acceptable to compromised category.

Mean systolic and diastolic blood pressure results indicated that the patients were in the acceptable category (mean = 149,94 mmHG). However, for the average systolic blood pressure, 43% were classified as poor control and for the average diastolic blood pressure, 38%.

Seventy five percent of the sample was on oral hypoglycaemic agents, with 21% patients using insulin for their diabetes.
Seventy six percent of the subjects were on treatment for hypertension.

TABLE 3.4

DIABETES KNOWLEDGE

The distribution of the scores in the five broad categories of the Diabetes Knowledge scale questionnaire is reported in Table 3.4.

Each item was assigned a score of one (1) for a correct response and zero (0) for an incorrect response. Items one to 12 in the questionnaire had a single correct answer. For items 13 to 15, several answers were correct and a score of one was allocated if all the answers were correct. Only scores of zero or one were used; for a partially correct answer, a score of zero was allocated.

Category of knowledge	N	Percentage of correct answers %
Basic physiology of diabetes including insulin action		
Insulin use during unusually heavy exercise	93	11
Effect of insulin on blood sugar	93	31
High blood or urine sugar level and insulin	93	13
Hypoglycaemia		
Normal range for blood glucose	93	52
Symptoms not associated with hypoglycaemia	93	38
Causes of hypoglycaemia	93	7
Food groups and substitutions		
Food group rice	93	75
Food rich in carbohydrate	93	73
Food group of which can eat limitless amount	93	54
Food approved by the diabetic clinic	93	0
Special diabetic foods	93	7
Sick day management		
Ill and unable to eat prescribed diet	93	18
Vomiting and diarrhoea	93	0
General diabetes care		
Preparation of food	93	23
Weight control	93	72

The mean (SD) total score of the Diabetes Knowledge scale for the sample group was 4.72 (2.05) and the median was 5.00. Scores ranged from zero to 11 out of 15. The percentage of correct answers was 31%.

A very low percentage of correct answers in the category on the basic physiology, including insulin action was seen. The sample scored higher in the category of knowledge about hypoglycaemia, but did not know the causes of hypoglycaemia. The subjects could answer the questions about basic food groups, but not the questions about special diabetic foods and food approved by the diabetes clinic. They were well informed about weight control in diabetes care, but scored low on the question about food preparation. Their knowledge about what to do when they become ill was nearly non existent.

TABLE 3.5

HOUSEHOLD, SPORT AND LEISURE TIME PHYSICAL ACTIVITY

The distribution of the total scores in household, sport and leisure time activities is reflected in Table 3.5.

Variable	N	Percentage %	Mean	SD	Median	Range
Household activities	93	100	2.05	0.56	2.10	0.10-3.40
Sport activities	3	3	0.01	0.10	0.00	0.00-0.94
Leisure-time activities	72	77	0.79	1.85	0.03	0.00-10.70

The total physical activity score resulting form the Modified Baecke Physical Activity Questionnaire ranged from 0.1 to 13.4. (Median = 2.23) The mean score (SD) for the questionnaire was 2.85 (2.09).

The subjects' physical activities mainly consisted of household physical activities and all the subjects did household physical activities to some extent:

- 62% always did light household work, like dusting, washing dishes, repairing clothes,
- 75% never or sometimes did heavy household work such as washing floors, windows, carrying garbage bags,
- the mean number of persons for whom they kept house was five,
- the mean number of rooms and floors they had to keep clean was one,
- 70% mostly or always prepared warm meals for themselves,
- 62% never used stairs on a daily basis,
- 68% of the sample used transport to move about in their hometown,
- 81% go shopping never or less than once a week and 80% travel by car to go shopping.

Only three subjects indicated that they were participating in a sport (two did bowling and one skipping) at the time of the interviews as can be seen from the low sport activity score.

Fifty-five (55%) of the subjects did physical activities consisting of walking, hand or arm and body movements. Seventy four percent did physical activities for only one to two hours per week and 83% indicated that they did physical activities for a period of less than one month per year.

The patients were asked if they had played any sport at school. Seventy three percent responded that they did take part in sport activities at school.

TABLE 3.6

ATTITUDES TOWARDS DIABETES AND ITS TREATMENT

Table 3.6 presents the descriptive statistics and Cronbach's alpha for each of the defined sub-scales after the items had been excluded.

The mean score for each sub-scale was calculated for the 93 patients. The items, which did not contribute to the reliability of the construct, as measured by Cronbach's alpha were excluded from the final analysis.

Individuals were classified into one of two groups. If an individual's score on a given sub-scale was less than 3.00, she was placed in the positive attitude group (Pos). If an individual's score was more or equal to 3.00, she was placed in the negative attitude group (Neg).

Sub-scale	N	No Of Items	Mean	SD	Range	Cron-bach's alpha	% Pos	% Neg
Special training	93	4	1.87	0.29	1.00-2.50	0.62	98	2
Seriousness of Type 2 DM	93	3	3.04	0.56	1.67-4.0	0.58	24	76
Value of tight control	93	3	2.79	0.49	1.67-3.67	0.55	37	63
Psychosocial impact	93	5	2.20	0.42	1.20-3.20	0.41	67	33
Patient autonomy	93	4	3.95	0.42	3.00-4.75	0.55	12	88

1 = Strongly agree

2 = Agree

3 = Neutral

4 = Disagree

5 = Strongly disagree

Pos = positive

Neg = negative

The mean is equal to the sample mean of construct averages. The reliabilities ranged from 0.41 for the psychosocial impact (5 items) to 0.62 for special training (4 items).

The sample mean reflects that the sample agrees with respect to sub-scale 1: the attitude that the health care professionals who care for patients with diabetes need teaching, counselling and change in behavioural skills. They also agree with respect to sub-scale 4: an attitude that diabetes usually has a substantial psychosocial impact on their lives.

The sample reacted neutrally with respect to sub-scale 2: that Type 2 DM is a serious disease. They also reacted neutrally to sub-scale 3: the relative value of tight glucose control.

The sample disagreed with respect to sub-scale 5, reflecting the attitude that patients should be the primary decision-makers regarding the daily self-care of their diabetes.

Individuals, who scored more or equal to 3.00, were placed in the negative attitude group. A substantial number of the responses for certain sub-scales was a "3", indicating a neutral response. The items with the highest neutral scores were item 21: *" ...Type 2 DM is a very serious disease"* and item 25: *"...Type 2 is as serious as Type I diabetes."*

The Pearson product-moment correlation for the five sub-scales is presented in Table 3.7.

TABLE 3.7

PEARSON PRODUCT-MOMENT CORRELATION BETWEEN SUB-SCALES

No	Sub-scale(SC)	SC1	SC2	SC3	SC4	SC5
1	Special training	-				
2	Seriousness of Type 2 DM	0.29	-			
3	Value of tight control	0.28	-0.01	-		
4	Psychosocial impact	0.41	0.11	0.17	-	
5	Patient autonomy	0.33	0.07	-0.27	0.12	-

No = sub-scale number

SC = sub-scale

The highest correlation between two sub-scales was between the need for special training and the psychosocial impact of the disease (r = 0.41). The remaining correlation was low to moderate, indicating that the sub-scales were measuring relatively independent attitudes; however, it is recognised that the sub-scale reliabilities are attenuating this correlation to some degree.[31]

The following variables were significantly correlated:

- Systolic blood pressure correlated significantly with the sub-scale: seriousness of Type 2 DM on the DAS-3 scale (r =0.22; $p<0.05$).
- Blood glucose correlated significantly with the sub-scale Patient autonomy on the DAS-3 scale (r = 0.28; $p<0.01$).
- Systolic blood pressure also correlated significantly with patient autonomy (r =0.21; $p<0.05$).

No statistically significant correlation between the indices of physical activity and age, BMI and blood glucose was found.

DISCUSSION

The principal findings of this study are that the participants know little about their disease and that they lead a sedentary lifestyle. The participants furthermore agree that diabetes has a negative impact on their lives and feel that health professionals taking care of them should be specially trained. Of importance is the fact that they disagreed with the attitude that they should be involved with decision-making about their health care, indicating a dependence of the health professionals.

The participants come from a cultural tradition where the patient is a passive participant in the consultation process. [202] They may therefore prefer a traditional, hierarchical, authoritarian approach to diabetes care. This factor may constitutes as a barrier to accept self-responsibility by these patients since they must belief that their actions will have an influence on their disease to commit to a change in life style. [220]

The total score of the Diabetes Knowledge scale (4.7), while very low, compares favourably to the score reported by Campbell. [228] He reported total scores of 4.8 to 5.8 out of a possible total score of 15 in a sample of 229 Type 2 DM patients, whose mean age was 59 years and of whom 52% were female. However Beeney and co-workers, [222] reported a mean score of 7.6, in a sample of 460 mostly older Type 2 DM population, which is 50% correct answers compared to the 33% of the current study.

The subjects' higher scores in the categories of knowledge about hypoglycaemia, basic food groups and weight control indicate that they had received some education, most probably at the Mamelodi Diabetes Clinic. The lack of knowledge about the basic physiology of diabetes, insulin action and causes of hypoglycaemia is an important finding, since 97% of the patients were on oral hypoglycaemic agents, insulin or a combination. The lack of knowledge of the subjects is further emphasised by the finding that only 52% of the sample knew what the acceptable HbA_{1c} value was.

On this issue, Beeney and co-workers [222] stated: " Patients with previous formal diabetes education who are not treated with exogenous insulin should still understand the physiological action of endogenous insulin secretion and its role in diabetes."

The low education level and the high mean age of the subjects can be considered as contributing factors to the lack of knowledge, since the ability of the elderly to learn and practise self-care, may be compromised by demographic and environmental factors. [2] Nilsson et al [229] report that the relative mortality risk is increased in women who are less well educated, single living and lacking socio-economic resources. Beckles et al[230] performed a population-based study among 48 315 adults with diabetes in 21 states in America. They found that insulin use, socio-economic status (as judged by level of education), access to care and extent of continuing education (as judged by awareness of HbA1c) were important factors related to diabetes management.

The measurement of knowledge remains important to diabetes management and is essential before an effective educational programme can be implemented. [231] Every patient should be provided with full and accurate information about the underlying patho-physiology of diabetes as a rationale for its treatment. Logically it would seem that more knowledge would enable the patient to put into practice those self-care behaviours, which will contribute to improvement in metabolic control. However, Tu and co-workers [219] performed a study on diabetes self-care knowledge, behaviours and metabolic control of older adults in a sample of 27 Type 2-diabetes patients. Their sample included 18 females and 13 black subjects with a mean age of 65 years. They reported that the focus of education for older adults with diabetes should be placed on effecting changes in self-care behaviours and that adherence should not be measured based solely on metabolic values.

This viewpoint is shared by Lockington et al [232] who did a study on knowledge profile and control on 72 Type 2 DM patients, mean age 58 years. They recommended that for good blood glucose control, a minimum level of knowledge is necessary above which other factors, including attitudes, health beliefs and motivation, are likely to be of much greater importance.

Another important finding of the study was that he subjects scored very low on the Modified Baecke Questionnaire on Physical Activity and clearly leading a sedentary lifestyle. [233] The more active subjects were doing household and leisure time activities, but not on a regular basis. In a study on 255 white postmenopausal women, aged 50-65 years, Cauley and co-workers [234] reported work, leisure and sport indices of respectively 2.7, 3.1 and 2.2. The household score of this study compares favourably with the one reported by Cauley and associates but the leisure and sport indices are much lower than the scores reported by them. Ligtenberg et al [235] showed a mean (SD) physical activity score of 8.7(5.2) in their study on the effects of physical training on metabolic control in 58 Dutch Type 2 DM patients with a mean age of 64 including 38 females. While only the total questionnaire score was reported, it was well above the total score obtained by the subjects in this study.

A decline in physical activity is generally observed with ageing and reduced energy expenditure. If energy intake is not adjusted, it may lead to overweight. The class I obesity status and sedentary lifestyle of this sample are risk factors for cardiovascular disease [225] and they may also lead to complications such as osteo-arthritis of the weight-bearing joints. [236] Overweight and obese people are less likely to engage in physical activity, because excess body weight may increase the difficulty of physical activity and this may lead to functional limitations. [237]

Hays and Clark [238] performed a study to assess physical activity behaviour and its correlates (i.e. physical activity knowledge, barriers and outcome expectations) in 260 older adults with Type 2 DM. They reported that individuals, who were older, had ≤ 12 years of education and perceived their health as fair or poor, were less likely to be physically active. They also showed that socio-demographic variables have an important influence on the odds of being physically active.

All the above mentioned factors are present in this study, such as the mean age of the subjects, the low level of education and clinical data. Therefore the encouragement of physical activity among these patients has become an important goal of preventative medical practice.

However, initiating and maintaining a physically active lifestyle is complex health behaviour. [237] Personal barriers to physical activity participation of these subjects are unknown and should be investigated.

Understanding the self-care behaviour of patients with diabetes and responding to their needs with appropriate patient education requires some knowledge of their attitudes toward the disease and diabetes care. Patients who report high levels of adherence for diet and exercise and monitoring reported higher levels of understanding diabetes, had more positive attitudes toward diabetes and better overall health. [31]

Ninety eight percent of subjects in this study agreed that there is a need for special training of health care professionals taking care of diabetes patients. (Cronbach's alpha = 0.62; Positive answers (Pos) = 98%). This finding shows that patients expect special expertise from their health care professionals. The results of this study correlate with a large study by Anderson et al, [31] consisting of 65% female subjects with a mean age of 51 years. They reported a Cronbach alpha = 0.71 and a percentage of positive answers of 99.7%.

The sample also agreed with the attitude that diabetes had a substantial psychosocial impact on their lives, which suggests that diabetes and its complications detract from the quality of life for most patients. (Cronbach's alpha = 0.41, % Pos = 67%). Anderson et al [31] reported a Cronbach's alpha of 0.68 and 94% positive answers for this attitude. They postulated that patients, who reported high adherence to exercise recommendations, expressed lower agreement on the sub-scale for negative impact of diabetes. The attitude of the participants that diabetes has a negative impact on their lives may therefore be a reason why they do not comply with instructions by the clinic staff to become more physically active. Westaway et al [224] reported that health status and quality of life were poorer for diabetic patients than for well persons staying in Mamelodi.

Pearson product-moment correlation between sub-scales in this study showed that the need for special training for health care workers correlated strongly with the psychosocial impact of the disease ($r = 0.41$). Anderson et al [31] found this correlation to be 0.35 in their study.

However, the neutral and negative responses to sub-scales 2, 3 and 5 are in contrast to results by Anderson and co-workers, [31] who reported positive responses to all three of the mentioned sub-scales. This finding suggests that the patients did not understand all the questions.

The revised Diabetes Attitude Scale was rewritten to eliminate technical terms and the reading level was lowered from the 12th to the 10th grade. However, it is clear that some of the concepts were unknown to the patients in the present study, for instance "*tight control*". One possible explanation may be the average low educational level of the sample. Despite the fact that the second interviewer received similar training to the first interviewer, the use of two interviewers may have influenced the results.

The process of translation of the measuring instruments into the idiom of the community was a limitation of this study. Although the process described by Anderson and associates [31] was followed, the free translation of the questionnaires may have resulted in altering the meaning of certain items. It is suggested that in addition to the translation process that was followed in the present study, diabetes educators, speaking the native language to clarify ambiguous words or terms should review the translated instruments. The instrument should then be pilot-tested with a sample of diabetic patients, and the understanding of each item of the instrument should be discussed with those patients. This may ensure that the patient's understanding of the terms used matches the investigator's definition.

CONCLUSION

In this study, baseline data were captured about the general health status, demographically profile, knowledge of and attitudes towards diabetes and exercise, as well as their current physical activity levels. The sample size was too small for the use of the instruments. Nunnely [227] stated that the sample size should have ten respondents per item in a questionnaire in order to test the reliability and validity of the instrument. However, the results can be used as baseline data. No attempt was made to control for extraneous factors such as stress, physical illness and the use of drugs, which can affect blood glucose levels.

The design of the study was sufficient to obtain baseline data, because all the data were collected at the same time and patients were contacted only once. The study was relatively cheap and easy to carry out, but contributed important new knowledge to our understanding of the female diabetics in Mamelodi.

CHAPTER 4

BARRIERS TO AND EXPECTATIONS OF PERFORMING PHYSICAL ACTIVITY IN FEMALE SUBJECTS WITH TYPE 2 DM MELLITUS

INTRODUCTION

Results form several important studies demonstrate that complications of diabetes can be prevented or delayed by controlling risk factors such as hyperglycaemia, hypertension and hyperlipidaemia. [55,56] Despite knowledge gained through these studies, adherence to treatment guidelines is low. [27]

The results of the first phase of the study have shown that the women with Type 2 DM attending the out-patient Clinic of the Mamelodi Hospital, are typically overweight, have high blood pressure, poor blood glucose control and lead sedentary lifestyles. These findings indicated that their adherence to treatment guidelines were not optimal. A logical next step would be to establish what the barriers to treatment adherence in this population of women would be.

The literature review has shown that patient-based barriers to diabetes care include socio-economic status (SES), out-of-pocket costs and physical access to services, transportation, and availability of health care personnel. It has also been shown that patients of a lower socio-economic standing have worse complication risk factor profiles, including glycaemic control and diabetes knowledge. [240]

Patients in Mamelodi have to travel to the Mamelodi Hospital to attend the diabetes out-patient clinic due to lack of suitable trained primary care providers in the suburb. Patients with lower income may want to see a doctor, but can afford neither the transport nor the hospital fee. It has been shown that such patients were less likely to report good health and had higher HbA_{1c} values. [241]

Access to quality diabetes care may also be a barrier to diabetes care. [242,240] The diabetes out-patient clinic at the Mamelodi hospital services approximately 3000 subjects annually. Routine blood tests are seldom done and only if indicated clinically. [243] The outcomes of the Epidemiology of Diabetes Complications Study have shown that care received from a diabetes specialist is associated with better self-management of the disease. [244]

Health beliefs may also be barriers to diabetes care. A heavier physique is indicative of health and happiness among many ethnic groups. [242] Food eaten and offered is a reflection of social status and prestige in many areas in the African tradition. [245]

Furthermore, the concept of a chronic disease is poorly understood by some African cultures and only acute symptoms are recognised. [22, 242]

Glasgow and co-workers [191] did a literature review on psychological barriers to diabetes self-management and reported that low self-efficacy and low levels of family support contribute to low levels of self-management and diabetes-related quality of life. Diabetes-related distress and depression may also be barriers of effective self-management according to these authors.

AIMS OF PHASE TWO OF THE STUDY

The aims of this study were to investigate the personal and environmental barriers to doing exercise in black females with Type 2 DM Mellitus residing in Mamelodi. The participants' knowledge and perceptions of exercise and the kind of exercise they wanted to do were also investigated. The last aim of the study was to establish the outcome expectations of performing physical activity in this sample of subjects.

METHOD

Ethical clearance was obtained form the Ethics committee of the Pretoria Academic Hospital) Number 116/99). The superintendent and matron of the Mamelodi Hospital also consented to the study.

The initial conceptual framework is presented in Figure 4.1.

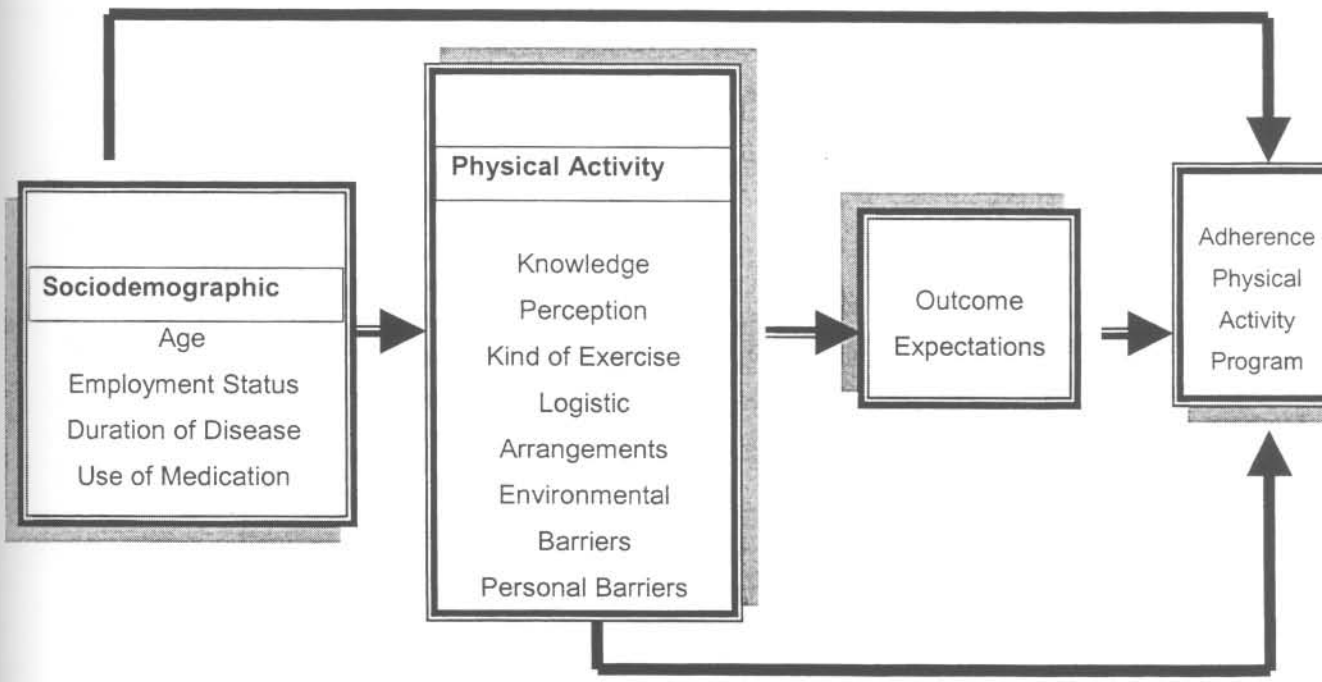

FIGURE 4.1 INITIAL CONCEPTUAL FRAMEWORK OF FACTORS INFLUENCING THE INITIATION AND MAINTENANCE OF PHYSICAL ACTIVITY IN BLACK WOMEN WITH TYPE 2 DM

STUDY DESIGN

Demographic and qualitative data were captured. The phenomenological approach by means of focus group interviews was used to provide an understanding of personal and environmental barriers to doing exercise in this sample of patients. The participants' knowledge and perceptions of exercise and the kind of exercise they wanted to do were also investigated in this way. [32]

SUBJECTS

The convenience, purposive sample consisted of a subset of a larger study that had been conducted one year prior.[246] Twenty-eight black women with Type 2 DM, between the ages of 48 and 70, who participated in the previous study, were contacted by telephone. All the women were attending the Mamelodi Hospital Diabetic Out-patient Clinic in Mamelodi. Subjects from the same gender and socio-economic background were used to ensure homogeneity of the group. [249] The only exclusion criterion was disinterest in doing exercise.

Four to 10 subjects were recruited for each focus group to avoid no shows, an unproductive discussion of too small a group of subjects or the danger that smaller discussions may start in a too large group. [32] Subjects were compensated for their transport costs and were served refreshments and received an incentive after the focus group. The data capturing commenced on the 22nd of March 2001 and was completed on the 10th of April 2001.

INSTRUMENTATION

Structured questions were used. The author developed these questions after a literature review and consultation with colleagues. [32,203] Open, probing questions around a topic were used to get maximum depth in the answers from subjects.

The focus group technique was a cost-effective method to obtain in-depth information from a homogeneous group that may be useful in developing intervention programs for risk reduction of chronic diseases. [247] It was also an effective method of obtaining data from subjects with a low educational level. [248]

The exploratory approach was followed to understand the needs, language and beliefs of the sample and to gain insight into the subjects' thoughts about exercise and what their thoughts on possible barriers were. Their outcome expectations could also be established this way. [249]

The open response format of the focus group provided an opportunity to obtain large and rich amounts of data in the participant's own words. However, generalisation of the results is difficult, because small numbers of subjects are interviewed and they are usually not randomly selected.

SETTING

The focus groups took place in a relaxed, informal setting at the Mamelodi Day Hospital, which was accessible, convenient, non-threatening and accepting to the participants and encourage open discussion. It had adequate seating, ensuring maximum opportunity for eye contact with both the facilitator and other group members. The two audio-tape recorders were placed centrally to ensure good quality recording.

INTERVIEWS

A skilled and expert group facilitator, a qualified physiotherapist, who was knowledgeable about Type 2 DM and familiar with group dynamics conducted the interviews. She also translated the questions into isiTswana.

A fieldworker, a qualified Tswana speaking nurse, was trained to take detailed field notes and record behavioural data.

The research team met beforehand to prepare the venue, test the equipment and to clarify each member's role. The focus groups were conducted in isiTswana.

The first question was simple and neutral to allow the participants to feel comfortable and the get to know a little bit about the other persons around the table and to allow rapport to be established. All the questions were addressed the group as a whole, taking care not to single out individual participants. The questions logically progressed from the general to the specific and were asked in the four main categories. The questions are presented in Table 4.1.

TABLE 4.1

QUESTIONS USED FOR INTERVIEWS DURING FOCUS GROUPS IN ENGLISH AND isiTSWANA

Knowledge and perceptions / *Kitso*
Do you want to do exercise?
A o batla go ikwetlisa?
What do you perceive exercise to be?
Go ya ka wena, o akanya gore go ikwetlisa ke eng?
Why do you think it is important to exercise?
O akanya gore botlhokwa ba go ikwetlisa ke eng?
Logistical / *Ditlhomamiso*
What sort of exercise do you want to do?
Ke mokgwa ofe o batlang go ikwetlisa ka one?
Do you want to exercise on you own or in a group?
A o batla go ikwetlisa oleng mong kgotsa le batho ba bang?
What is the best time of day for you to exercise and where do you want to exercise?
Ke nako efe va letsatsi e e gosiametseng go ikwetlisa?
Where do you want to exercise?
O batla go ikwetlisa felo gofe?
Environmental and personal barriers / *Dikgoreletsi*
What will keep you from exercising?
Ke eng se seka go thibelang go ikwetlisa?
What would make you leave and exercise program?
Ke eng se seka dirang go re o tlogele go ikwetlisa?
What would make you stay in an exercise program?
Ke eng se seka dirang gore o kgothalle go ikwetlisa?
Expected outcomes / *Ditlamorago*
How do you think you can benefit from doing exercise?
O akanya gore ditlamorago tse mosola tsa go ikwetlisa mo go wena e ka ba eng?
How do you want to feel if you exercise?
Maikutlo a gago, o batla a bajwang morago ga go ikwetlisa?

RESEARCH PROCESS

The subjects reported on the day of their appointment to the research venue at 09:00 in the morning. Each subject was welcomed and introduced to the research team members. Informed consent was obtained from each patient after the aims, procedures and possible benefits of the study were explained to them. Subjects had the opportunity to ask questions before the consent form was signed, witnessed and each subject received a signed copy of her own consent form. A short demographic questionnaire was then completed.

The subjects, who consented to the study, were thanked, given a nametag to provide a basis of building greater rapport between the facilitator and the participants. It also enabled the facilitator to direct questions at a group member by name and simultaneous eye contact. It also develops greater identity and cohesiveness between the group members.

The facilitator welcomed the participants and introduced herself and the fieldworker. Subjects were asked to introduce themselves as an icebreaker. The facilitator explained the purpose of and the course of the focus group discussion. The importance of each participant's contribution was stressed. The rules for the group discussion were given and the role of the fieldworker was explained.

The use of the two audio-tape recorders was explained and subjects were ensured that the recordings will only be listened to or looked at by the researcher and that the participants will stay anonymous.

A definition of physical activity and exercise was given. The research question was put forward and participants were asked to participate in the discussion. The facilitator addressed the questions to the group as a whole and no subject was singled out. Asking inquisitive questions, using summaries and reflection, without interfering with the dialogue of the interview, facilitated active participation of all group members.

The fieldworker documented the order in which subjects spoke to aid voice recognition of the recording. Non-verbal behaviour such as eye contact, posture, gestures between group members were also documented.

After the focus group, subjects were thanked and acknowledged for the useful information. Teas and eats were served.

Debriefing with the research team was done to discuss important information during the post-group discussions.

The focus groups with different participants were conducted until a clear pattern emerged and subsequent focus groups repeated information. [250,251]

POSSIBLE SOURCES OF BIAS

Multiple focus groups were held to decrease threats to external validity. Careful selection and training of the facilitator in the manner of questioning, reduced bias in data collection. Aggressive and dominant subjects were prevented from taking over the discussion.

STATISTICAL AND DATA ANALYSIS

Demographic data were entered into a file on the Statistics – program on the computer, screened for missing values and ranged checked. Data were analysed using Statistics ® software. Data were summarised with descriptive statistics: mean, SD, median, range, frequency and percentage.

The qualitative data were analysed using a grounded theory approach. [251] The tape recordings were transcribed in extenso. The Tswana transcripts were transcibed and then translated into English by a trained multilingual nurse working at the Mamelodi hospital. Detailed field notes were made both during and immediately after the observations at the hospital.

Transcripts were read through several times by the researcher to get a sense of common themes that were relevant to the research question. [251]

OPEN CODING

Line-by- line analysis was done to generate categories. Notes were made, throughout the reading on general themes in the transcripts. This enabled the researcher to become more fully aware of the participants' frames of reference. Open coding was done by reading through the transcripts again and by making as many headings as necessary to describe all aspects of the content. These headings formed the concepts identified.

AXIAL CODING

Similar concepts were then grouped together into broader categories. In this way the numbers of categories were reduced. Repetitious and very similar headings were removed to compile a final list of categories. These were then coded. [251]

IDENTIFICATION OF THEMES

Making connections between the categories identified the most important themes from the data. From this, the theory or relationships between categories could be identified. [251]

RELIABILITY CHECK

An independent qualified physiotherapist, who is also a qualitative researcher, was asked to review subsets of the data and to generate categories without seeing the researcher's list. In this way researcher bias was reduced. Lists were compared, discussed and adjustments were made.

The degree to which the chosen categories covered all aspects of the interviews were evaluated and adjusted. Each transcript was then worked through with the list of categories and sub-headings and coded according to it. Ten percent of the data was given to an independent researcher for a reliability check at the researcher's coding scheme. A percent agreement was performed between independent researcher's and the researcher's codes. The use of the codes that were unclear was identified.

Decision rules were created to clarify the use of the codes that were unclear. Another small subset was then re-coded until the inter-rater reliability was 85%.

This process ensured that the researcher's codes and categories were understandable, exhaustive, mutually exclusive and independent. [251]

Each coded section of the interview was then cut out of the transcript and all items of each code were grouped. The cut out sections was pasted onto sheets, headed-up with the appropriate headings and sub-headings. All sections were filed together for direct reference when writing up the findings. Copies of the complete interviews and the audio tape recordings were kept in a save place.

TRUSTWORTHINESS OF THE DATA

Credibility of the data was obtained by the fact that the researcher did not facilitate the focus groups. In this way the researcher could not have influenced the subjects with her knowledge in the field (*reflexivity*).

Field notes were kept throughout the research process. The researcher discussed the research process and findings with an impartial colleague who has experience with qualitative research (*triangulation*).

The transferability of the data was improved by providing a dense description of the background information on the subjects. The description of the exact methods of data gathering, analysis and interpretation contributed to the auditability of the study. A colleague, who was not involved in any other aspects of the study, but who is familiar with the process of category generation was asked to read through two transcripts and to identify a category system. It was then discussed with and compared to the researcher's category system (*confirmability*).

The exact language of the interviews was analysed with meaningful segments of speech (*thick low inference data*).

RESULTS

The results are presented in the following order:
Demographic, focus group data and integrated results.

DEMOGRAPHICAL DATA

The demographics of this sample by ethnicity, employment status, receiving pension, duration of diabetes and type of medicine used are provided in Table 4.2.

TABLE 4.2

DEMOGRAPHICAL DATA

Demographics		N	%
Ethnic group	North Sotho	5	18
	Ndebele	4	14
	Zulu	5	18
	Mopaedi	3	11
	Tswana	5	18
	Tsonga	2	7
	Other	4	14
Employment status	Full day work	1	4
	Part-time work	1	4
	Unemployed	26	92
Pension	Yes	14	50
	No	14	50
Duration of disease (years)	1-4	8	29
	5-7	7	25
	8-10	4	14
	11-13	4	14
	17-19	2	7
	20-22	3	11
Medication	Insulin injections	5	18
	Tablets	23	82

The mean age of the sample group was 60,18 years (6.55). Ages ranged from 48 to 70 years, with a median of 60.5. Other ethnic groups included single Coloured, Mopele, Moswazi, and Motebele subjects. All of the metioned ethnic groups could understand and speak Tswana.

FOCUS GROUP DATA

The subjects were relaxed during the focus groups. They laughed easily and used a lot of hand signs and body movements during talking. Three subjects got up and demonstrated how they would do certain household tasks.
The following categories were derived from the data:

- Perception of exercise.
- Personal barriers.
- Environmental barriers and logistical arrangements.
- Outcome expectations of an exercise program.
- Adherence to an exercise programme.

PERCEPTION OF EXERCISE

All 28 subjects reported that they were doing household chores and that they saw that as a way of exercising. Household chores consisted of doing laundry, going to the shops, cooking, washing, gardening, cleaning the home, carrying a baby on the back.

Walking as a way of exercising was mentioned 40 times during the 5 focus groups, however the intensity of walking ranged from walking far distances to a walking as a possible way to exercise.

Two of the participants put it like this:
" I always walk distances and I do household chores and that way I exercise"
" To me exercise means going to the garden to water my crops and harvest and then go home. When I arrive home, I clean the yard and then I sit down. In the afternoons I take a walk around my yard."

Subjects also expressed the following benefits of exercise:

TABLE 4.3

SUMMARY OF IDENTIFIED BENEFITS OF EXERCISE

Identified Benefit	N	Frequency of response	Percentage %
Weight loss	28	9	32
Better circulation	28	6	21
Helps for Arthritis	28	17	61
Body stay healthy	28	6	21
Constipation	28	1	4
Sleep better	28	1	4
Improve blood sugar	28	10	36
Feel better	28	7	25
Relaxes them	28	5	18

In the words of one of the participants: "*Sometimes when you wake up, you are not feeling well, sometimes you meditate about your problems, but when you exercise, you don't concentrate on those things and you become happy and you believe that everything will be fine.*"

PERSONAL BARRIERS

Subjects expressed psychological and physiological barriers to exercise. Psychological barriers were stress-related, not feeling well and forgetfulness.

"When you arrive home an you feel bad and you meditate on other things in life and your sugar level goes up…."

"I am meditating a lot about my problems and you know diabetes makes you forgetful"

" I am always on and off and I can't be active"

Several subjects also mentioned that their bodies were *" already sick with diabetes".*

Two subjects also felt that they had lost too much weight.

Two more subjects indicated that they were too lazy to exercise. *" I know that we are supposed to exercise, its just that we are so lazy to exercise"*

Subjects also indicated that they did not know what other exercises to do apart from walking and doing household chores and that they were not used to make choices regarding health care for themselves. One subject was of the opinion that people would think that she is insane if she exercise, it is for older people.

Two other subjects indicated that they did not want to lift their legs in lying, did not like running around and that they did not want to wear gym clothes.

One subject felt that diabetes patients were not treated well at the Diabetes clinic and had to wait long time to see the doctor, only not to be informed about their illness.

"Sometimes you come in very tired and the doctor do not tell you anything….. "

Physiological barriers to exercise are presented in Table 4.4

TABLE 4.4

SUMMARY OF PHYSIOLOGICAL BARRIERS TO EXERCISE

Identified Physiological barrier	N	Frequency of response	Percentage %
Tiredness	28	10	36
Arthritis	28	10	36
Foot problems	28	6	21
Sore body	28	4	14
Respiratory problems	28	3	11
Other illnesses	28	2	7

ENVIRONMENTAL BARRIERS AND LOGISTICAL ARRANGEMENTS

The lack of a convenient venue to do exercise in was the main environmental barrier. Sixty-one percent of the subjects staying in different areas of the Mamelodi community indicated that the Mamelodi Day Hospital was too far to travel to on a regular basis. The subjects wanted a venue for diabetics only, because they felt that there would not be harmony if other people joined the group. The venue should be easily accessible due to the cost of transport. They did not want to do exercises on Thursdays, because it is the day when they go to church. The majority of the subjects also felt that the exercise classes should not be on a clinic day, due to the long waiting periods at the clinic.

One subject mentioned that the community members were impatient with the older people, walking slowly.

OUTCOME EXPECTATIONS

Subjects had the following outcome expectations from an exercise program:

- Better health

  "When you wake up, you should not feel tired and heavy; your body must be flexible"

- Improved quality of life

  " We want to have a good life, there is nothing that can conquer a good life"

- Education

  "Apart from exercises, we need some advises one how to handle the illness and how to deal with problems like stress"

- Weight loss

  " It will help me reduce my appetite, because people with diabetes eat a lot"

- Stress relieve

  " I want to feel relaxed and peaceful….now after we have exercised we will be laughing and we will feel very good afterwards"

- Better control of the HbA_{1c}

  " I will remember that my sugar level is high"

- Group support

  " Advises that we can give each other, as we meet and chat"

- Fun

  " Attending exercises to be fun, so that we always want to come back again next Tuesday and that you will be looking forward to that day"

ADHERENCE TO THE PROGRAMME

The factors considered by the subjects to influence their adherence to an exercise programme are presented in Table 4.5.

TABLE 4.5

FACTORS INFLUENCING ADHERENCE TO THE PROGRAMME

Positive influences	Negative influences
• A program suitable for their physical abilities • Good working relationship • Group support • Only diabetes patients • Agreement with program • Patience of presenters of program • Improvement in health	• Visitors • Illness • "Not feeling well" • Social responsibilities • Household chores • Cost of transport • Family affairs • Difficulties at home • Tiredness • Laziness

Subjects felt that they were compelled to try the exercises if they were serious about their health.

"We won't stop as soon as we have started, it is not possible, we follow what we have been told…but if you are disrespectful you will not come to exercise"

DISCUSSION

Qualitative research methodology was used to improve the understanding of the perception of exercise, personal and environmental barriers to doing exercise and outcome expectations of an exercise program in a sample of mainly older female Type 2 DM Mellitus patients, attending the Mamelodi Diabetes Clinic. The sample group consisted of 11 ethnic groups of whom 92% were unemployed. The duration of the disease ranged from one to 22 years and 82% of the patients were using oral hypoglycaemic agents.

PERCEPTION OF EXERCISE

All 28 subjects reported that they considered doing household chores namely gardening, housework and walking as exercise. This perception of exercise by the sample corresponded well with the types of physical activity for older people as documented by the World Health Organisation. [252] It also correlates with the role of women in the African tradition, where the younger women usually do the hard physical work, while older women look after the home and small children. [23] Walking is done at a slow place when attending community functions and going to church. Kriska, [253] also reported that housework and family care taking, appears to take a substantial portion of the total energy expenditure of women in an average day.

In spite of this finding, the results of the first phase of the study demonstrated that the subjects were leading a sedentary lifestyle. [246] It makes therefore good sense to include the activities considered by the sample to be exercise in any planned intervention.

Overall, evidence points to the benefit of continued regular moderate physical activity. It does not need to be strenuous or prolonged and can include at least 30 minutes of daily leisure activities such as walking or gardening, which are readily attainable by this sample group. [254,255]

PERSONAL BARRIERS

Personal barriers are patients' representations of their illness, including disease-related beliefs, emotions, knowledge and experiences. Subjects in this study expressed lack of knowledge, psychological and physiological barriers to exercise. These findings correlate with the results of a recent study by Samuel-Hodge and associates [203], on the influences on day-to day self-management of Type 2 DM among African-American women. Being tired can be attributed to multiple causes including general life stress, physical exertion and diabetes. Older adults with diabetes are often incorrectly stereotyped as being slow and unmotivated in managing their diabetes. Diabetic complications can interfere with sleep and increase the risks of falls. Fear of falling will force patients to reduce their mobility.

Sameul-Hodge and co-workers [203] who reported that health-related stress was described in terms of "worry" and feeling "tired", have also described the psychological impact of Type 2 DM. According to Glasgow et al, [191] diabetes-related tiredness may be caused by the psychological impact of the disease on the patient in terms of fear and worry about the disease. This is also demonstrated by the following quotations by participants in this study: *"I am meditating a lot about my problems "*and *" I am already sick with diabetes".*

The physiological barriers can be attributed to a sedentary lifestyle and complications of Type 2 DM, such as hypertension and macro-vascular disease. [2] Bopape [195] examined the beliefs and attitudes of patients with Type 2 DM in the Northern Province of South Africa and reported that patients, who were diabetic and hypertensive, reported that they were short-tempered. They also complained about complications such as dizziness, fatigue, exhaustion, disrupted sleep, blurred vision and foot cramps.

The lack of diabetes knowledge can also contribute to health-related stress: *"Sometimes you come in very tired and the doctor does not tell you anything."*

Subjects indicated that they did not know what other exercises to do apart from walking and doing household chores and that they were not used to make choices regarding health care for themselves. In a recent focus group study on African American women's exercise barriers the following was stated: "We as Black women have not been taught about exercise, where this is like a luxury thing. I was not taught the value of exercising or eating right until I got to be an adult..." [256]

The Consumer Information processing theory [175] states that knowledge is essential for patient to make a decision to start exercising. The World Health Organzation [173] states that an individual would have to have technical knowledge and skills of the required health behaviour. An effective diabetes management program must therefore address these barriers. It should also respect an individual's habits, routines and lifestyle and incorporate social support. [184]

ENVIRONMENTAL BARRIERS

The lack of a convenient venue for exercise was the main environmental barrier mentioned by the majority of the subjects. The women with Type 2 DM in Mamelodi stay in nine different divisions spread over an area of 48,9km ^{2}. Community resources and venues are scarce and usually used for several other community activities. Others have also reported no access to exercise facilities, cultural appropriateness of women walking alone and their safety. [32,108,151]

OUTCOME EXPECTATIONS

The major expectations of the subjects were that the exercise programme would improve their functional capabilities, increase their knowledge and improve their well being. These outcome expectations support findings by Crosson, [256] who reported outcome expectations such as decrease in weight and release of stress in her focus groups with African American women.

The findings of the current study also correlate with findings from the study by Maillet et al. [32] She reported that subjects wanted education and support from their families.

ADHERENCE TO EXERCISE

Researchers have been unable to conclusively distinguish strong characteristics of exercise adherence and exercise non-adherence. [174,192]

The following categories could however be identified:

- Attitude towards exercise
- Support by significant other persons
- Perception of control
- Motivation

The responses of the subjects in the present study have shown that the same categories will also influence their adherence to exercise. Subjects had a positive attitude towards exercise, because they had a good perception of exercise and knew what the benefits of exercise were. The need for support by significant other persons was expressed by their need for good working relationships, patience by the presenters of the exercise program and group support. The respondents wanted to have control in the program by stating that it should be suitable for their physical abilities, that they should agree with the program and that it should be for diabetic patients only.

The negative influences on adherence to exercise mentioned by the subjects may be an indication of poor motivation to do exercise. Extended adherence and compliance with behaviour changes is a critical factor in the success of a diabetes self-management programme. However, the decision not to comply with such a program may be quite reasonable, particularly if the program does not meet patient expectations, is inconvenient or conflicts with other priorities, such as social responsibilities, household chores and family affairs. Exercise is voluntary and time-consuming. It can therefore interfere with other activities and responsibilities of daily life. [27]

Oldridge and Spencer [257] have shown those barriers to exercise; specifically lack of spouse support and inconvenience was associated with the highest risk for dropout from an exercise program.

CONCLUSION

It can be concluded from the results of this qualitative study that the subjects had a good perception of exercise. They knew the benefits of exercise and wanted to have a better quality of life by means of feeling better and improved functioning on a daily basis.

However personal and environmental barriers may contribute to a risk for dropout from an exercise program if it is not addressed. Patient beliefs, attitudes and behaviours are influenced by cultural and socio-economic factors and are important. The relationship of culture to health beliefs, attitudes and behaviour is especially important in the treatment of diabetes, which usually includes changing patterns of eating, physical activity and other culturally embedded behaviours. If a diabetes exercise program is to effective, it must be sensitive and relevant to the culture of the people expected to carry them out.

It is clear from the results that a co-ordinated team approach is needed to address these outcome expectations. Clark et al [142] also endorses such an approach in a recent publication on changing the way diabetes is treated.

The findings of this study contributed to the planning of the exercise intervention in a number of ways. Since the subjects indicated that they their perception of exercise was doing household chores and walking, it was incorporated into the home-exercise programme.

The patients also expressed lack of knowledge about exercise and it was therefore decided to have fortnightly educational and exercise sessions at the Mamelodi Hospital to educate the patients, to supervise the home-programmes and to improve exercise skills. The conceptual framework was therefore revised and is presented in Figure 4.2.

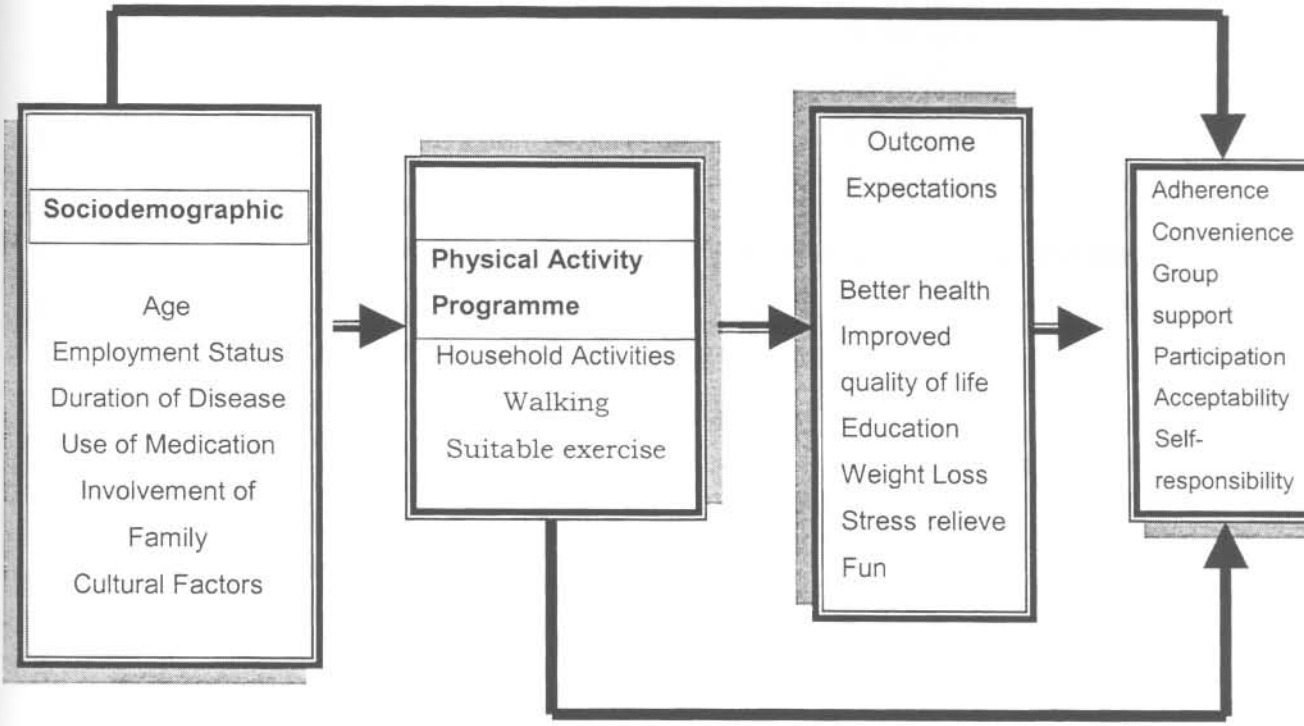

FIGURE 4.2 REVISED CONCEPTUAL FRAMEWORK OF FACTORS INFLUENCING THE INITIATION AND MAINTENANCE OF PHYSICAL ACTIVITY IN BLACK WOMEN WITH TYPE 2 DM

The Mamelodi hospital physiotherapy department was chosen as an exercise venue, since participants who would be recruited to take part in the study came from the all the sections of Mamelodi. They all know the hospital well, since they come there for follow-up visits on a regular basis.

Furthermore, due to logistical, resource and financial constraints it would not have been possible to do and control the planned intervention in the different sections of Mamelodi. The intervention is described in Chapter 5.

CHAPTER 5

EFFECT OF EXERCISE ON HAEMOGLOBIN A_{1C} IN BLACK FEMALES WITH TYPE 2 DM MELLITUS

INTRODUCTION

A small increase in physical activity has benefits on health outcomes including all-cause mortality. Evidence obtained from several recent randomized controlled trials have shown that increasing physical activity has beneficial effects on metabolic control over and above its effect on weight. [12,57,126,133]

The cornerstones of diabetes care in South Africa are education, medical nutritional therapy, hypoglycaemic agents and exercise. [8] However, the overall physical activity level (activities of both daily living and occupational physical activity) have been shown to be low in this population, as demonstrated in an earlier study in a similar population. [246]

A qualitative study in a subset of the population has shown that patients are keen to do exercise, but lacked knowledge about exercise as well as a venue in which to do exercises. [258]

The aim of this final phase of the study was therefore to establish the efficacy of an exercise intervention to decrease $HbA1_c$ over a period of 12 weeks, in Type 2 DM black female subjects, aged 40 to 65 years. Secondary outcomes to be assessed were body mass index, walking distance and the subjective experiences of the subjects.

METHOD

ETHICAL CLEARANCE

The Protocol and Ethics Committee of the University of Pretoria approved the study (Appendix 2).

The superintendent, the chief executive officer of the Mamelodi Hospital and physicians providing medical services at the diabetes out-patient clinic were informed about the study and their approval was obtained.

Each subject gave verbal consent prior to the baseline testing when she was recruited to take part in the study. When the participants reported for the baseline testing, they received information about the study in their own language and had the opportunity to ask questions. If the participants indicated that they were willing to take part in the study, they were requested to give written informed consent. Each participant received a signed copy of the consent form (Appendix 2).

STUDY DESIGN

A single blind, randomised controlled clinical trial design was used for the study. The two groups differed only with respect to exercise being prescribed for the one group. Subjects, who arrived for the baseline test, were randomised into either an exercise group or a control group by means of block randomisation by computer. (http://www.randomisation.com). [33]

HYPOTHESIS

An exercise / physical activity intervention will decrease the HbA_{1c} by 1% given a SD of 2.23% with α=0.05 and β=0.10 in a sample of 144 female Type 2 DM patients, aged 40 to 65 years.

SAMPLE SIZE

A total sample of at least 144 subjects, with 72 in the experimental and 72 in the control groups, was necessary to detect a difference of 1% in HbA_{1c} levels (assuming an SD of 2.23%) between the two groups at the end of the 12 weeks trial period. For an one-sided test, improvement would only be considered if α=0.05 and β=0.10 with a power of 80%. In anticipation of a possible dropout rate of 10% it was decided to recruit 80 participants for each group.

SUBJECTS

The study was conducted at the Mamelodi Day Hospital, east of Pretoria, in the Gauteng Province of South Africa. The study participants were black females between the ages of 40 and 65, with Type 2 DM and a known duration of the disease for at least one (1) year. All participants were residents of the suburb of Mamelodi and attended the diabetic out-patient clinic at the Mamelodi Hospital on a regular basis. Due to the relatively small number of men seen at the clinic, the study was restricted to women with Type 2 DM. Females were also chosen because it was thought that they would be more likely to keep research-related appointment visits than the men. This may have biased the sample.

The recruitment of subjects commenced on 26 February 2002 at the diabetic out patient clinic. The clinic was conducted on Tuesdays and Thursdays at the Mamelodi Hospital. Subjects were approached individually, while they were waiting to see the doctor. The researcher introduced herself to each subject, requested permission to look at the subject's file, as well as to ask the subject a few questions. All consecutive eligible subjects attending the clinic over a period of six months were approached and invited to take part in the study. Duration of diabetes was not recorded.

Subjects were screened for chest pain on effort, possible infarction and intermittent claudication, cerebro-vascular incidents, arthritis, macrovascular disease, general health and retinopathy by means of the London School of Hygiene Cardiovascular Questionnaire [259] (Appendix 3). Cases where there was uncertainty regarding the aforementioned conditions were referred to the attending specialist physician (PR), for clinical evaluation. Subjects were not tested for HIV infection.

Subjects were excluded from the study in the following instances:

- Mental incompetence
- Inability to walk
- Chest pain on effort
- Self-reported history of myocardial infarction
- Intermittent claudication grade 2
- Autonomic neuropathy
- Respiratory dyspnoea
- Heart failure
- Stroke
- Severe limiting osteoarthritis
- Wounds on or infections of the feet
- Presence of other major diseases
- Previous laser therapy for the eyes
- Pregnancy
- Full-time employment
- Plans to move from the area during the study period.

Subjects' files were marked with a small green sticker, with a note to inform the attending physician of the subjects' intended participation. The presence of a green sticker on a file also helped the researcher to identify subjects who were recruited but did not turn up for the baseline test.

If a subject was still interested in taking part in the study, a new appointment date for baseline testing was made.

After preliminary verbal consent was obtained, an appointment was made for the baseline test on the first Wednesday that was convenient for the recruited subject. This was done to ensure that the recruited persons did not forget about the project or lose interest. Appointments were made for 08h00, 09h00 and 10h00 to prevent unnecessarily long waiting periods. [258]

Recruited persons received a typed reminder with the date of the appointment on it. The subjects, who had telephones, were reminded telephonically two days prior to the appointment day. A new appointment was made if the previous set date no longer suited them. Subjects who were booked for the baseline test, but did arrive were telephoned, and if the subject still verbally consented, a new appointment date was set. The subjects, who did not have telephones, were again approached when they had a follow-up visit at the diabetes clinic. A new appointment date was set if the subject still consented to take part in the study.

THE RESEARCH TEAM

The principle researcher, who was not blinded to the randomisation of the subjects, did the administrative work, for instance phoning for randomisation, paying of the transport and the making of the next appointments.

The research assistant, a multilingual registered nurse, was employed and trained to capture the demographic and clinical data and to administer the translated questionnaire. She was not present during the randomisation of the subjects, nor did she receive a list with the names of the subjects or the randomisation.

A nurse from the Institute of Pathology took all the blood samples for HbA_{1c} testing. Samples were marked with the subjects' research numbers and were collected by a courier from the Institute of Pathology.

The nurse who took the samples and the laboratory technician were both blinded to the randomisation of the subjects.

The dietician at the Mamelodi hospital who gave the lectures on diet was also blinded.

IDENTIFICATION OF SUBJECTS

A study number, consisting of the first two letters of the surname of each subject and a number was allocated to each subject prior to randomisation. If for instance, Constance Mothabeng (fictitious name) was the 50th patient who consented to take part in the study, she would be allocated the number "MO50". This number was then used on all assessment forms, the questionnaire and the blood samples of the patient. Therefore no person other than the author was aware of the randomisation of the patient.

RANDOMISATION

The principal researcher prepared 180 envelopes with either the letter A or B enclosed in each envelope. The letter A indicated the exercise group and B indicated the control group. The envelopes were then sealed and put in order according to the computer-generated randomisation list. Subjects were randomised into either an exercise group or a relaxation group in 17 blocks of 10 each. The envelopes were put in a holder and kept in an administrative office at the Department of Clinical Epidemiology, Faculty of Health Sciences at the Pretoria Academic Hospital. When a subject reported for the baseline test and consented to take part in the study, the principle researcher telephoned the administrative office and the next envelope was opened and the contents read to the researcher over the telephone. The name of the subject was then written on the opened envelope and it was returned to the holder. The list of subjects and their randomisation was kept in a safe place by the researcher.

To further ensure that the research assistant was blind to the randomisation of the participants, the only form of identification on the questionnaires, EDTA-tubes and the clinical data forms, were the study numbers of the subjects.

PILOT STUDY

On 13 March 2002 a pilot study was conducted on six subjects to test the research procedure. The data of these six subjects were included in the pre-test and post-test data with the rest of the sample.

INSTRUMENTS

The American Diabetes Association's Position statement on Diabetes and Exercise [25] was used as the basic reference for the planning of the clinical evaluation at baseline.

Demographic, clinical and quality of life data were captured. A structured questionnaire was used to obtain information on general health, well-being and treatment satisfaction. The questionnaire was available in English, Afrikaans, isiPedi/isiSotho/isiTswana and isiZulu (Appendix 3). The questionnaire had been standardised and validated by testing it on 85 black diabetic subjects attending the Kalafong and Pretoria Academic Hospitals during October/ November 2001. [260]

The questionnaire consisted of three sub-scales.

GENERAL HEALTH

The 5-item health perception sub-scale from the 36-item abbreviation of the Rand Medical Outcomes Scale (SF-36) was used to measure general health. [261] Each item is scored on a 1 to 5 basis, with the score reversed on the first, third and fourth items. Item 1 was re-scored to indicate the unequal intervals in the ordinal response scale: 1 = 5; 2 = 4.36; 3 = 3.43; 4 = 1.99 and 5 = 1 more accurately.

Scores were then transformed linearly from zero to 100, where zero and 100 are assigned to the lowest and highest scores, respectively. The cut-off points for poor general health is a score of 70 or less. Reliability coefficient for the scale was 0.98. [260]

THE DIABETES TREATMENT SATISFACTION QUESTIONNAIRE (DTSQ)

This questionnaire has been specifically designed to measure satisfaction with diabetes treatment regimens in people with diabetes. [262] The scale consists of six items that measure satisfaction and two items that are concerned with hypoglycaemia and hyperglycaemia. Subjects rate their treatment and experience over the past two weeks on a six-point scale ranging from six (very satisfied/convenient/flexible/definitely recommend) to zero (very dissatisfied/inconvenient/inflexible/definitely not recommended). Scores are totalled to give an overall treatment satisfaction score (range 0-36) with higher scores denoting greater treatment satisfaction.

The hypo/hyperglycaemia items are also rated on a 6-point scale, ranging between six (most of the time) and zero (none of the time). Scores are totalled to give an overall blood glucose control score (range 0-12), with lower scores indicating better blood glucose control. The reliability coefficient was 0.90 in the study by Westaway et al [260]

WELL-BEING

The Well-being scales, designed by Bradley and her associates [262] consist of six items to measure depression, six items to measure anxiety and six items to measure positive well-being (range 0-18). Respondents indicate how often they felt that each statement applied to them during the last two weeks on a 4-point scale from zero (not at all) to three (all the time).

Ratings for items on each sub-scale should be totalled after reversing scores where necessary (Depression items 1,3,4, 6 and Anxiety items 5 and 6).
Sub-scales are scored so that a higher score on each sub-scale indicates a higher level of the mood described by the sub-scale label.

A General Well-being total score is obtained by totalling the sub-scale scores after reversing the scores on the Depression and Anxiety sub-scales. Reliability coefficients ranged between 0.66 and 0.70 for the Depression scale and 0.76 and 0.88 for the Anxiety sub-scale. The value for the Positive Well-being ranged between 0.88 and 0.89. [260]

CLINICAL MEASUREMENTS

Body mass was determined to the nearest 0.1 kg standing barefoot in light clothing on a calibrated electronic scale (Soehnle Digital ®). Height was measured to the nearest 0.1cm using a 2m Panamedic stadiometer attached to the wall. Each subject's body mass index was calculated by dividing the body mass by the square of the subject's height. [223]

Blood pressure was measured according to published guidelines using a Mercury Baumanometer ®.[263] The subject was seated with right arm supported on a table and rested for five minutes. The mid-arm circumference was measured and a large cuff (15 cm-rubber bladder) was used for an arm circumference of 33 cm or greater. Two measurements were taken and if there was a difference of more than 5 mmHG between readings, a third measurement was taken. The mean of the nearest measurements was used to determine the mean blood pressure.

The Six-minute walk test was conducted in an enclosed area on a course 33 metre long course. A Webco Steel Measuring tape was used to measure out the 33 metre course. The subject was instructed to walk from end to end, covering as much ground as she could during the allotted time of six minutes. The subject was also instructed to stop the test and to report any chest pain, light-headedness, severe tiredness or any other adverse effect experienced during the test. The research assistant faced the subject and called out one of a predetermined set of encouraging phrases, such as "You're doing well!" or "Keep going", after each completed lap. At the end of the test she called out "Stop", and the distance covered was recorded. A calibrated Avant Sport timer ® was used to time the six minutes for all the subjects. [162]

Rating of perceived exertion was assessed using the Borg Perceived Exertion Scale [264] (Appendix 3). Although significantly less specific, it is possible to perform a reasonably accurate exercise prescription without a maximal exercise test. The Rating of Perceived Exertion (RPE) is closely associated with the relative metabolic rate and the relative heart rate in most individuals. [264] Lactate threshold (LT) appears to be an important anchor point for perception of effort during exercise and is not affected by the state of training or gender. An exercise intensity equal to LT can be prescribed by having people exercise at an intensity that is perceived as "somewhat hard" or equivalent to a Borg scale rating of 13 to 14.

The Haemoglobin A1c (HbA1c) Reagent Kit in conjunction with SYNCHRON® Systems HbA1c Calibrators and SYNCHRON Systems Hemolyzing Reagent, were used for the quantitative determination of haemoglobin A1c concentration as a percentage of total haemoglobin in whole blood. [265] Freshly drawn blood samples were collected in EDTA-tubes as routinely done in any laboratory test. The samples were then transported in ice to the Institute of Pathology, University of Pretoria within six hours of being drawn by a courier. Subjects did not fast before the blood samples were taken.

A physical activity diary with illustrations of some of the most common physical activities at home was compiled. The illustrations were used to enable those subjects who were illiterate, to keep a diary. An example of the physical activity diary is presented in Appendix 4. The subjects in the exercise group were instructed to keep a daily record of the time they spent on each of the activities in the diary. Subjects received a new diary form each time they reported for an exercise class. The metabolic equivalent intensity levels (MET) for these activities were known and could be calculated. [266] The body mass of the subject in kilograms was multiplied by the MET value of the activity and the duration of the activity to estimate the kilocalorie energy cost of each activity at home. The type of activities included in the physical activity form, as well as the MET values are presented in Table 5.1.

TABLE 5.1

PHYSICAL ACTIVITIES AT HOME AND MET-VALUES [266]

Physical activity	MET-value
Cleaning windows	3.0
Ironing	2.3
Scrubbing floors on hands and knees	3.8
Sweeping floors / carpets	3.3
Multiple household tasks at once (light effort)	2.5
Walking slow pace, firm surface	2.5
Vacuuming	3.5
Gardening in general	4.0
Raking yard	4.0
Sitting, knitting	1.5
Tailoring, hand sewing	2.0
Tailoring, machine sewing	2.5
Child care, standing-dressing, bathing, grooming, occasional lifting	3.0
Doing laundry by hand	3.5
Cooking and food preparation	2.5
Washing dishes, clearing from table	2.5

GENERAL INFORMATION QUESTIONNAIRE

The questionnaire consists of questions to evaluate the subjective experience of the subjects after the 12-week intervention. Questions about the logistical aspects of the programme and interest in the continuation of the programme were asked. Subjects' interest in becoming group leaders for future interest groups was established. Subjects were also asked for any other suggestions they may have for future planning purposes.

RESEARCH PROCESS

Data capturing commenced on Wednesday 13 March 2002. Six to 16 subjects reported every Wednesday to the Physiotherapy department at the Mamelodi Hospital for baseline testing and again after completing the 12 weeks programme.

The order for the pre- and post-intervention assessments was the same for both the exercise and relaxation groups and is presented in Table 5.2.

TABLE 5.2

THE ORDER OF THE BASELINE AND POST-INTERVENTION ASSESSMENTS OF PATIENTS IN BOTH THE EXERCISE AND RELAXATION GROUPS

Welcome, introductions and expression of appreciation

↓

Name labels

↓

Information in isiSotho/isiTswana/isiPedi/isiZulu and English

↓

Answering of questions

↓

Written and witnessed informed consent (copy to patient)

↓

Allocation of study number

↓

HbA_{1c} sample

↓

Demographic data

↓

Health, Well-being and Treatment Satisfaction questionnaire

↓

Measurement of blood pressure

↓

Measurement of heart rate

↓

Measurement of height

↓

Measurement of body mass

↓

Calculation of body mass index

↓

Six-minute walk test

↓

RPE

↓

Heart rate

↓

Refreshments

↓

Information and payment of transport

↓

Next appointment

After the baseline test, appointments were made with the subjects in the exercise group for the following Monday. Appointments for the subjects in the relaxation group were made for the following Friday. Subjects were instructed to wear suitable clothes and shoes.

A typed note with the date and time of the new appointment was given to each subject. The subject was then paid R20-00 for transport and thanked for her attendance.

THE INTERVENTION

The exercise- and relaxation groups differed only with regard to the exercise intervention.

Since a clinical trial is an experiment on human beings, the ethical aspects of the study are indisputable. The findings of the studies described in Chapters 3 and 4 with similar sample groups have shown that the subjects had knowledge about the benefits of exercise and they expressed the need for a structured exercise programme. [258] Therefore expectation of some form of exercise was created through the kinds of questions that were asked in both of the previous studies. To solve the problem of what treatment to give the relaxation group, it was decided to do self-relaxation training with them in order to control for the non-specific social and psychological aspects of exercise.

It was also clear during the recruitment of subjects at the Diabetic out-patient clinic at the Mamelodi Hospital, that the subjects did not understand the concept of randomisation. They often requested to be in the exercise group when the research process was explained to them. For ethical reasons, care was taken to have beneficial interventions for both groups, that the intervention would be interesting for the subjects, to ensure the subjects' adherence to the programme.

The exercise and relaxation group interventions were held on Monday and Friday mornings respectively. These two days were also chosen to keep contamination of the groups to the minimum. Care was taken to strictly keep participants in their specific groups by means of an list of attendance and appointments for specific dates. Care was taken to point out the subject's self-responsibility for her health care and that the programme was structured to empower her with knowledge and exercise skills.

Table 5.3 gives an overview of the course followed during the 12 – week intervention period.

TABLE 5.3

INTERVENTIONS FOR THE EXERCISE AND RELAXATION GROUPS RESPECTIVELY

Exercise group Monday mornings 08:00-11:00	Relaxation group Friday mornings 08:00-11:00
Welcome ↓ List of attendance ↓ Name label ↓ Introduction of subjects coming for the first time ↓ Discuss exercise book Addressing problems ↓ Physical activity record ↓ Aerobic exercise (< 60% of maximal heart rate) for 45 minutes ↓ Stress importance of home exercise and walking ↓ Education ↓ Refreshments ↓ Payment of transport ↓ Next appointment	Welcome ↓ List of attendance ↓ Name label ↓ Introduction of subjects coming for the first time ↓ Relaxation class 30 minutes ↓ Education ↓ Refreshments ↓ Payment of transport ↓ Next appointment

THE EXERCISE GROUP

The overall physical activity level (of both daily living and occupational physical activity) was low in this population as demonstrated in an earlier study in the same population (described in Chapter 3). [246] The aim of the exercise intervention was to promote regular participation in moderate intensity physical activity on most days of the week in a community with limited resources.

The choice of the intervention was influenced by the fact that the subjects were not used to exercise and by the fact that most of them were overweight. Furthermore, the participants were only clinically screened and no ischaemic response to exercise was done.

The intervention consisted of an incremental daily home exercise programme, the use daily of physical activity records and six fortnightly aerobic exercise classes. [27] This form of intervention was chosen because the Department of Health of South Africa supports management of diabetes at primary level.

Care was therefore taken to choose a mode of exercise, which could be practised safely in a community setting, but also with the aim of empowering the participants in exercise skills. It has been shown that a programme of lifestyle activity may offer similar health benefits and may be a suitable alternative to vigorous exercise for overweight women. [267]

THE EXERCISE INTERVENTION

The aim of the exercise intervention was to promote regular participation in moderate intensity physical activity on most days of the week in a community with limited resources. The intervention consisted of an incremental daily home exercise programme, the use of daily of physical activity records and six fortnightly aerobic exercise classes.

The Mamelodi Hospital was chosen as a venue because the patients all knew the venue and could use public transport to reach it. It would have been better to have exercise venues closer to the patients' homes, but since the patients were randomised after they consented to take part in the study, no prior arrangements for venues in the different neighbourhoods in Mamelodi could be made. Also the negotiations regarding the use of community centres would be a lengthy process. The author was also unknown to the community leaders. Furthermore, the community centres are used for a wide variety of community activities and exercise classes would also be subordinate to other regular community activities. It would also be difficult for the researcher to control the circumstances under which the patients received education and exercise, since some venues were unsuitable for exercise and educational purposes.

HOME EXERCISE PROGRAMME

A home-based exercise programme was chosen due to the participants' home responsibilities, such as taking care of children, older people and community activities. It has been shown that lifestyle physical activity is as effective as structured exercise for improving fitness in adults. [120,267] The fact that the participants were women, who needed to exercise in a safe environment, also contributed to this decision.

A further aim of the programme as mentioned earlier was to empower the participants to take responsibility for their own health and to exercise on their own. [172] Participants were encouraged to form small groups of women living near each other to join in the exercises, and to increase the social support, which was one of the outcome expectations expressed as described in Chapter 4.

While it would have been preferable to have the support of a spouse, the majority of patients were single (54.3%).[257] This limitation was addressed by offering fortnightly exercise sessions at the Mamelodi Hospital. It was hoped that these session would provide social and group support.

Patients were instructed to increase walking at home from 10 to 45 minute bouts over the 12 weeks of training. Subjects were instructed to walk twice a day starting with 5 minutes per session and to increase their total daily walking time with 10 minutes every two weeks up to 45 minutes per day. It was decided to use short bouts of exercise in order to incorporate exercise into the lifestyle of the mainly sedentary population. [150] Instructions were to walk fast and swing the arms. [268,150] Subjects were encouraged to work up a slight sweat and a quicker respiratory rate, thus working at a moderate RPE of 12-14 or somewhat hard. [269]

This method was used, because the traditional method of monitoring heart rate by palpation could not be followed due to the fact that most of the subjects do not wear watches. Walking was indicated by the subjects of the previous study (Chapter 4) as a suitable form of exercise.

Each subject also received a notebook with instructions and graphic demonstrations of the gentle flexibility exercises to improve and maintain range of motion and to stretch the major muscle groups. (Appendix 5). This was done to educate the patients about exercise and to address the other outcome expectations, namely better health and flexibility.

Subjects were urged to do their home exercises at least five times per week, but if possible every day of the week. [27]

PHYSICAL ACTIVITY DAIRY

The aim of the physical activity diary (Appendix 4) was to provide a detailed account of habitual daily activities and their associated duration. [266] Subjects were continuously reminded that physical work at home was also a form of exercise, but that they had to increase the speed, duration and intensity of doing these activities. [25]

A physical activity diary with illustrations of some of the most common physical activities at home was compiled. The illustrations were used to enable the subjects who were illiterate, to keep a diary. Subjects were instructed to keep a daily record of the time they spent on each of the activities in the diary. Multi-coloured stickers were used to remind the subject at which week in the programme she was and when to return the physical activity log.

The metabolic equivalent intensity levels (MET) for these activities were known and could be calculated. [266] The physical activity logs were checked; problems discussed and new logs were handed out for the next fortnight. In this way problems experienced could be addressed and the patient could be motivated to keep on trying. [180]

HOSPITAL EXERCISE PROGRAMME

The fortnightly exercise sessions at the Mamelodi hospital were used to educate the subjects about exercise, to demonstrate the home exercises and to address problems experienced with their home programmes.

Exercises consisted of low-impact aerobic large range movements performed to rhythmic music in the gymnasium that had suitable lighting and ceiling fans.

The duration of the aerobic exercise class presented at the Mamelodi Hospital was 45 minutes and was divided as listed below:

- 10 minute warm-up period.
- 25 minutes of aerobic exercise.
- 10-minute cool-down period.

During the warm-up session aerobic walking at low intensity level was done to prepare the skeletal muscles, heart and lungs for the progressive increase in exercise intensity. This was followed by gentle stretch exercises of all the muscle groups that would be used during the active exercise session.

The intensity of the training was set at moderate, obtaining a maximal heart rate percentage of 55-69% and a RPE of 12-13. [25]

The cool-down consisted of 10 minutes of gentle stretching of the muscle groups used during the active exercise session.

PRECAUTIONARY MEASURES

The aerobic exercise class was done in the gymnasium. Participants were urged to drink 200 to 800 ml of water per hour during the exercise session to ensure adequate hydration. [270] Although the subjects were clinically screened for the various signs and symptoms of disease affecting the heart and blood vessels, eyes, kidneys and nervous system, the precautionary measures taken into consideration are described in Table 5.4.

TABLE 5.4

PRECAUTIONARY MEASURES DURING EXERCISE CLASSES FOR THE EXERCISE GROUP

Take medication as prescribed by the physician.
Have a small snack before coming for exercise.
Do not to exercise if the diabetes is out of control.
Drink ± 200 ml water two hours before exercise.
Wear suitable clothing and shoes for the exercise session.
Drink 200-800 ml water during the exercise session.
Report any of the following during the exercise session:
- Excessive sweating
- Palpitations
- Chest pain
- Dizziness
- Any other discomfort not usually experienced
- Rest when tired

Subjects were also observed and instructed to look out for any adverse signs and symptoms during the exercise. Anaerobic exercise and exercise involving straining, jarring or Valsalva –like manoeuvres were avoided.

High-intensity and strenuous exercises were avoided and participants were never forced to go on if they felt tired. Repetitive weight-bearing exercises were avoided to prevent any injury to the feet. Subjects did weight-bearing exercise on the gymnasium mats if they did not have suitable shoes and always wore socks. Care was taken to remove any apparatus that could injure a subject during the exercise class. Subjects were constantly reminded of these precautions to avoid any injuries while exercising at home.

EDUCATION

The education was the same for both the exercise and the relaxation groups and consisted of inter-active group sessions on the same day as the intervention at the hospital (Appendix 6). The subjects received education on the management of Type 2 DM and the role of exercise in the management of the disease. The prevention of hypoglycaemia during exercise was included in the education on the role of exercise.

Food sample examples were used to show subjects the different products and also to teach them to look at the labels on the products. They could also taste products for salt and fat content. This was done since not all subjects could read the fine print on the labels due to poor eyesight and lack of glasses in this sample.

Sessions on food portion size and use of fat, fibre and the use of salt in the diet were given. The first two lectures were given by the researcher in English, but with handouts in isiPedi/isiSotho/isiTswana and isiZulu. Ms Monique Roux, a qualified dietician and a staff member of the Mamelodi Hospital, gave the lectures on diet.

THE RELAXATION GROUP

Subjects in the relaxation group attended fortnightly education and relaxation classes at the hospital (Appendix 7). All questions about exercise were answered, since it would be unethical to withhold information from patients. During the relaxation classes, subjects were instructed to progressively tense, then relax alternative muscle groups. They were also told to what to think, for instance "Notice your body relaxing, feel how relaxed and warm your body is becoming and how it spreads to other parts of the body". [214]

RECORD OF ATTENDANCE

An attendance list was kept for both groups and subjects were not allowed to attend on days other than those allocated to them to prevent contamination between the exercise and relaxation groups.

FOLLOW-UP OF SUBJECTS IN BOTH GROUPS

When a subject, from either the exercise or the relaxation group did not come for her next session, one of the following steps were taken:

If the subject had a telephone number, she was telephoned. The problem was discussed and a new appointment was made for the following exercise class.

In the case where the subject did not have a telephone number, and the researcher saw her again at the Diabetes Clinic, she was approached and the problem was discussed and a new appointment was made. If the subject did not have a telephone number and also did not come for two appointments in a row, a letter was send to the subject's physical address, requesting the subject to come on the following relevant date. The problem was then discussed and solved if possible.

When a subject did not react to any of the above mentioned steps, it was accepted that the subject was no longer willing to take part in the project and exercised her choice to withdraw from the study, as was stipulated in the informed consent document.

In cases where a subject in the exercise group accidentally left her physical activity diary at home, she was instructed to bring it with her the next time. When a subject did not complete the diary, she was questioned about it and the problem was addressed.

POST-TRIAL TEST PROCEDURE

The post-trial test was conducted after 12 weeks and the procedure is described in Table 5.2. Each subject received a written report of the research results within one month after completion of the trial. A copy of this report was also sent to the attending physicians for their information and record keeping.

All patients who completed the programme, received a certificate of attendance as a token of appreciation (Appendix 8).

STATISTICAL ANALYSES

Data were analysed using Statistix ® and Stata ® software. Data are presented as means ± SD, frequencies and percentages. The paired *t*-test was used to calculate p values for the comparison of means within the experimental and control groups respectively.

An analysis of co-variance (ANCOVA) was used to compare the experimental and control groups with respect to change in $HbA1_c$ and change in BMI and the six-minute walking distance, using baseline values as cofactor respectively. [33] A p-value < 0.05 was regarded as statistically significant for a one-sided test.

RESULTS

Data capturing commenced on Wednesday 13 March 2002 and ended on 12 November 2002.

The progress through the various stages of the study, including the flow of participants, withdrawals and the timing of primary and secondary outcomes are presented in Figure 5.1.

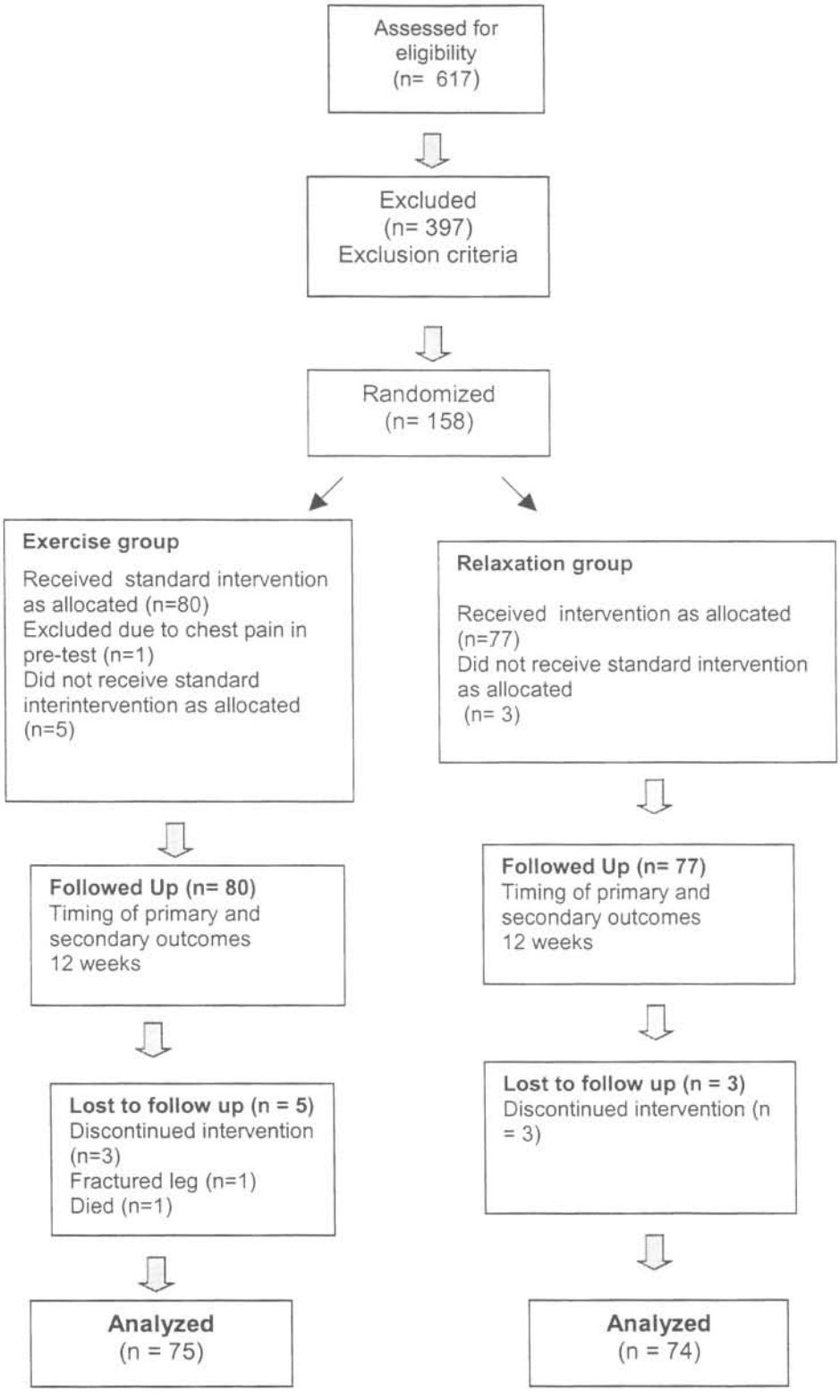

Figure 5.1 FLOW DIAGRAM OF PROCESS THROUGH THE PHASES OF THE TRIAL.

The baseline characteristics of the eight (8) subjects who did not complete the program (five (5) exercise and three (3) relaxation subjects) did not differ from the baseline characteristics of those subjects who completed the program. Subjects were followed up by means of telephone calls, letters and at the diabetes outpatient clinic. Psychosocial problems, death in the family and illness were reasons for not attending sessions at the hospital. No adverse events were reported in the exercise or the relaxation group during the trial.

DEMOGRAPHIC DATA

TABLE 5.5

The frequency distribution of the demographic variables is presented in Table 5.5.

Demographics		Frequency (%)	
		Exp (n= 80)	Contr (n=77)
Schooling (Years)	Unknown	26(32.5)	30(39)
	2-4 years	3(3.8)	2(2.6)
	5-7 years	41(51.3)	31(40.3)
	8-10 years	10(12.5)	12(15.6)
	Post St 10	0	2(2.6)
Language	IsiPedi	34(42.5)	33(42.9)
	Zulu	16(20)	15(19.5)
	IsiTswana	9(11.3)	7(9.1)
	Venda/ Ndebele	9(11.3)	7(9.1)
	Tsonga	4(5)	9(11.7)
	IsiSotho	4(5)	4(5.2)
	Afrikaans	4(5)	2(2.6)
Marital status	Married	36(45)	44(57.1)
	Widowed	20(25)	14(18.2)
	Single	15(18)	12(15.6)
	Separated	9(11.3)	7(9.1)
Income	Pension	30(37.5)	27(35.1)
	No answer	17(21.3)	21(27.3)
	Piece job	15(18.8)	12(15.6)
	Partner	10(12.5)	12(15.6)
	Relatives	7(8.8)	4(5.2)
	Friends	1(1.3)	1(1.3)
Other longstanding illnesses	None	14(17.5)	15(19.5)
	Hypertension	53(66.3)	45(58.4)
	Arthritis	1(1.3)	2(2.6)
	Combination	8(10)	9(11.7)
Type of treatment	Injections	23(28.8)	20(26)
	OHAs[1]	51(63.8)	50(64.9)
	Inject and OHA's	5(6.3)	7(9.1)
	Diet alone	1(1.3)	0

[1] Oral hypoglycaemic agents

The mean ages of the exercise and relaxation groups were respectively 54 and 55 years.

Percentages in parenthesis are as found in the exercise and relaxation groups respectively. The majority of the sample in both the experimental (64%) and control (56%) groups had schooling of between five and 10 years. Only two subjects had post-school qualifications. The subjects in both groups spoke mainly Isipedi (both groups = 43%), were married (45; 57%) and were pensioners (38; 35%). Most subjects in both groups indicated hypertension as their other long-standing illness (66; 58 %). Subjects were mainly treated with oral hypoglycaemic agents (64; 65%).

TABLE 5.6

The difference in clinical outcomes between the exercise and relaxation groups is presented in Table 5.6.[2]

Variable	Timing	N		Mean(sd)		Comparison of groups with respect to change from baseline	
		Exp	Contr	Exp	Contr	95% CI	p-value
$HbA1_c$ %	Pre-test	80	77	9.36(2.42)	9.25(2.28)	(-1.16;-0.01)	0.05
	Post-test	75	74	8.99(2.59)	8.26(1.97)		
BMI (kg / m^2)	Pre-test	80	77	31.73(6.01)	33.72(6.64)	(-0.14;0.47)	0.28
	Post-test	75	74	31.82(6.10)	33.36(6.62)		
Systolic BP (mmHg)	Pre-test	80	77	131.81(18.07)	132.95(16.75)	(-3.42;5.58)	0.64
	Post-test	75	74	128.11(16.27)	129.81(14.46)		
Diastolic BP (mmHg)	Pre-test	80	77	80.14(10.63)	81.23(10.90)	(-2.62;2.99)	0.90
	Post-test	75	74	79.01(9.44)	79.58(8.40)		
Six minute (Meters)	Pre-test	80	77	452.83(88.17)	449.02(72.69)	(9.07; 39.04)	0.00
	Post-test	75	74	501.40(80.62)	476.8(65.52)		
RPE	Pre-test	80	77	12.33(3.88)	11.94(3.94)	(-1.47;0.97)	0.69
	Post-test	75	74	12.09(4.14)	11.80(3.98)		

The adjusted baseline mean $HbA1_c$ change in the exercise group after 12 weeks was -0.39% (95% CI -0.8 to 0.02) and was barely not significantly different (p=0.05) from the mean for the relaxation group -0.97% (95% CI -1.38 to 0.55). However, the relaxation group improved more than the experimental group.

[2] An analysis of co-variance (ANCOVA) was used to compare the exercise and relaxation groups using the baseline values as covariate.

The adjusted baseline mean BMI change in the exercise group was -0.07kg.m^2 (95% CI -0.28 to 0.14) and was not significantly different (p=0.28) from the mean for the control group -0.23kg.m^2 (95% CI-0.44 to 0.02).

The difference in adjusted baseline adjusted mean walking distance change in the exercise group of 46.76m (95% CI 36.20 to 57.32) was significantly better (p<0.01) than the change for the relaxation group of 22.7m (95% CI 12.07 to 33.33).

Systolic blood pressure improved in both groups, but the change was not significant (p=0.64) between groups (95% CI 3.42 to 5.58). This was also the case with the diastolic blood pressure (p=0.90) (95%CI –2.62;2.99).

The difference in the baseline adjusted mean rate of perceived exertion change from baseline in the exercise group after the six minute walking test was not significantly different (p=0.69) from the baseline value in the control group (95% CI-1.47;0.97).

Significant within-group improvements in both the exercise and the relaxation groups were demonstrated in the means of HbA_{1c} and walking distance as can be seen in Table 5.7.

TABLE 5.7

The difference in means within the exercise and relaxation groups respectively is presented in Table 5.7. [3]

Variable	Group	N	Mean(sd)	Comparison of means within the exercise and relaxation groups from baseline	
				95%CI	p-value
$HbA1_c$ %	Exercise	75	-0.63(0.31)	(-1.25;-0.02)	0.04
	Relaxation	74	-0.91(0.23)	(-1.38;-0.45)	<0.01
BMI (kg/m^2)	Exercise	75	-0.05(0.13)	(-0.31;0.21)	0.70
	Relaxation	74	-0.25(0.08)	(-0.41;-0.10)	0<.01
Six minute walk test (meters)	Exercise	75	46,36(6.5)	(33.43;59.28)	<0.01
	Relaxation	74	22.46(4.7)	(13.09;31.82)	<0.01

[3] The paired t-test was used to calculate a p value for the comparison of means within the exercise and relaxation groups respectively.

The comparison of the change in mean HbA_{1c} and mean walking distance over the period of 12 weeks between the exercise and relaxation groups are demonstrated in Figures 5.2 and 5.3 respectively.

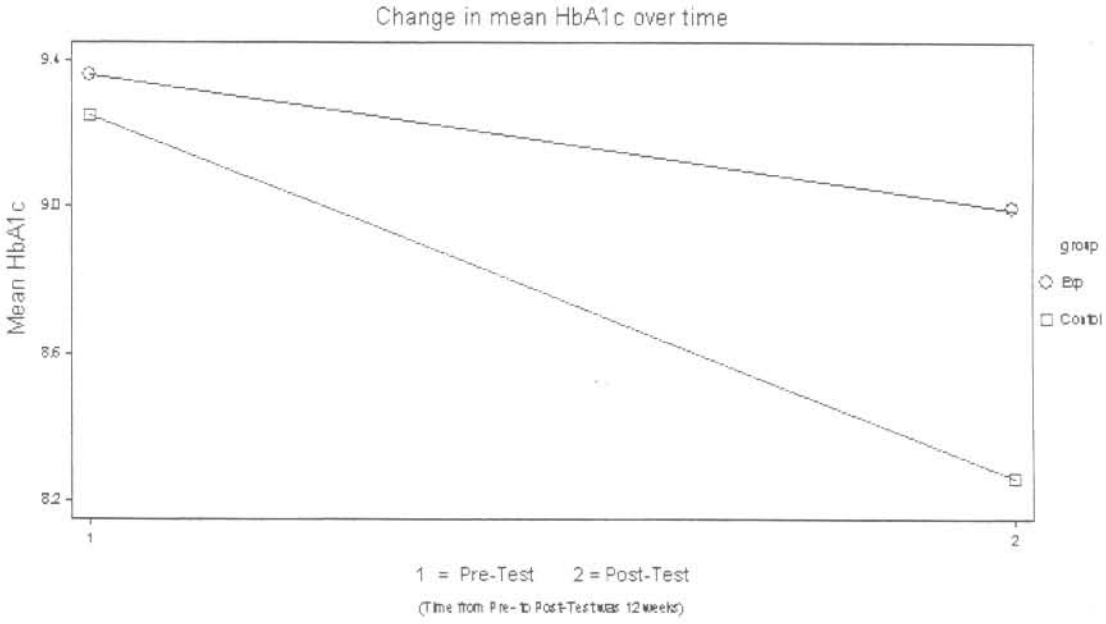

Figure 5.2. COMPARISON OF THE MEAN HbA_{1c} OVER 12 WEEKS BETWEEN THE TWO GROUPS

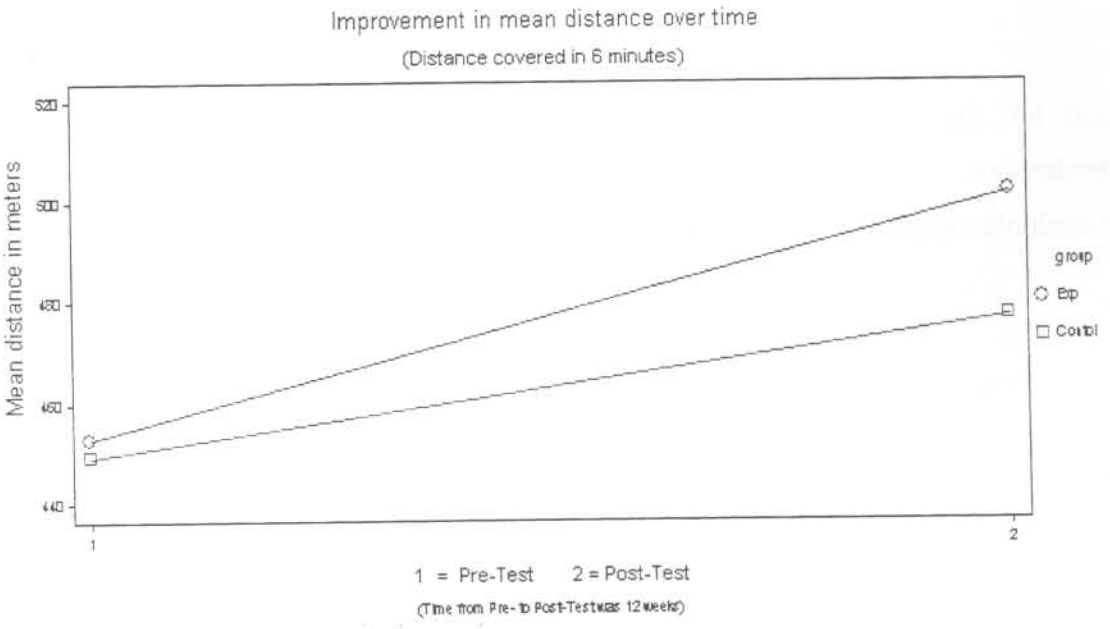

Figure 5.3 COMPARISON OF THE IMPROVEMENT IN MEAN WALKING DISTANCE OVER 12 WEEKS BETWEEN THE TWO GROUPS

PHYSICAL ACTIVITY AT HOME

In spite of repeated instructions subjects in the exercise group did not complete the physical activity records correctly. The metabolic equivalent intensity levels for these activities could therefore not be accurately calculated and were not included in the analysis of the data.

TABLE 5.8

HEALTH PERCEPTION

The quality of life questionnaire results are presented in Table 5.8.[4]

Variable	Timing	N		Mean(sd)		Comparison of groups with respect to change: baseline Baseline	
		Exer	Relax	Exer	Relax	95% CI	p-value
Perception of health	Pre-test	80	77	67.9(22.3)	69.16(22.87)		
	Post-test	75	74	85.19(12.33)	85.37(12.10)	(-8.44;7.03)	0.86
Satisf With Rx	Pre-test	80	77	30.61(2.38)	30.82(3.38)		
	Post-test	75	74	35.71(1.21)	35.96(0.26)	(-1.08;1.03)	0.96
Hyper-Hypo-Glycaemia	Pre-test	80	77	3.21(3.13)	3.57(3.48)		
	Post-test	75	74	0.31(1.05)	0.04(0.20)	(-1.82;0.44)	0.23
Depression	Pre-test	80	77	4.96(2.47)	4.53(2.23)		
	Post-test	75	74	4.57(2.11)	4.26(2.15)	(-1.01;0.95)	0.95
Anxiety	Pre-test	80	77	4.1(3.24)	3.60(2.66)		
	Post-test	75	74	0.59(1.18)	0.72(1.15)	(-0.30;1.80)	0.16
Positive Well-being	Pre-test	80	77	17.11(1.94)	17.18(1.46)		
	Post-test	75	74	17.96(0.35)	18(0)	(-0.61;0.47)	0.80
General Well-being	Pre-test	80	77	8.05(5.33)	9.05(4.04)	(-2.52;0.95)	0.37
	Post-test	75	74	12.8(2.68)	13.03(2.43)		

Both the exercise and relaxation groups' average scores placed them in the poor health perception category (≤ 70) before the intervention. The difference in the change from baseline health perception in the exercise group was not significantly different (p=0.86) from baseline in the relaxation group (95%CI-8.44;7.03).

[4] An analysis of co-variance (ANCOVA) was used to compare the exercise and relaxation groups using the baseline values as covariate.

However, the change from baseline within the experimental and the control groups, both with $p<0.01$, respectively, was significant. (Table 5.9) Cronbach's alpha coefficient (0.74) indicates a good internal consistency.

TREATMENT SATISFACTION

The difference in change from baseline treatment satisfaction in the exercise group was not significantly different ($p=0.96$) from the baseline in the relaxation group (95%CI –1.08; 1.03). The change within the two groups was once again significant ($p<0.01$). Item 4 did not contribute to the reliability of the construct as measured by Cronbach's alpha and was therefore excluded. Cronbach's alpha coefficient (0.60) indicates a satisfactory internal consistency for a 5-item scale.

The difference in change from baseline perceived frequency of hyper- and hypoglycaemia was not significant ($p=0.23$) (95%CI –1.82;0.44), but within the groups it was highly significant ($p<0.01$) as can be seen in Table 5.9.

DEPRESSION

The average scores for the depression scale were 4.96 in the exercise and 4.53 in the relaxation group. Neither the change from baseline depression in both groups ($p=0.95$), nor the change within the exercise ($p=0.49$) and the relaxation groups ($p=0.39$) were significant (95%CI –1.01;0.95). Cronbach's alpha coefficient (0.38) indicates a poor internal consistency for a 6-item scale.

ANXIETY

Seven subjects (6.7%) in the exercise group and one subject in the relaxation group reported an above average (9/18) on the anxiety scale before the intervention. After the intervention, 100% of subjects reported anxiety levels of less than 8 out of 18 on the scale.

Item six did not contribute to the reliability of the construct as measured by Cronbach's alpha (0.60) and was therefore excluded.

The change from baseline anxiety was not significant (p=0.16) when the two groups were compared (95%CI –0.30;1.80), but the change within the groups were significant (p< 0.01) in both instances as demonstrated in Table 5.9.

POSITIVE WELL-BEING

The difference in change from baseline positive well-being in the exercise group was not significantly different (p=0.80) from the baseline in the relaxation group (95%CI –0.61;0.47). However, the change from baseline within the experimental and the relaxation groups (Table 5.9), respectively, was significant (p<0.01). Cronbach's alpha coefficient (0.82) indicates an excellent internal consistency for the sub-scale.

GENERAL WELL-BEING

The change from baseline in the general well-being score of the exercise group was significant (p<0.01), as was the change within the relaxation group (p<0.01). When comparing the two groups, the difference was not significant (p=0.37) (95%CI-2.52;0.95).

TABLE 5.9 THE DIFFERENCE IN MEANS WITHIN THE EXERCISE AND RELAXATION GROUPS[5]

The difference in means within the exercise and relaxation groups with respect to the quality of life questionnaire results is demonstrated in Table 5.9.

Variable	Group	N	Mean(sd)	Comparison of means within the exercise and relaxation groups from baseline	
				95%CI	p-value
Perception of Health	Exercise	75	3.51(0.58)	(2.36;4.67)	<0.01
	Relaxation	73*	3.22(0.51)	(2.20;4.25)	<0.01
Satisfaction with treatment	Exercise	75	5.05(0.37)	(4.32;5.79)	<0.01
	Relaxation	73	5.01(0.39)	(4.23;5.8)	<0.01
Anxiety	Exercise	75	-3.65(0.41)	(-4.46;-2.84)	<0.01
	Relaxation	73	-2.89(0.35)	(-3.58;-2.2)	
Positive well-being	Exercise	75	0.84(0.22)	(0.41;1.27)	<0.01
	Relaxation	73	0.71(0.16)	(0.4;1.03)	<0.01
General well-being	Exercise	75	4.76(0.71)	(3.35;6.17)	<0.01
	Relaxation	73	3.88(0.52)	(2.84;4.91)	<0.01
Depression	Exercise	75	-0.27(0.39)	(-1.04;0.5)	0.49
	Relaxation	73	-0.27(0.32)	(-0.9;0.36)	0.39

* one case missing

[5] The paired t-test was used to calculate a p value for the comparison of means within the exercise and relaxation groups respectively.

GENERAL DATA

TABLE 5.10

SUMMARY OF GENERAL FEEDBACK ON BENEFITS OF EXERCISE

The results of the general feedback data are presented in Table 5.10

Benefit (frequency)	Frequency of response	
	Exp (n=75)	Control (n=74)
More energy(33)	19	14
Feel relaxed(20)	10	10
Improved flexibility(14)	5	9
Healthy and strong (47)	21	26
Improved sexual life(4)	1	3
Less pain(10)	7	3
Lost weight(32)	14	18
Cope better with life(5)	5	0

All the subjects in the exercise and relaxation groups enjoyed the intervention and wished to continue with it. The composition of the total intervention consisting of exercise or relaxation group support and education was enjoyed by most of the subjects in both groups (84%: 86.5%). They felt more energetic and healthy after the intervention as can be seen in Table 5.10.

The main benefits for the exercise group was that they felt more energetic, relaxed, stronger, had less pain and could cope better with life.
The relaxation group also felt more relaxed, healthier and stronger and more flexible. Participants in both groups were glad that they had lost weight. Responsibilities at home would be the main barrier to attending sessions in both groups. However, both groups agreed that the venue was suitable and that they were interested in becoming group leaders for small groups in their immediate environment. For the exercise group, Mondays was a good day for exercise, while the relaxation group preferred Fridays.

TABLE 5.11

FREQUENCY DISTRIBUTION OF GENERAL FEEDBACK ON THE INTERVENTION

Variables		Frequency	
		Exercise (n= 75)	Relaxation (n=74)
Enjoyment	Yes	75	74
	No	0	0
Aspect enjoyed most	Exercise / Relaxation	11	9
	Education	0	1
	Groups	1	0
	Everything	63	64
	Not applicable	0	0
Continuation	Yes	75	73
	No	0	1
Barriers to attending	Responsibilities home	54	49
	Transport fees	6	11
	Nothing	13	12
	Other	2	2
Day of week	Monday	43	10
	Tuesday	5	2
	Wednesday	2	5
	Thursday	1	2
	Friday	24	55
Venue	Yes	74	73
	No	1	1
Group leader	Yes	74	73
	No	1	1
Benefited	Yes	75	74
	No	0	0

ADHERENCE TO THE INTERVENTIONS

One hundred percent adherence of the exercise or relaxation sessions at the Mamelodi Hospital was set at six sessions (fortnightly for 12 weeks). Adherence to the exercise group among the 80 subjects averaged 91%. For the 77 subjects in the relaxation group it was 94%. Of the five subjects in the exercise group who did not receive the standard intervention as allocated, two missed more than half of the sessions, while three subjects missed one to three sessions.

Psychosocial problems, death of family members and colds were the main reasons for not attending the sessions.

DISCUSSION

The primary outcome of the study demonstrated that an exercise intervention to decrease $HbA1_c$ over a period of 12 weeks, in Type 2 DM female subjects, aged 40 to 65 years, was no more efficacious than a supervised self-relaxation training intervention in the relaxation group. The hypothesis is thus rejected.

The present results are in agreement with results reported by Keyserling and associates. [152] They reported minimal changes in HbA_{1c} ($p>0.05$) in all the groups) and weight gain after six and 12 months follow-up in their intervention to improve self-care behaviours of African American women with Type 2 DM. The authors were of the opinion that their programme had little effect on glycaemic control, because it did not address diabetes medication adherence, which could also be true for the present study. The improvement in the HbA1c level of 0.39% in this exercise group is also in line with the results by Dunstan and co-workers [147] who reported a reduction of 0.34% in their moderate exercise group. The decrease in HbA_{1c} levels of 0.39% in this study must be viewed against the decrease of 1% to 2% with medication, which is seen as clinically significant.

Therefore, the exercise interventions together with the use of medication may contribute to the achievement of a HbA_{1c} level of lower than 7.5% and thus reduced morbidity. [25]

In contrast, Goldhaber-Fiebert and co-workers [153] reported a more substantial reduction of 1.8 ± 2.3% in HbA_{1c} in their 12-week lifestyle intervention. This intervention included 11 weekly nutrition classes and supervised walking groups three times per week. The high contact time and direct supervision of exercise may have contributed to the success of the study.

These trials, as well as the present study are indicative of the complexity of behaviour change in the diabetic patient.

The difficulty of measuring change in physical activity in free-living populations remains unresolved. Included in this is the type of physical activity that is most likely to be beneficial to long-term risk management and the amount of activity that is required to have a health benefit.

A criticism of the exercise intervention may be that it was not intensive enough. The general recommendation that subjects should accumulate 30 minutes of moderate intensity aerobic exercise on most days of the week was followed in the present study. [27,271] Although 91% of participants in the exercise group attended the hospital sessions, it was clear from the results that compliance with exercise at home was unsatisfactory.

The physical activity diaries and exercise notebooks with instructions were used to encourage subjects to be more active at home. The physical activity records were handed in and checked fortnightly and the home program was discussed with the individual patients when they reported for the exercise sessions at the hospital.
It was clear that the subjects did not complete the physical activity forms correctly.

Poor responses may have been due to the fact that subjects engaged in activities other than those listed on the log. At least three subjects admitted that they depended on grandchildren to complete the log, and poor individual recall ability may have played a role in recording the data.[269]

Keyserling et al [152] reported physical activity levels of 44.1 kcal/day and 33.1 kcal/day assessed by means of the Caltrac accelerometer compared to the present study's 19.3 kcal/day. The Caltrac accelerometer may have been a more objective tool to assess physical activity at home.

The fact that home exercises were not supervised influenced the adherence to the home exercises. Studies that reported significant improvements in HbA_{1c} involved intensive individual counselling, group sessions [146,152] and also supervised exercise sessions. [126,146,152] The contact time with patients was too limited to facilitate behaviour change in the individual patients. Each patient has her own health perceptions, personality, motivation, values and preferences, which will influence the outcome and adherence to any planned intervention. McNabb et al [108] recommended that at least one and a half hours (1.5) hours individual contact time per week was necessary to facilitate behaviour change.

The lack of access to exercise facilities was a problem in this study. The suburb of Mamelodi is unsafe for women walking unescorted. In future sampling should be stratified to the adjacent neighbourhoods in Mamelodi. Exercise interventions should be offered at suitable venues within the neighbourhoods, such as churches or other centres to improve accessibility for the participants. Sessions in venues familiar to the participants may enhance exercise adherence, because they are accustomed to going there on a regular basis. [108] Since exercise represents positive health advice, it is advisable that participants go to a community setting for exercise, rather than a hospital where they go for medical attention. [16]

The sample also came from a culture where regular exercise, other than tasks of daily living, is not the norm. Tshabalala and Gill [22] report that in the African tradition, older people are usually excluded from exercise and hard physical work due to their seniority. They furthermore suggest that this traditional practice must be kept in mind when prescribing exercise. It is therefore difficult for the patient to change a long-established, culturally acceptable and habitual lifestyle.

Behaviour change is a long and complex process. When considering the Readiness for Change Model, [180] it is possible that the participants were in the action stage. They started to exercise at the hospital, but the influences of the environment, lack of social and cultural support in the community and family impacted negatively on their home exercise programme. The physical and emotional energy required to maintain the change in behaviour may have been too much for the patients to cope with. [180] Since the women were not routinely engaging in exercise, the exercise intervention could have added "mental stress" to the exercise group. This perceived stress could have adversely affected any possible physiological effects brought on by exercise. [272]

The fact that the score for perception of health of this experimental group placed them in the poor health perception category (≤ 70) and that they had between five and 10 years of schooling may have acted as a motivational barrier to doing exercise. Hays and Clark [238] found that individuals who were older, had equal or less than 12 years of education and who perceived their health as fair or poor, were less likely to be physically active.

Being tired seems to be viewed as a symptom of having diabetes by diabetics, rather than a sign of poorly controlled diabetes. This factor could also have influenced the frequency and intensity with which this exercise group performed their home exercises. [203,258]

The three-month study period was long enough to observe changes in the primary and secondary outcomes, but too short to have sustainable results.

Middle-aged sedentary and older participants may need a longer adaptation period to enjoy the optimal benefits from the program. [180]

Beliefs and attitudes of black patients with Type 2 DM also play a role in their adherence to exercise. The degree of westernisation, the level of education, socio-economic circumstances and status of the individual participants may have influenced their decisions to do exercise. [202]

The conflict between traditional health beliefs, where the patient is usually a passive participant and the western health care, where the patient is expected to be an active participant in the management of her disease may have influenced acceptance of self-responsibility to exercise in this exercise group. [22,27,202]

Bopape also illustrated this. [195] She reported dependence on the health care professional and medication by 80% of the South African diabetics in her study. It has been shown that beliefs held by an individual may influence her decision to comply with preventative action. The patient also needs the support and resources to act on information about behaviour change. [172] According to Tshabalala and Gill: [22] "Older people are usually excluded from exercise by virtue of their senior status. They usually sit in the sun, while the young do the hard work". It is also inappropriate for black women to walk fast.

The decrease in the control group's HbA_{1c} of 0.97% was an unexpected finding. The fact that the control group's drop in HbA_{1c} was more than that of the experimental group may be incidental; however the baseline characteristics of the experimental and the control groups do not suggest selection bias. An improvement in HbA_{1c} in both groups may be ascribed to the Hawthorne effect. [273] The subjects' participation in the trial and interest shown by the health care workers may have contributed to the improvement in both groups rather than the exercise per se.

The benefits of both the relaxation program and emotional support could also have influenced the outcome in the relaxation group.

The change in the HbA_{1c} of 0.97% is however, a clinically important finding, because according to data from the United Kingdom Prospective Diabetes study [59], a reduction of 0.6% in HbA_{1c} can reduce the risk of micro-vascular complications by 25%.

This finding is in agreement with the finding by Surwit and co-workers, [211] who reported an improvement of 0.5% in the HbA_{1c} after 12 months, in their study on the efficacy and feasibility of cost-effective outpatient group-stress management training.

In the case of the control group, participants were not expected to do anything other than to attend a group session once fortnightly. They could therefore enjoy the relaxation without any intermediate impact of perceived stress due to exercise that they are not used to. Furthermore, the group sessions provided social support, which was one of the expected outcomes expressed during the second phase of the study.

It is furthermore well known that exercising muscles use glucose, which leads to independent insulin secretion. The insulin sensitivity of the muscle is also improved and this effect can persist for several hours. [38,69] The progressive muscle contraction during relaxation classes could have contributed to the improved use of glucose by the major muscle groups, as they take up approximately 40% of the body mass. [38] Therefore, the combination of stress relief and muscle contraction may have contributed to the improvement in HbA_{1c} levels in the relaxation group.

The participants in the relaxation group also received general health advice at the baseline visit and at the fortnightly sessions at the hospital. Although they were not instructed to exercise at home, it is possible that they increased their physical activities on the basis of their new knowledge about the benefits of exercise. [114]

It is also possible that the participants practiced the relaxation exercises at home in between the fortnightly sessions at the hospital, and this might have led to improved insulin-sensitivity of the large muscle groups used during relaxation.

Other documented physical benefits of relaxation include reducing anxiety, heart rate, respiratory rate, and muscle tension, improving self-esteem, decreasing fear and an enhanced sense of self-importance. [214] The physical benefits of relaxation may have contributed to less stress and anxiety in the relaxation group and improved self-esteem of the participants. [214] Bopape [195] reported that diabetic patients were stressed by the physical complications that are caused by disease. They felt that it limited their physical ability and made them feel disabled. An observation made by the research assistant during this study was that many patients asked for a certificate in order to apply for a disability grant. Jacobson et al [196] reported that self-management was better in diabetics who have a good self-esteem. In a previous study on the barriers to and expectations of performing physical activity in a similar sample of females with Type 2 DM, relaxation was identified by 51% of the respondents as an outcome expectation. [258] It is clear that this outcome expectation has been met and this could have contributed to the better results in the relaxation group.

Average scores placed both the exercise and relaxation groups in the poor health perception category before the intervention. Westaway et al [260] reported an average health perception score of 60.4 (34.6) in a sample of 160 black diabetic patients. The baseline average score in this study was higher than the one reported by Westaway. [260] The reason for this is unknown. The health perception scores improved significantly within both groups, indicating that the intervention contributed to an improved perception of health in both groups.

The subjects in both groups of this study reported low levels of depression and anxiety. The Cronbach's alpha coefficient of 0.38 for the depression scale indicates a poor consistency for a six-item scale. It is therefore possible that the subjects did not understand the questions.
Both groups scored high on the positive well-being scale, which agrees with the score of 20.7 reported by Westaway et al [260] While the difference in positive and general well-being between the exercise and relaxation groups was not significant, the general well being improved significantly within both groups, demonstrating that both groups benefited from the interventions.

This is an important finding, since it has been documented that improvement in quality-of-life outcomes could have indirect, longer term benefits not evaluated in the assessment of biomedical endpoints immediately after intervention. [196]

No relationship between the health-related quality of life outcomes and diabetes control (HbA_{1c}) could be shown. This finding supports previous research reports of low correlation between diabetes control and subjective well being. [274]

The significant increase in walking distance of the exercise group in this study is in agreement with the Position statement of the American College of Sports Medicine [27] that low-fit, sedentary and clinical populations can improve fitness with lower-intensity, longer-duration exercise sessions. The exercise group has therefore improved their initial sedentary status. However, the improvement did not translate into the expected improvement in glycaemic control.

Another critism of the exercise intervention could be that exercise stress testing should have been performed to provide data about the sub maximal heart rate and blood pressure responses during strenuous exercise. In this way a more optimal exercise prescription might have been compiled. [20,25,34] Such an exercise test is however not practical for this sample.

Patients should be trained in the use of the Borg scale of perceived exertion [264] because a recent research report by Beling et al [275] has shown that subjects may underestimate their heart rate by means of palpation by as much as 15% while exercising. In any case, most of the participants did not have wrist watches to be able to determine their heart rates. Using the Borg scale of perceived exertion the exerciser is allowed to subjectively rate his or her feelings during exercise, taking into account personal fitness level, environmental conditions and general fatigue levels. It is easily understood and a cardio respiratory training effect can be obtained by exercising at a rating of "somewhat hard" which is more or less a rating of 12-16 on the category scale. [27]

The fact that the difference in change in the mean BMI between the groups was not significantly different ($p = 0.28$), stresses the importance of a lifestyle intervention including weight loss monitoring, as well as supervised exercise groups. Weight loss is one of the cornerstones of diabetic management, but it difficult for diabetics to loose weight. [62] A combination of a low-calorie diet and physical activity results in a greater weight loss than either diet or physical activity in isolation. [64]

The low educational level of the participants, illiteracy and language proficiency may have had an influence on the understanding of the educational material about good dietary practices. While the educational material was available in isiZulu and isiSotho, it may be possible that some patients did not understand it. Furthermore, some of the illiterate patients had to depend on family members to read the handouts for them, which might have led to misunderstandings. Measuring body mass during the fortnightly exercise sessions to monitor weight loss could have contributed to better weight loss results.

Due to poor socio-economic circumstances in the community, participants reported that they often did not have money to buy the correct foods. Participants using the money paid for transport purposes during the study to buy fresh products illustrated this.

Furthermore, food eaten and offered is a reflection of social status and prestige in many areas. [276] Participants reported that it was rude to refuse food offered by the hosts when attending community gatherings such as weddings and funerals. Since regular attendance of these community gatherings are very important, it can have a negative impact on weight control by these patients.

The attendance of exercise sessions (Group1) was high at 91%. It is possible that the participants attended the sessions at the hospital for the transport money, which they used to buy food. It was observed that many of the participants reported poor socio-economic and domestic circumstances. However, the qualitative data showed that the outcome expectations of the participants had been met and that they had enjoyed the programme.

In conclusion it can be stated that participants in both groups benefited from the intervention. It also demonstrated the need for education and support in the diabetic community.

As the Department of Health of South Africa [8] supports management of diabetes at primary care level, patients should be taught to exercise safely in a community setting. Conducting action research in the community, involving community leaders, community health workers and persons with diabetes to establish exercise facilities away from the hospital that are more accessible to all, may facilitate the promotion of educating diabetics in self-management.

Cognitive behavioural strategies, such as contracting and rewards for exercise programme attendance to increase physical activity and exercise adherence should be investigated and implemented to meet the unique needs of the women in this community. [277] An example of such a reward may be free medication or food parcels to patients who maintained good glucose control.

CHAPTER 6

CONCLUSIONS

The aim of this study was to investigate if an exercise intervention would be effective to improve HbA_{1c} levels in an urban black female diabetic population. Information was also sought on the knowledge of and attitudes towards diabetes and exercise of this population and their current physical activity levels. Personal and environmental barriers to doing exercise were determined; also what the population's outcome expectations of performing exercise were. The research was conducted in three phases and consisted of quantitative and qualitative data capturing. Data obtained from the first two phases of the study were used to plan the exercise intervention.

The most significant finding of this research was that **exercise as implemented in this study was not more effective than supervised self-relaxation training in improving HbA_{1c} levels in black urban female patients with Type 2 DM** after a 12-week intervention period. We have seen that an intervention of any kind is welcomed and enjoyed by the women with Type 2 DM, and that it contributed towards an enhanced quality of life for individual patients. Interventions in the exercise and relaxation groups led to improvements in HbA_{1c}. The improvements in HbA_{1c} in both groups were obtained by non-pharmacological means.

The patients in the study had many risk factors for diabetes-related complications and are representative of other urbanised South African populations. The socio-demographic profiles of patients in this study were similar to that of other international studies. I therefore consider the results of this study to be transferable to other populations.

The findings of this study reflect the complexity of helping patients to implement and sustain changes in lifestyle to improve diabetes self-management. Furthermore, the results of the different phases of the study contributed towards our understanding of the complex integration of relationships between the characteristics of the individual patients and the characteristics of the environment from which they come and how it may influence clinical outcomes.

Accordingly I conclude that unless the characteristic of the individual patient and the environment from which she comes is addressed, no intervention will be successful. It is therefore the role of the health care worker to identify the barriers to exercise and to accompany the patient on the road to a healthier lifestyle.

The principal goal of clinical care is to improve patient outcomes. Improved patient outcomes would mean improved control of the disease and therefore less diabetes-related complications, improved functioning and perception of health and eventually overall quality of life. [278] Blood glucose control, medical nutritional therapy, education and physical activity are the cornerstones of diabetes management and are important to prevent many diabetes-related complications. [8,38] To realise these outcomes, the patients have to be active participants in making changes in long-established behaviours. Although the intervention was planned on the basis of knowledge gained from the first and second phases of the study, it was clear that the women were not ready to accept self-responsibility for unsupervised exercise.

It was however clear from the primary and secondary outcomes of both groups, that doing exercise or relaxation compared to potentially nothing along with education does appear to improve health and quality of life for these women.

The challenge facing the research team was to develop an exercise programme to change sedentary lifestyle behaviour in a population of black female Type 2 DM patients. Exercise is one of the cornerstones of diabetes management, which offers a non-pharmacological means of controlling hyperglycaemia, lower blood pressure and encourages weight loss.[12,13] Furthermore it improves the functionality of the patient, reduces cardiovascular risk factors such as hypertension and contributes to improved quality of life. [14,15,27]

Another important finding of this research was that certain cultural practices and community activities took priority over adherence to exercise prescriptions. Community activities, such as religious meetings, care of children and the ill and attending funerals are important activities in the life of the female Type DM patient. The senior stature of these women in the community means that certain community activities take first priority and that all other daily activities are subordinate to these community commitments. Apart from illness, these community activities were reasons given for not doing home exercises or attending the exercise sessions at the Mamelodi hospital. A patient may therefore have started to change her sedentary lifestyle by attending the sessions at the hospital, but relapsed because of demands on her time and energy.

Poor socio-economic and domestic circumstances and stressful life situations are psychosocial factors that may have determined the women's adaptation to diabetes and adherence to the diabetic regimen. This was illustrated by the improvement of HbA_{1c} levels in the control group. High unemployment, high crime rates and family problems such as HIV / AIDS contribute to stress in the family and contribute to psychological stress in both groups of participants. There is a dire need for social welfare services in this population.

Social and psychological support is necessary for health-related behaviour change. Since the participants came from a community and age group, which do not regularly engage in exercise, social and psychological support for doing exercise and changing lifelong habits may have been lacking.
It has been shown that social problems influence learning and behaviour. The sessions at the hospital may have offered an escape form the mentioned environmental and personal stresses. However, this support was lacking when the patients returned home and may have contributed to poor adherence to home exercises.

The outcomes of this study therefore break new ground in the search for understanding the role of exercise in black female Type 2 diabetics. We have seen that data on exercise in Type 2 DM Mellitus in the African population is scarce. The importance of exercise as a non-pharmacological means to lower HbA_{1c} cannot be negated. Therefore, this study has contributed valuable new knowledge in this field and also a better understanding of the complexity of behavioural change in an urban black population.

The outcomes are furthermore important against the background of an increasing prevalence of diabetes in South Africa, especially amongst females and problems with diabetes control. Also of importance is the fact that the incidence of Type 2 DM is increasing in children and that the traditional lifestyle is being abandoned for a westernised lifestyle with decreased physical activity and poor dietary habits. Education of and positive health-related lifestyle changes in adult female patients with Type 2 DM can empower them to educate their families and also the wider community about healthy lifestyles and the prevention and control of this disease can be addressed.

The safety of unsupervised exercise by women with longstanding diabetes was a concern of the author. Since compulsory community service for physiotherapists has now been implemented in South Africa, more physiotherapists are available in the public health system.

These physiotherapists can be used to supervise and run exercise programmes in the community.

Regular supervised exercise sessions per week may enable patients to attend sessions when convenient for them. The participants of this study indicated that they were willing to become group leaders for exercise support groups. They are important contact persons to facilitate negotiations with the different community and church leaders in order to obtain suitable venues for exercise classes.

The results of this study have provided a foundation for future research on exercise for black females with Type 2 DM Mellitus. The participants have been empowered with knowledge, exercise and relaxation skills. The empowerment of the women with Type 2 DM will hopefully contribute to their general knowledge of the disease and therefore also improve the knowledge of their families and the community.

I conclude that it is possible to improve blood glucose control by means other than medication in urban black female patients with Type 2 DM. The patients are willing to change their sedentary lifestyle to a more active one, but several environmental and personal barriers impact negatively on their attempts to do so. The role of the health care worker is to identify these barriers and to accompany the patient on the road to a healthier lifestyle. However, this population of women may need more assistance and support initially to eventually take self-responsibility for their diabetes self-management.

In the words of one of the participants: " *I want to feel relaxed and peaceful.....now after we have exercised we will be laughing and we will feel very good afterwards.*"

CHAPTER 7

RECOMMENDATIONS

On completion of this research the following recommendations for further research on exercise for Type 2 DM Mellitus patients are made:

1. That the effect of an exercise intervention should be assessed after a run-in period, because earlier assessment may be biased as a result of changes made only because subjects are conscious of being studied. A run-in period before the start of the intervention is necessary to prevent the Hawthorne effect in these patients. An initial run-in period such as a period of education and small group meetings, before randomisation into exercise and relaxation groups may have distinguished between the effect of the exercise and the effect of study participation.

2. That the relaxation group should receive the usual care and be wait-listed for an intervention similar to the exercise group after the study is completed. In such an instance it could be called a control group.

3. That change in the use of prescribed oral hypoglycaemic agents be investigated during an exercise intervention.

4. That the exercise intervention is repeated for at least one year with supervised exercise sessions at community-based venues.

5. That the exercise intervention should include individualised counselling sessions with each participant and the monitoring of weight loss.

6. That the use of accelerometers as a means to detect both frequency and velocity of movement in this population be investigated.

7. That the effect of resistance-type exercises be investigated in this population.

8. That a psychologist and social worker should be part of the research team to address the social problems of participants

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APPENDICES

APPENDIX 1

DEFINITION OF KEY CONCEPTS

TYPE 2 DIABETES MELLITUS

The latest classification of diabetes was adopted by the World Health Organisation in 1999 and will be used in this study (WHO 1999).
Diabetes mellitus is defined as a group of metabolic diseases characterised by hyperglycaemia resulting from defects in insulin secretion, insulin action of both. Type 2 includes the common major form of diabetes, which results from defects in insulin secretion, almost always with a major contribution from insulin resistance. The chronic hyperglycaemia is associated with long-term damage, dysfunction and failure of various organs, especially the eyes, kidneys, nerves, heart and blood vessels.

De Courten M, Bennett PH, Tuomilehto J, et al. Epidemiology of NIDDM in Non-Europids. In: Alberti KGMM, Zimmet P, DeFronzo RA, Keen H, editors. International Textbook of Diabetes Mellitus 2nd ed. West Sussex: John Wiley & Sons Ltd.; 2001.p. 150.

PHYSICAL ACTIVITY

The definition of the American College of Sports Medicine is accepted for this study. Physical activity is defined as bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure.

Pate RR, Pratt M, Blair SN et al. Physical activity and public health: a recommendation from the Centres for Disease Control and Prevention and the American College of Sports Medicine. JAMA 1995;273:402-7.

EXERCISE

Exercise is a subclass of physical activity and is defined as planned, structured and repetitive bodily movement done to improve or maintain one or more components of physical fitness for the purposes of this study.

Both the quality and quantity of physical activity recommended relate to exercise recommendations by the American College of Sports Medicine.

Pate RR, Pratt M, Blair SN et al. Physical activity and public health: a recommendation from the Centres for Disease Control and Prevention and the American College of Sports Medicine. JAMA 1995;273:402-7.

MODERATE EXERCISE

Moderate exercise is defined as activities that are approximately 3-6 METs or the equivalent of brisk walking. Since brisk walking might be considered to be "hard" to "very hard" by some sedentary, older persons, an alternative definition is provided. Moderate exercise can also be defined as intensity well within the individual's capacity and which can be comfortably sustained for a long period of time. It has a gradual initiation and progression and is generally not competitive.

American College of Sports Medicine. Guidelines for exercise testing and prescription. 6th ed. Philadelphia: Lippincott Williams and Wilkins; 2000.

HEALTH-RELATED PHYSICAL FITNESS

The American College of Sports Medicine's definition is accepted for this study. Physical fitness is defined as a set of attributes that people have or achieve that relates to the ability to perform physical activity. Health-related physical fitness includes cardio respiratory endurance, body composition, muscular strength and endurance and flexibility. A better status in each of the components is associated with lower risk for development of disease and/or functional disability.

Pate RR, Pratt M, Blair SN et al. Physical activity and public health: a recommendation from the Centres for Disease Control and Prevention and the American College of Sports Medicine. JAMA 1995;273:402-7.

American College of Sports Medicine. Guidelines for exercise testing and prescription. 6th ed. Philadelphia: Lippincott Williams and Wilkins; 2000.

PHYSICAL INACTIVITY

The National Institutes of Health's definition states that physical inactivity denotes a level of activity less than that needed to maintain good health.

Pate RR, Pratt M, Blair SN et al. Physical activity and public health: a recommendation from the Centres for Disease Control and Prevention and the American College of Sports Medicine. JAMA 1995;273:402-7.

EFFECTIVENESS

Effectiveness is the extent to which the intervention does what is intended to do 'in the field' or 'in the real world'. The term is accepted for the purposes of this study.

Cochrane AL. Effectiveness and efficiency: random reflections on health services. In: Williams R, Herman W, Kinmonth AL, Wareham NJ, editors. The Evidence Base for Diabetes Care. West Sussex: John Wiley & Sons; 2002. p. 5.

SELF-MANAGEMENT

Self-management is defined as active patient engagement in making decisions about the management plan and carrying out the planned treatment behaviors and activities.

Roter D, Kinmonth A-L. What is the evidence that increasing participation of individuals in self-management improves the processes and outcomes of care? In: Williams R, Herman W, Kinmonth AL, Wareham NJ, editors. In: The Evidence Base for Diabetes Care. West Sussex: John Wiley & Sons; 2002. p.682-700.

APPENDIX 2

PROTOCOL NUMBER

INTRODUCTION OF PROJECT AT CLINIC BEFORE RECRUITMENT STARTED

EXAMPLES OF INFORMED CONSENT FORMS USED DURING THE STUDY (ENGLISH VERSIONS)

The nurse in charge of the diabetes outpatient clinic introduced the researcher and informed the patients about the intended project in an African language according to these guidelines. This was done everyday before recruitment of subjects started for the duration of the study.

DIABETES RESEARCH PROJECT

My name is Tania van Rooijen and I am a physiotherapist from the University of Pretoria.

I am doing research about the effect of exercise and education on the sugar level of the blood.

The co-operation of ladies 40-65 years with Diabetes, who are not working, is requested.

I am also requesting permission to look in you files for the medication, and to ask a few questions about your health.

Patients who are interested, will be divided into 2 groups by the computer:

- All patients will be tested for blood pressure; weight, height, walking and one test tube of blood will be taken for the blood glucose.
- One group will do exercise for 12 weeks – they will have to come to the Mamelodi hospital every second week straight to physiotherapy – they do not need to take out the files.
- One group will receive education for 12 weeks – they will have to come to the Mamelodi hospital every second week straight to physiotherapy – they do not need to take out the files.
- After 12 weeks the 2 groups will be compared to see which group of patients benefited the most.
- All patients attending the research will receive a transport fee, every time they attend a session.

Patients will receive appointment dates.

The Physiotherapy department is in the main corridor. Walk past the Pharmacy (where you get the tablets) and find it on your left.

Thank you very much for receiving me.

PROVINSIALE ADMINISTRASIE
GAUTENG

Enquiries: Mev M Smith

Tel: (012) 354 1560

Fax: (012) 354 1831

Adres: Ethics Committee
Ward 4 Room 19
Pretoria Academic
Hospital
Private Bag x 169
PRETORIA
0001

Prof/~~Dr/Sr/Mev~~ P Rheeder x 1488

Number : S116/99

Title : The Knowledge, Attitudes and Physical Activity Levels of Urban Black Female Patients with Type II Diabetes Mellitus.

Investigator : Mev AJ van Rooijen; Dept of Physiotherapy
Pretoria Academic Hospital; Pretoria

1. Die voorgestelde protokol is ontvang op 30/06/99.
2. Die Ingeligte Toestemmingsvorm met al die opskrifte is aangeheg.
3. Die Departementshoof het die protokol skriftelik goedgekeur.
4. Dit word vir skriftelike kommentaar na u verwys.

SEKRETARIAAT

Kommentaar terug voor **16/07/99** vir vergadering van **28/07/99** asb.!
As u hierdie protokol goedkeur, beteken dit nie noodwendig dat dit deur die Etiek komitee goedgekeur sal word nie.

Consent form needs to be changed (Page 1).

UNIVERSITY OF PRETORIA

DEPARTMENT OF PHYSIOTHERAPY

INFORMED CONSENT

AUTHORISATION TO PARTICIPATE IN AN RESEARCH PROJECT

TITLE OF THE STUDY: A cost-effective intervention including an exercise programme to improve the quality of life of urban female patients with non-insulin-dependent Diabetes Mellitus

Dear Mr/.Ms .....

Date :...../...../2000

1. THE NATURE AND PURPOSE OF THE STUDY:

I understand that I am being requested to take part in a research study. The aim of this study is to assess the knowledge of and attitudes towards Non-insulin-dependent Diabetes Mellitus, and exercise of female patients with NIDDM attending the Diabetes Clinic at the Pretoria Academic Hospital.

2. EXPLANATION OF PROCEDURES TO BE FOLLOWED:

For the purpose of this study we will ask some personal questions concerning yourself. The questions will be asked in a language, which you understand.

3. RISK AND DISCOMFORT INVOLVED:

For the purpose of this study only questions will be asked. Some questions are of a personal nature.

4. POSSIBLE BENEFITS OF THIS STUDY:

This study will provide a better understanding regarding the knowledge of and attitudes towards the disease, and the benefit of exercise of diabetic patients for improving the quality of health care.

5. INFORMATION:

Should I have any questions concerning this study, I should contact: Mrs AJ van Rooijen

(Tel (012) 3542018, of the Department of Physiotherapy, University of Pretoria.

6. VOLUNTARY PARTICIPATION:

Participation in this study is voluntary. No compensation for participation will be given. You are free to withdraw your consent to participate in this study at any time. Refusing to participate will involve no penalty or loss of benefits.

7. CONFIDENTIALITY:

All records obtained in this study will be regarded as confidential. Results will be published or presented in such a way that no person will be identified by name.

8. CONSENT TO PARTICIPATE IN THIS STUDY:

I have read or had read to me in a language that I understand the above information before signing this consent form. The content and meaning of this information have been explained to me. I have been given the opportunity to ask questions and am satisfied that they have been answered satisfactorily. I hereby volunteer to take part in this study. I have received a signed copy of this informed consent agreement.

Interviewee signature
Date

Witness
Date

Witness
Date

UNIVERSITY OF PRETORIA

DEPARTMENT OF PHYSIOTHERAPY

PATIENT INFORMATION AND INFORMED CONSENT

Authorisation to participate in a Research Project

Study title:

The effect of an exercise / physical activity intervention on the HbA_{1c} and weight in a sample of black female Type 2 Diabetes Mellitus patients.

The purpose of the study:

I understand that I am being requested to take part in a research study. The aim of this study is to test a culturally acceptable physical activity program in urban black female patients with Type 2 Diabetes.

Explanation of procedures to be followed:

For this study we will at the beginning and the end of the study:

- Ask some personal questions concerning yourself and your diabetes.
- Draw one vial of blood.
- Do a physical examination.
- Do an exercise test.

Duration of the study:

If you decide to take part, you will be one of approximately 160 patients. The study will last for 3 months (12 weeks).

Ethical approval:

This study protocol was submitted to the Research Ethics Committee of the Pretoria Academic Hospital and written approval has been granted by that committee (116/99).

Rights as a participant in this study:

Participation in this study is voluntary. No compensation for participation will be given. I may withdraw from this study at any point in time without it affecting my treatment in any way.

Risk and discomfort involved:

The blood test may be a bit painful. All the other physical tests will not be painful at all. You will have to undress for the physical examination, but this will be done in a private place and you will at no stage be exposed to people

other than the researchers. The exercise test and classes, where applicable, will be conducted in a safe place at normal walking speed and contraindications. You may sweat a bit from it, but all patients will be observed for discomfort at all times.

Possible benefits of the study:

The study will contribute to our knowledge of diabetes and may lead to improved care in the future.

Confidentiality:

All records obtained in this study will be regarded as confidential. Results will be published or presented in such a fashion that patients remain unidentifiable.

Information:

If I have any questions concerning this study, I should contact:
Mrs AJ van Rooijen
Tel (012) 3542018
Dept of Physiotherapy
University of Pretoria

Consent to participate in this study:

I have read or had read to me in a language that I understand the above information before signing this consent form. The content and meaning of this information have been explained to me. I have been given the opportunity to ask questions and I am satisfied that they have been answered satisfactorily.

I understand that if I do not want to partake in this study, I shall still receive standard treatment for my illness.

I hereby volunteer to take part in this study. I have received a signed copy of this informed consent agreement.

Patient's name:
Please print

AJ VAN ROOIJEN
Researcher

I, AJ van Rooijen herewith confirm that the above patient has been informed fully about the nature, conduct and risks of the above study.

Witness:
Please print

Date:

VERBAL PATIENT INFORMED CONSENT

(Applicable when patients cannot read or write)

I, the undersigned, Mrs AJ van Rooijen, have read and have explained fully to the patient, named---------- and/or her relative, the patient information, which has indicated the nature and purpose of the study in which I have asked the patient to participate.

The explanation I have given has mentioned both the possible risks and benefits of the study.

The patient indicated that she understands that she will be free to withdraw form the study at any time for any reason and without jeopardising her treatment.

I hereby certify that the patient has agreed to participate in this study.

Patient's name

Researcher's name

Witness' name
(Please print)

Date

APPENDIX 3

QUESTIONNAIRE: PHASE 1

DATA COLLECTION SHEETS PHASE 3

QUESTIONNAIRES: PHASE 3

QUESTIONNAIRE USED: PHASE 1 OF THE STUDY

Demographic questionnaire

V1	Respondent number	☐☐☐ 1-3
V2	Card number	☐☐ 4-5
V3	Area	☐ 6
V4	Age	☐☐ 7-8
V5	Weight	☐☐☐ 9-11
V6	Height	☐☐☐ 12-14
V7	Body Mass Index (kg.m2)	☐☐☐ 15-17
V8	Blood pressure (mmHg)	Systolic ☐☐☐ Diastolic ☐☐☐ 18-23
V9	Pulse rate (min)	☐☐☐ 24-26
V10	Blood Glucose level (mmol/l)	☐☐☐ 27-29

V 11 **Educational level**	None	1	☐ 30
	St 1-4	2	☐
	St 5-7	3	☐
	St 8-10	4	☐
	Post St 10	5	☐
Current employment status	None	1	☐ 31
	Part-time	2	☐
	Full-time	3	☐
	Pensioner	4	☐

V 13 **Housing**	Live with family	1	☐ 32
	Live alone	2	☐
	Other	3	☐

V 14 **Ethnicity**	Black	1	☐ 33
	Indian	2	☐
	Coloured	3	☐
	White	4	☐

DAS 3 ATTITUDE Scale

In general I believe that:

		Strongly agree	Agree	Neutral	Disagree	Strongly Disagree	☐
V15	Health care professionals who treat people with diabetes should be trained to communicate well with their patients	1	2	3	4	5	☐ 34
V16	People who do not need to take insulin to treat their diabetes have a pretty mild disease						☐ 35
V17	There is not much use in trying to have good blood sugar control because the complications of diabetes will happen anyway						☐ 36
V18	Diabetes affects almost every part of a diabetic person's life						☐ 37
V19	The important decisions regarding daily diabetes care should be made by the person with diabetes						☐ 38
V20	Health care professionals should be taught how daily diabetes care affects patient's lives						☐ 39
V21	Older people with Type 2 diabetes do not usually get complications						☐ 40
V22	Keeping the blood sugar close to normal can help prevent the complications of diabetes						☐ 41
V23	Most people can enjoy life and still keep tight blood sugar control						☐ 42
V24	Health care professionals should help patients make informed choices about their care plans						☐ 43
V25	It is important for the nurses and dieticians who teach people with diabetes to learn counselling skills						☐ 44
V26	People whose diabetes is treated by just a diet do not have to worry about getting long-term complications						☐ 45
V27	Almost everyone with diabetes should do whatever it takes to keep their blood sugar close to normal						☐ 46

V28	The emotional effects of diabetes are pretty small						☐ 47
V29	People with diabetes should have the final say in setting their blood glucose goals						☐ 48
V30	Blood sugar testing is nit needed for people with Type 2 diabetes						☐ 49
V31	Low blood sugar reactions make tight control too risky for most people						☐ 50
V32	Health professionals should learn how to set goals with patients, not just tell them what to do						☐ 51
V33	Diabetes is hard because you never get a break from it						☐ 52
V34	The person with diabetes is the most important member of the diabetes care team						☐ 53
V35	To do a good job, diabetes educators should learn a lot about being teachers						☐ 54
V36	Type 2 diabetes is a very serious disease						☐ 55
V37	Having diabetes changes a person's outlook on life						☐ 56
V38	People who have Type 2 diabetes will probably not get much payoff form tight control of their blood sugars						☐ 57
V39	People with diabetes should learn a lot about the disease so that they can be in charge of their own diabetes care						☐ 58
V40	Type 2 diabetes is as serious as Type I diabetes						☐ 59
V41	Tight control is too much work						☐ 60
V42	A person with diabetes can lead a normal life						☐ 61
V43	What the patient does has more effect on the outcome of diabetes care than anything a health professional does						☐ 62

V44	Tight control of blood sugar makes sense only for people with Type 1 diabetes						☐ 63
V45	It is frustrating for people with diabetes to take care of their disease						☐ 64
V46	People with diabetes have a right to decide how hard they will work to control their blood sugar						☐ 65
V47	People who takes diabetes pills should be as concerned about their blood sugar as people who take insulin						☐ 66
V48	People with diabetes have the right not to take good care of their diabetes						☐ 67
V49	Support form family and friends is important in dealing with diabetes						☐ 68

DKN SCALE FORM C

V50	**When a person with diabetes on insulin undertakes unusually heavy exercise, they should have:**	More insulin	1	69 ☐
		Extra carbohydrate (bread) beforehand	2	
		Less food beforehand	3	
		I don't know	4	
V51	**People with diabetes should**	Have their food cooked separately from that of the family	1	70 ☐
		Eat the same foods at the same time each day	2	
		Vary their diet by substituting different foods at the same time each day	3	
		I don't know	4	
V52	**The normal range for blood glucose is:**	4-8mmol/l	1	71 ☐
		7-15mmol/l	2	
		2-10mmol/l	3	
		I don't know	4	
V53	**Rice is mainly:**	Protein	1	72 ☐
		Carbohydrate	2	
		Fat	3	
		Mineral and vitamin	4	
		I don't know	5	
V54	**Insulin causes blood sugar to:**	Decrease	1	73 ☐
		Increase	2	
		Neither of the above	3	
		I don't know	4	
V55	**Which of the following is rich in carbohydrate?**	Meat	1	74 ☐
		Eggs	2	
		Butter	3	
		Corn	4	
		I don't know	5	
V56	**Which of the following is not usually associated with low blood sugar**	Weakness	1	75 ☐
		Hunger	2	
		Chest pain	3	
		I don't know	4	
V57	**If a person on insulin has a high blood or urine sugar level and ketones were present they should:**	Increase insulin	1	76 ☐
		Decrease insulin	2	
		Keep insulin and diet the same and test blood/urine later	3	
		I don't know	4	

V58	**When a person with diabetes on insulin becomes ill and unable to eat the prescribed diet:**	They should immediately stop taking insulin	1	77
		They must continue to take insulin	2	
		They should use tablets instead of insulin	3	
		I don't know	4	
V59	**You can eat as much as you like of which one of the following foods?**	Fruit	1	
		Lettuce	2	78
		Steak	3	
		Honey	4	
		I don't know	5	
V60	**You must avoid becoming overweight if you have diabetes because:**	Insulin can be harmful to overweight people	1	79
		Being overweight makes diabetes worse	2	
		Hypo attacks occur more frequently in overweight people	3	
		I don't know	4	
V61	**Low blood sugar is caused by:**	Too much insulin	1	80
		Too little insulin	2	
		Too little exercise	3	
		I don't know	4	
V62	**Which of the following so-called Diabetic food items are approved by the diabetic clinic?**	Diabetic jam	1	81
		Diabetic jellies	2	
		Sugar free canned fruit	3	
		Low calorie soft drinks	4	
		I don't know	5	
V63	**If someone with diabetes becomes sick and has vomiting and diarrhoea, he/she should:**	Stop all food and drink	1	82
		Take their insulin	2	
		Take sugar sweetened drinks every two hours	3	
		Call the doctor if vomiting persists	4	
		I don't know	5	
V64	**Special DIABETIC foods are:**	Forbidden in a diabetic diet	1	83
		Essential in a diabetic diet	2	
		Acceptable if used selectively and correctly	3	
		Usually more expensive than the non-diabetic equivalent	4	
		I don't know	5	

MOFIFIED BAECKE QUESTIONNAIRE FOR OLDER ADULTS

Household activities

V65	**Do you do the light household work** (dusting, washing dishes, repairing clothes, etc.)	Never (once a month)	0	84 ☐
		Sometimes	1	
		Mostly	2	
		Always	3	
V66	**Do you the heavy housework?** (Washing floors, windows, carrying trash bags)	Never (< once a month)	0	85 ☐
		Sometimes	1	
		Mostly	2	
		Always	3	
V67	**For how many persons do you keep house?** (Including yourself)	***Fill in 0 if answered "never" in questions 65 and 66***		☐☐ 86-87
V68	**How many rooms do you keep clean, including kitchen, bedroom, bathroom, etc.?**	Never do housekeeping	0	88 ☐
		1 to 6 rooms	1	
		7 to 9 rooms	2	
		10 or more rooms	3	
V69	**If any rooms, how many floors?**	*Fill in 0 if "never" in V68*		☐☐ 89-90
V70	**Do you prepare warm meals yourself, or do you assist in preparing?**	Never	0	91 ☐
		Sometimes (once or twice a week)	1	
		Mostly (3-5 times as week)	2	
		Always (more than 5 times a week	3	
V71	**How many flights of stairs do you walk up per day?**	I never walk stairs	0	92 ☐
		1-5 stairs	1	
		6-10 stairs	2	
		More than 10	3	
V72	**If you go somewhere in your hometown, what kind of transport do you use?**	I never go out	0	93 ☐
		Car	1	
		Public transport	2	
		Bicycle	3	
		Walking	4	
V73	**How often do you go out for shopping?**	Never or less than once a week	0	94 ☐
		Once a week	1	
		2-4 times a week	2	
		Every day	3	
V74	**If you go out for shopping, what kind of transportation do you use?**	I never go out	0	95 ☐
		Car	1	
		Public transport	2	
		Bicycle	3	
		Walking	4	

	Sport activities			
V75	**Do you play sport?**	No	0	96 ☐
		Yes	1	
	Name of sport			
	Intensity (code)			
	Hours per week (code)			
	Period of the year (code)			
V76	**Do you have any other physical activities?**	No	0	
		Yes	1	
	Name			
	Intensity (code)			
	Hours per week (code)			
	Period of the year (code)			

HEALTH QUESTIONNAIRE USED FOR SCREENING OF THE PATIENTS IN PHASE 3 OF THE STUDY

Patient name	
Tel Contact no	
Hospital File no	
Study number	

Cardiovascular questionnaire

V1	Have you ever been admitted to hospital because of heart problems? 1= yes 2= no What? Where?	☐ 1
	When?	
V2	Do you suffer from any heart problems? 1= yes 2= no verify from file no verification possible patient says verified form file as being:	☐ 2

Rose questionnaire Dyspnea

V3	Do you get short of breath walking with other people of your own age on level ground? 1= yes 2= no if "no" stop here if Yes" proceed to next question	☐ 3
V4	Do you have to stop for breath when walking at your won pace on level ground? 1= yes 2= no 3= not applicable	☐ 4
V5	Are you short of breath on washing or dressing? 1= yes 2= no 3= not applicable	☐ 5

Section A: Angina

V6	Have you ever had any pain or discomfort in your chest? 1= yes 2= no if "no" proceed to Section C if "yes" ask next question if during the remainder of section A an answer is recorded in a box marked *, proceed to section B	☐ 6
V7	Do you get it when you walk uphill or hurry? 1= yes 2= no 3= never hurries or walks uphill 4= not applicable	☐ 7

V8	Do you get it when you walk at an ordinary pace on level ground? 1= yes 2= no 3= not applicable	☐ 8
V9	What do you do if you get it while walking? 1= stop or slow down 2= carry on 3= not applicable Record "stop or slow down" if subject carries on after taking nitroglycerine	☐ 9
V10	If you stand still, what happens to it? 1= relieved 2= not relieved 3= not applicable	☐ 10
V11	How soon is it relieved? 1= 10 minutes or less 2= more than 10 minutes 3= not applicable	☐ 11
V12	Will you show me where it was? 1= sternum (upper or middle) 2= sternum (lower) 3= Left anterior chest 4= left arm 5= other 6= not applicable Record all areas mentioned	☐ 12
V13	Do you feel it anywhere else? 1= yes 2= no 3= not applicable if "yes" record additional information	☐ 13
Section B: Possible infarction		
V14	Have you ever had a severe pain across the front of your chest lasting for half an hour or more? 1= yes 2= no 3= not applicable	☐ 14
Section C: Intermittent claudication		
V15	IF an answer is recorded in a box marked * no further questions need to be asked Do you get pain in either leg on walking? 1= yes 2= no*	☐ 15
V16	Does the pain ever begin when you are standing or sitting? 1= yes* 2= no 3= not applicable	☐ 16

V17	In what part of your leg do you feel it? 1= pain includes calves 2= pain does not include calves* 3= not applicable	☐ 17
V18	Do you get it when you walk uphill or hurry? 1= yes 2= no* 3= never hurries or walk uphill 4= not applicable	☐ 18
V19	Do you get it when you walk at an ordinary pace on the level? 1 = yes 2= no 3= not applicable	☐ 19
V20	Does the pain ever disappear while you are Walking? 1= Yes* 2= no 3= not applicable	☐ 20
V21	What do you do if you get it while walking? 1= stop or slow down? 2= carry on* 3= not applicable	☐ 21
V22	What happens to it if you stand still? 1= relieved 2= not relieved* 3= not applicable	☐ 22
V23	How soon? 1= 10 minutes or less 2= more than 10 minutes 3= not applicable	☐ 23
Stroke		
V24	Have you ever had a paralysis of the arm or leg or face? 1 = yes 2= no	☐ 24
V25	It lasted 1= less than 24 hours 2= more than 24 hours 3= not applicable	☐ 25
V26	Did a doctor diagnosed stroke 1= yes 2= no 3= not applicable When Where	☐ 26

Arthritis		
V27	Did you ever have a fracture of the hip? 1= yes 2= no	27
V28	Do you fall more than twice a year? 1= yes 2= no	28
V29	Do you have painful knees or hips? 1= yes 2= no	29
V30	Does this limit you walking? 1= yes 2= no 3= not applicable	30
Micro-Vascular disease		
V31	Do you have any ulcerated wounds or cuts on your feet that do no seem to heal? 1= yes 2= no	31
General health		
V32	Do you have any other big diseases that I have not asked you about? 1= yes 2= no what?	32
Retinopathy		
V33	Have you ever been referred to HF Verwoerd or Kalafong Hospital to have your eyes checked? 1= yes 2= no	33
V34	Have you ever had "laser therapy" to your eyes? (Light shot at your eyes) 1= yes 2= no	34

FIELDWORK CLINICAL DATA	
Variables	**Data**
Name	
Informed consent	
Study number	
File number	
HQOL-questionnaire	
Pulse	
Arm circumference	
Blood Pressure	
Height	
Weight	
6-minute walk test	
RPE	
HbA_{1c}	
Next appointment	

Next appointment Maandag/Monday 17 Junie 2002 08:00 Diabetes Exercise/Oefening Tania van Rooijen Tel 6620548	Next appointment Maandag/Monday 17 Junie 2002 08:00 Diabetes Exercise/Oefening Tania van Rooijen Tel 6620548	Next appointment Maandag/Monday 17 Junie 2002 08:00 Diabetes Exercise/Oefening Tania van Rooijen Tel 6620548	Next appointment Maandag/Monday 17 Junie 2002 08:00 Diabetes Exercise/Oefening Tania van Rooijen Tel 6620548
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QUESTIONNAIRE USED FOR PHASE 3

V1	Study number ☐☐		☐☐☐ 1-5
V2	**Age** (in years)		☐☐ 6-7
V3	**Years of schooling** Do not know St 1-4 St 5-7 St 8-10 Post St 10	 1 2 3 4 5	☐ 8
V4	**Home language** (preferred) Zulu Sotho Xhosa Tsonga Pedi Tswana Venda/ Ndebele/ Swazi Afrikaans English	 1 2 3 4 5 6 7 8 9	☐ 9
V5	**Marital status** Single Married Widowed Separated/Divorced	 1 2 3 4	☐ 10
V6	**Employment status** Are you working? Yes No	 1 2	☐ 11
V7	**Kind of work** Selling Domestic Cleaning Dressmaking Office Other (specify) Not applicable	 1 2 3 4 5 6 7	☐ 12
V8	**Remuneration** How do you get money to live? Husband Relatives Piece jobs Pension Friends/ disability/grant/retrenched No answer	 1 2 3 4 5 6	☐ 13

HEALTH RELATED QUALITY OF LIFE QUESTIONNAIRE

Mark only 1 answer

V1	**In general would you say your health is:** Excellent Very good Good Fair Poor	 1 2 3 4 5	☐	14

Circle one number on each line

V2	**I seem to get sick a little easier than other people** Definitely true Mostly true Don't know Mostly false Definitely false	 1 2 3 4 5	☐	15
V3	**I am as healthy as anybody I know** Definitely true Mostly true Don't know Mostly false Definitely false	 1 2 3 4 5	☐	16
V4	**I expect my health to get worse** Definitely true Mostly true Don't know Mostly false Definitely false	 1 2 3 4 5	☐	17
V5	**My health is excellent** Definitely true Mostly true Don't know Mostly false Definitely false	 1 2 3 4 5	☐	18
V6	**Do you have any other long standing illness, disability of infirmity?** Yes No	 1 2	☐	19
V7	**What kind of treatment do you receive for your diabetes?** Injections only Tablets Tablets and injections Nothing (diet)	 1 2 3 4	☐	20

TREATMENT SATISFACTION

The following questions are concerned with the treatment for your diabetes (including insulin, tablets and/or diet) and your experience over the past 2 weeks. Please answer each question by circling a number on each of the scales.

V8 ☐ 21

How satisfied are you with your current treatment?

Very satisfied 6 5 4 3 2 1 0 very dissatisfied

V9 ☐ 22

How often have you felt that your blood sugars have been unacceptably high recently?

Most of the time 6 5 4 3 2 1 0 none of the time

V10 ☐ 23

How often have you felt that your blood sugars have been unacceptably low recently?

Most of the time 6 5 4 3 2 1 0 none of the time

V11 ☐ 24

How convenient have you been finding your treatment to be recently?

Very convenient 6 5 4 3 2 1 0 very inconvenient

V12 ☐ 25

How flexible have you been finding your treatment to be recently?

Very flexible 6 5 4 3 2 1 0 very inflexible

V13 ☐ 26

How satisfied are you with your understanding of your diabetes?

Very satisfied 6 5 4 3 2 1 0 very dissatisfied

V14 ☐ 27

Would you recommend this form of treatment to someone else?

Yes, I would definitely 6 5 4 3 2 1 0 No, I would not

V15 ☐

How satisfied would you be to continue with your present form of treatment?

Very satisfied 6 5 4 3 2 1 0 very dissatisfied

Please make sure that you have circled one number on each of the scales.

Please indicate how often you felt each statement applied to you in the last two weeks from 3 (all the time) to 0 (not at all)

DEPRESSION

		All the time			Not at all	
V16	I feel that I am useful and needed	3	2	1	0	☐ 29
V17	I have crying spells or feel like crying	3	2	1	0	☐ 30
V18	I find I can thing quite clearly	3	2	1	0	☐ 31
V19	My life is pretty full	3	2	1	0	☐ 32
V20	I feel downhearted and blue	3	2	1	0	☐ 33
V21	I enjoy the things I do	3	2	1	0	☐ 34

ANXIETY

		All the time			Not at all	
V22	I feel nervous and anxious	3	2	1	0	☐ 35
V23	I feel afraid for no reason at all	3	2	1	0	☐ 36
V24	I get upset easily or feel panicky	3	2	1	0	☐ 37
V25	I feel like I'm falling apart and going to pieces	3	2	1	0	☐ 38
V26	I feel calm and can sit still easily	3	2	1	0	☐ 39

V27	I fall asleep easily and get a good night's rest	3	2	1	0	☐ 40

POSITIVE WELL-BEING

		All the time			Not at all	
V28	I have been happy, satisfied or pleased with my personal life	3	2	1	0	☐ 41
V29	I have felt well adjusted to my life situation	3	2	1	0	☐ 42
V30	I have lived the kind of life I wanted to	3	2	1	0	☐ 43
V31	I have felt eager to tackle my daily tasks or make new decisions	3	2	1	0	☐ 44
V32	I have felt I could easily handle or cope with any serious problem or major change in my life	3	2	1	0	☐ 45
V33	My daily life has been full of things that were interesting to me	3	2	1	0	☐ 46

DIABETES PROJECT
MAMELODI HOSPITAL
POST TEST QUALITATIVE DATA

NAME
STUDYNO

V1	**Did you enjoy the program?** 1 = yes 2 = some what 3 = no	☐
V2	**If yes, what did you enjoy the most?** 1= exercises at the hospital 2= education 3= meeting other women with diabetes? 4 = everything 5 = not applicable	☐
V3	**Do you want to continue with the program at the hospital?** 1 = yes 2 = no	☐
V4	**What will keep you from coming to an exercise class regularly?** 1 = responsibilities at home 2 = transport fees 3 = nothing 4 = other, please name	☐
V5	**Which day of the week will be best for an exercise class?** 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday	☐
V6	**Is the Mamelodi hospital a suitable venue for exercise?** 1 = yes 2 = no	☐
V7	**Are you interested in becoming a voluntary leader of an exercise support group for women living near to you?** 1 = yes 2 = no	
V8	**If yes, please give your physical address to Debra**	☐
V9	**Do you feel that you as a woman benefited from this program?** 1 = yes 2 = no	☐
V10	**If yes, how?**	
V11	**Do you have any suggestions or comments?**	

BORG RATE OF PERCEIVED EXERTION SCALE

Lebitso la molwetse

Study number:

BORG rate of perceived exertion scale RPE

Tlhagiso ya molomo	Sekala
	6
Botlhofo thata thata (E ya bonagala)	7
	8
Botlhofo thata	9
	10
Botlhofo go le gonye	11
	12
Magareng	13
	14
Bokete	15
	16
Bokete thata	17
	18
Bokete thata thata	19
	20

RPE < 11 e emela **70%** ya pelo e o e otlang sentle ya balwetse

RPE of 12-14 e tsamaelana le go otla ga pelo ya molwetse **70-80%**.

APPENDIX 4

PHYSICAL ACTIVITY DIARY

Physical activity	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
							
							
							
							

Physical activity	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
							
							
							
							

Physical activity	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
							
							
							
							

Physical activity	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
							
							
							
							

APPENDIX 5

HOME EXERCISE

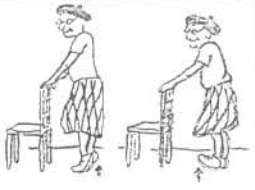
Walk on the spot
Stap op die plek
20X

Shoulder stretch
Relax in position for 60 counts
Skouer strek
Ontspan in posisie vir 60 tellings

Shoulder circles forward and backward
Skouer sirkels vorentoe en agtertoe
10 X

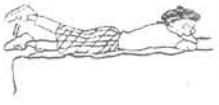
Hamstring stretch
Hold for 30 counts
Hamstring strek
Hou vir 30 tellings

Toe and heel raises
Toon en hak oplig
Count 30 in each direction X 5
Tel 30 in elke rigting X 5

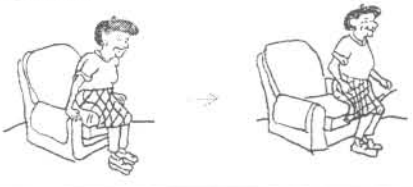


Quadriceps stretch
Hold for 30 counts
Quadriceps strek
Hou vir 30 tellings

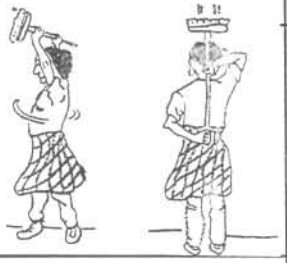
Leg lift
Been oplig
5 X



Hip lifts out of armchair
opstote uit gemakstoel
5 X



Trunk stretch with broom
Lyf strek met besem
Count to 10
Tel tot 10 in elke rigting



Calf stretch
Kuit strek
Count to 30
Tel vir 30

Shoulder stretch backwards
Skouer strek agtertoe
Count for 30
Tel vir 30 tellings

Shake out
Los skut
Vir 20 tellings

March on the spot
20 X
Masjeer op die plek
20X

Push-ups against wall
5 X
Opstote teen muur
5 X

Leg lifts
Each leg X 5
Been oplig
Elke been X 5

Biscep curl
10 X

Leg swings
Been swaai
10 X

Curl-up
Opsitte
2 X

Forearm stretch
Voorarm strek
5 X

Shoulder stretch
Hold for 30 counts
Skouer strek
Hou vir 30 tellings

Arms raise
Arms oplig
Hold for 30 counts
hou vir 30 tellings

Hamstring stretch
Hold for 30 counts
Hamstring strek
Hou vir 30 tellings

Ankle stretch
Enkel strek
Count 30 in each direction X 5
Tel 30 in elke rigting X 5

Quadriceps stretch
Hold for 30 counts
Quadriceps strek
Hou vir 30 tellings

Leg swing
10 X
Been swaaie
20X

Sideward bending
Hold for 30 counts
Sywaarts buig
Hou vir 30 tellings

Elbow and shoulder exercise
Hold for 30 counts
Elmboog en skouer oefening
Hou vir 30 tellings

Strengthening exercise
5 X
Versterkingsoefening
5 X

APPENDIX 6

EDUCATION NOTES

LEARNING ABOUT DIABETES 1

WHAT IS DIABETES?

- Everything we eat (fruit, vegetables, pap, bread and meat) are broker down to sugar (glucose) after eating it
- These sugars goes to the blood and are the fuel (petrol) the body use
- Insulin, that the pancreas (lebete) makes, takes the sugar out of the blood and to the body, where it is used as energy
- People with Diabetes can not use the sugar properly because the suga can not be taken out of the blood into the body itself, not enough insulin
- Sugar stays behind in the blood and that is why we also call Diabetes high blood sugar
- Three important things help us to control the sugar in the blood
    - Medicine
    - Exercise
    - Diet

HOW CAN I CHANGE MY DIET?

- loose weight if you are overweight
- eat small meals often, rather than one big meal a day
- do not skip meals
- always eat when taking medication
- do not eat sugar - also things like brown sugar, jam, syrup, honey, sweets, chocolate, pudding, cake, biscuits, white bread and normal Coke should not be eaten. Rather drink Coke light, Tab or any other diet cold drink and use saccharine in coffee/tea

LEARNING ABOUT DIABETES 2

HOW CAN I CHANGE MY DIET? (continue)

Eat less fat because of the risk for heart disease, by:

- Using low fat/skimmed milk and milk products. Skimmed milk powder are also cheaper than full cream milk powder
- Using very little margarine in a tub rather than a brick
- Using very little peanut butter on bread, without margarine
- Not using coffee creamers like Cremora
- Cutting extra fat off meat
- Taking off the chicken's skin
- Avoiding fatty foods like bacon, polony, viennas, russians, boerewors, meat pies, liver, mala/mogodu, atchar, vetkoek
- Not using fish oil to cook or add it to food
- Rather cooking, steaming, roasting or baking food
- Using fish canned in water NOT oil
- Using low fat mayonnaise and salad dressing

Eat more fibre (roughage) to help lower blood sugar by:

- Using wheat products with fibre like brown bread, provitas, weetbix, samp, jungle oats, mabela
- Eating at least one fruit and one vegetable a day (with skin and raw if possible) REMEMBER fruit have natural sugar in and should be eaten in small amounts
- Eating legumes like dried beans, lentils, soya beans, dried peas one to twice a week. This can be used in soup or with meat dishes to save money on meat

LEARNING ABOUT DIABETES 3

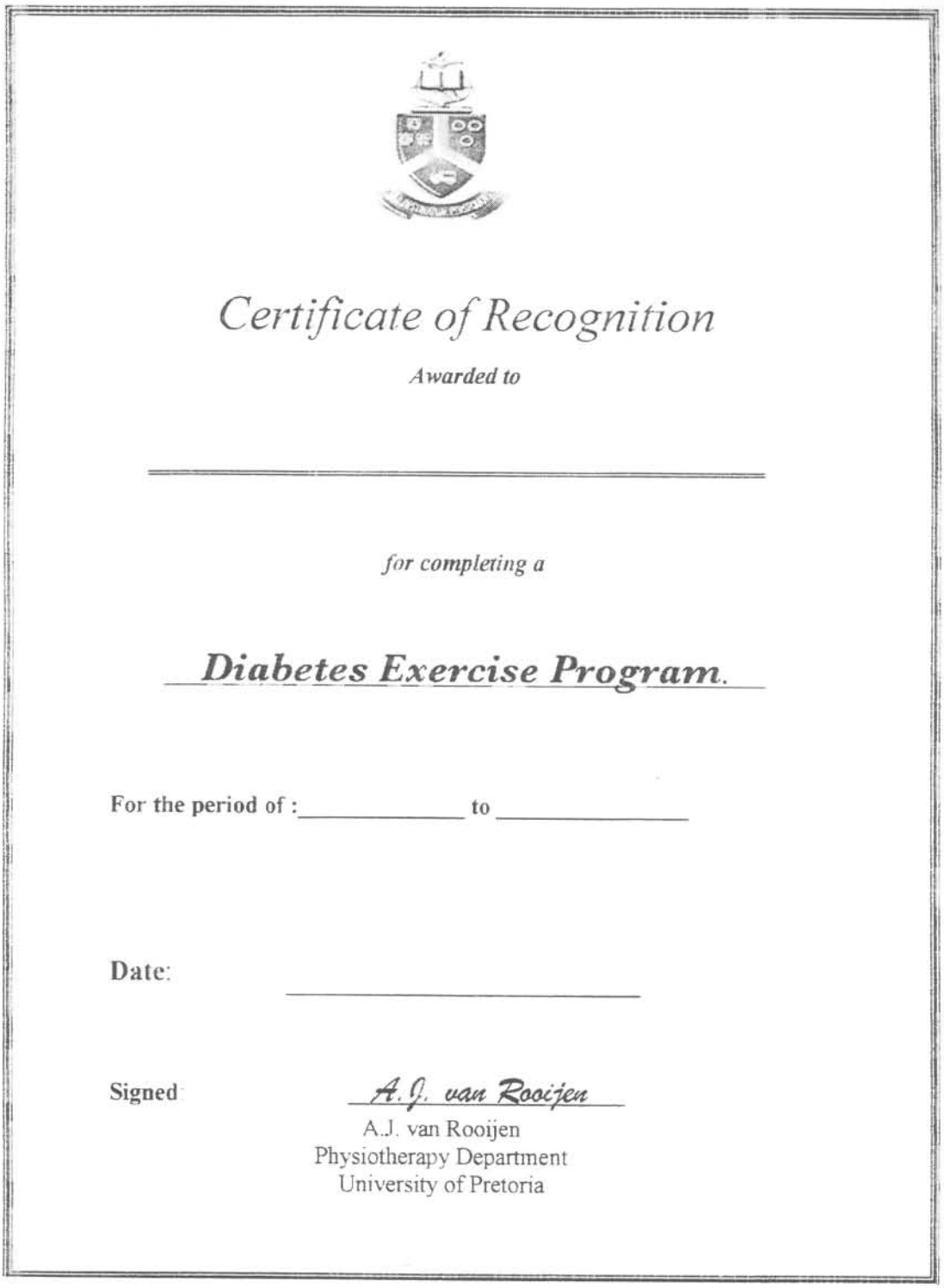
HOW CAN I CHANGE MY DIET? (continue)

Eat less salt because of hypertension and the risk for kidney disease by:

- Adding very little salt when cooking and NO salt afterwards
- Avoiding products in bottles, like
  - Tomato sauce, mustard sauce, Worchester sauce, soya sauce
  - Chutney
  - Beef and chicken stock
  - Aromat
  - Chicken and barbeque spice
  - Garlic and onion salt
  - Bovril, oxo and marmite
  - Fish paste, sandwich spread
- Avoiding products in packets, like
  - Soup powder (Maggie) and gravy powder (Bisto)
  - Soya mince (Imana, Toppers)
- Avoiding products in cans, like
  - Canned vegetables (mixed vegetables, green beans)
  - Bully beef
  - Canned fish in brine
  - Canned soup
  - Spaghetti in tomato sauce, baked beans
- Avoiding snacks and high salt foods, like
  - Crisps (Simba)
  - Salted peanuts and biscuits
  - Processed meat (polony, salami, viennas, boerewors)
  - Meat pies
- Use the following products to flavor food with
  - Herbs, like parsley, sage, thyme and mixed herbs
  - Pepper, curry, turmeric, mustard powder, paprika, coriander
  - Nutmeg, cinnamon, vanilla essence
  - Onions, tomato, onion, chillies, green pepper, garlic
  - Vinegar, lemon juice

APPENDIX 7

CERTIFICATE OF RECOGNITION



Certificate of Recognition

Awarded to

_____

for completing a

Diabetes Exercise Program.

For the period of :_____ to _____

Date: _____

Signed *A.J. van Rooijen*

A.J. van Rooijen
Physiotherapy Department
University of Pretoria