Chapter – 1

INTRODUCTION

Diabetes\(^1\) is perhaps as old as mankind. Cognizance of related to diabetes and recognition of the disorder was confined to a few geographic and cultural locations in the Ancient Era (up to 600 A.D.) The knowledge acquired this period was lost sight of progress was tardy and indiscrete during the medieval period (600-1500 A.D.). With the advent of Modern Age (1500-1750 A.D.) and its progression to renaissance and industrial revolution (1750-1850 A.D.) certain key features of diabetes were rediscovered and some new in formations were generated which stand out as landmarks in characterizing diabetes. During the later decades of 19\(^{th}\) and first half of the 20\(^{th}\) centaury, all round progress was achieved in the knowledge of pathology, predisposing factors, management, course and complications of diabetes mellitus. Growth of knowledge has been very fast in course of the second half of the last centaury (contemporary period) involving epidemiology, genetics, immunology and molecular biology, which has led to accumulation of voluminous informations on various aspects of this versatile disorder.

\(^1\) MMA Ahuja Et.al., “RSSDI Text Book of Diabetes Mellitus,” (Hyderabad, RSSDI, 2000) p- 1.
Diabetes\(^2\) is one of the leading causes of death in the developed countries. This disease has apparently plagued man for a very long time, since the writing from the earliest civilization (Asia Minor, China, Egypt and India). The term diabetes is derived from the Greek word meaning siphon, or the passing through of water, while mellitus is Latin for honeysweet. Diabetes is also as common in India as in other parts of the world. Mankind knows it from time immemorial. Indian physician, Sushruta & Charak (about 500 A.D.) described the disease as “Madhumeha” (passing honey urine) with symptoms of thirst, foul breath and voracious appetite.

Diabetes mellitus constitutes of a number of heterogeneous chronic metabolic disorders involving the principal metabolic fuels (carbohydrate & fats) as well as the proteins. The disorder results from relative or absolute deficiency of insulin secretion (production). Hence the syndrome of diabetes mellitus is characterized by chronic hyperglycemia with or without glucosuria and a tendency to develop ketoacidosis, polyuria, polydipsia, asthenia, and weight loss are the cardinal symptoms, but may not be present in a sizeable proportion of

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cases. There is an increase in the susceptibility to bacterial and fungal infections.

Primarily diabetes evolves from interaction of genetic and environmental factors. Diabetes also occurs in association with some well-defined genetic syndromes and acquired disorders of the pancreas or the endocrine apparatus as well as in a number of other situations—with changing environment urbanization and altered life style. Diabetes mellitus is identified as a major cause of morbidity and mortality in India; further, Indians have a high ethnic susceptibility for developing diabetes at a younger age group and develop vascular complication earlier and more frequently during the natural progression of the disease.

There are two major forms of diabetes mellitus: - Type -1 (IDDM) and Type - 2 (NIDDM). IDDM can occur at any age but especially in the young. (The beta cells of the pancreas of IDDM patients which normally produce and secrete insulin are destroyed by immune system.) Only about 10% of all diabetics have IDDM. NIDDM accounts for approximately 90% of all cases, usually occurs in people over age 40, and most frequently in the age of 55 and over group.
Approximately 85% of patients with NIDDM are obese at the time of diagnosis.

The prevalence\(^3\) of diabetes is increasing quite rapidly in our country. In fact, most people now feel that we should consider this as an "epidemic". Globally there were estimated to be approximately 135 million adults with diabetes in 1995. By the year 2025 the figure is expected to 300 million, an increase of approximately 120 % whereas the rise will be of 40 % in the developed countries, it will be 170 % in the developing countries by the year 2025. For both 1995 and 2025, the "Top Three" countries for number of persons with diabetes are India, China and United States of America.

The reasons that type 2 diabetes\(^4\) occurs are different from those that trigger type 1 diabetes. Unlike people to produce insulin, people with type 2 diabetes produce insulin. But, either the body does not respond to insulin's action - it's resistant - or there is just not enough insulin to go around - there's too much body for the amount of insulin that's made. Either problem leads to the cells that need it, and there's

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too much glucose to the cells that need it, and there's too much glucose in the blood.

Virtually all cells in the body contain special proteins called receptors that bind to insulin. They work like a lock and key. In order for glucose to enter the cell, insulin (the key) must first fit into the insulin receptor (the lock). But for some reason, in some people with type 2 diabetes, there is a faulty lock, or insulin receptor. The key doesn't open the lock, and glucose is shut out of the cell. And in some people with type 2 diabetes, there are not enough locks, or insulin receptors, on the cells to allow enough glucose to enter. But for most people with diabetes, it's not so much that the key doesn't fit the lock, but that insulin doesn't work properly. In rare cases, the insulin is mutated or built incorrectly, and does not fit the insulin receptor.

In addition to problems with insulin and the insulin receptor, in many people with type 2 diabetes, the beta cells in the pancreas do not produce enough insulin. Without enough insulin to meet the body's needs, glucose levels raise and diabetes results. Scientists do not know why the pancreas does not function well in these people. Some believe that the system that controls glucose levels in the blood does not function properly. Others think that the pancreas, after many years of
overtime, overproducing insulin to overcome insulin resistance, simply begins to "burn out." Although researchers do not fully understand why type 2 diabetes develops.

The role of exercise in diabetes has been known since ages. Our ancient ayurvedic physician Sushruta and Charak knew the importance of exercise in the treatment of the diabetes. They stressed the need for vigorous exercise in the obese diabetics, like wrestling, sports, horse-riding, long walks, etc., while in thin diabetics were not allowed vigorous exercises.

Researchers have shown repeatedly that physical exercises can improve both the health and disease status of diabetics. Exercise has been often advised as a first step in the treatment of type-2 diabetes mellitus along with diet. The American Diabetic Association also recommends regular physical activity as part of the standard treatment for type-2 diabetes mellitus.

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Recent\textsuperscript{7} clinical trials, and a number of large cohort studies, provide strong evidence for the value of physical activity in reducing the incidence of type 2 diabetes. The Da Qing IGT and Diabetes Study (103) was the first randomized trial evaluating lifestyle interventions for the prevention of type 2 diabetes. In this study, 577 people with IGT from 33 clinics were randomized, by clinic, to diet only, exercise only, diet plus exercise, or control. After 6 years of follow-up, cumulative incidence of type 2 diabetes was 68\% in control, 44\% in diet only, 41\% in exercise only, and 46\% in diet plus exercise groups. This study provides evidence that both diet and exercise can be effective diabetes prevention modalities.

Regular exercise\textsuperscript{8} programs have proved effective in controlling the risk factors associated with macro-vascular disease in non-diabetic patients and the diabetic patients are also likely to drive a similar benefit from a regular exercise program. Exercise improves the condition of diabetic patients due to several factors. There is an increase in the number of insulin receptors as well as the sensitivity of insulin receptors. Both these factors help in the control of 2-3 DPG levels in the RBC and reduction in the HbA1c. These promote the

\textsuperscript{7} Ronald J. Sigal et al., "Physical Activity / Exercise and Type 2 Diabetes", Diabetes Care 27;10 (Oct 2004) p. 2524.
\textsuperscript{8} Ibid.
delivery of oxygen to the peripheral tissues, which results in the improved efficiency of the diabetic Physical exercise improves the glucose tolerance in some non-insulin dependent diabetes and insulin dependent diabetes, thereby reducing the insulin requirements.

More than 2000 years back⁹, Charak in his Charak Sahita advocated the use of exercise in treating diabetes. In fact, the use of exercise in the treatment of diabetes was prescribed as early as 600 B.C. by the Indian physician Sushruta, and was widely recommended by physicians of the 18th century. Elliott Joslin, often called the father of modern diabetes, identified exercise along with dietary management and insulin administration as one of the three components of good therapy in the 1920's.

It could be argued that in the absence of any other forms of treatment, the older day physicians had no choice but to fall back on diet and exercise. Later with the wide availability of oral hypoglycemic agent and insulin, the relative importance of exercise as a treatment for diabetes seemed to go into a decline from which it is just emerging.

If a diabetic can be managed with the use of diet and exercise alone, or if the addition of exercise can lead to a substantial decrease in the dose of the oral agent or the insulin, can there be any justification for not prescribing exercise to the diabetic!

During prolonged\textsuperscript{10} exercise blood insulin concentrations drop, while blood glucagon concentrations increase. These changes take place to counterbalance the “insulin – like” effect of muscle contraction. As the muscles contract during exercise, they do not need the same amount of insulin needed during rest to transport glucose into muscle cells. This is because the movement of the muscle cells during exercise makes their membrane more permeable to glucose. The exercising muscle may increase uptake seven to twenty fold during the first 30 -40 minutes depending on intensity. In addition, the receptors become more “sensitive” to the lower amount of insulin present during exercise.

Insulin\textsuperscript{11} sensitivity improves after long – term training by diabetics, this advantage is rapidly lost if exercise is stopped. It appears that each bout of exercise leads to an improvement of insulin sensitivity.


\textsuperscript{11} Ibid.
that lasts for one to two days and which then can be just as quickly negated by a lack of exercise for two days. In other words, exercise by diabetics must be regular to maintain enhanced insulin sensitivity.

The science of Yoga\textsuperscript{12} is an ancient one. It is a rich heritage of our culture. It has become the subject of modern scientific evolution, resulting in the recognition of some of its influences on the human body and its metabolism. Several older books make a mention of the usefulness of yoga in the treatment of certain diseases such as diabetes, hypertension, bronchial asthma, obesity etc.

It has been observed that practice of pranayama (such as bhastrika) and asanas (such as dhanurasana, halasana, ardh machsyendrasana, pachimotanasana etc.) produce a significant fall in the fasting blood sugar and post-prandial blood sugar. This effect is also observed in both NIDDM and IDDM patients with reduction in the drug requirement, development of a sense of well-being and normalization of the insulin/glucose ratios.

Diet and exercise\textsuperscript{13} is the mainstay of good diabetes management. In fact, many patients can be controlled quite adequately with the use of diet and exercise alone. In pointing out the importance of exercise, one is not saying anything new. More than 2000 years ago Sushruta advocated the use of exercise in the management of diabetes. Unfortunately, with the advent of insulin and oral agents, the role played by exercise went into an eclipse from which it is now emerging.

A regular program of exercise not only helps in correcting many of metabolic abnormalities associated with diabetes, but also makes the person more fitter and healthier person. Exercise decreases the blood glucose levels, it leads to an increase in insulin sensitivity, decrease the levels of triglycerides and the LDL-cholesterol, whilst increasing the HDL-cholesterol values.

One great benefits\textsuperscript{14} of regular exercise, especially aerobic exercise, is that it improves heart, lungs, and blood vessels (cardiovascular system) and protects against heart disease and stroke. It does this by strengthening your heart and circulatory system. This is important for anyone, but especially for people with diabetes, who are

\textsuperscript{13} Arvind S. R. and Sadikot S.M., "A Clinical Approach to Diabetes Mellitus" (Hyderabad, Pragati Art Printers), p. 58.

\textsuperscript{14} Touchette Nancy, PhD, "American Diabetes Association Complete Guide to Diabetes, 2\textsuperscript{nd} Indian Edition" (New Delhi, Replika Press Pvt Ltd.), pp. 266 – 267.
at greater risk for developing hardening of the arteries (arteriosclerosis) and other types of cardiovascular disease. Active movement, the kind that makes you breathe a little deeper and gets your heart pumping, improves the flow of blood through your blood vessels. Exercise helps to decrease blood cholesterol and increase levels of “good” high-density lipoprotein (HDL) cholesterol in the blood. Not only that, exercise removes glucose from your blood, both while you are exercising and for several hours afterward. For people who treat their diabetes with insulin, this could mean that you can use less insulin or eat more on the days you work out. For people with type 2 diabetes, a regular exercise program combined with a healthy diet could mean that you can control your diet without the use of insulin or oral agents, or that you can get by with less medication.

Regular exercise not improves only glucose level but also improves physical and mental health, which is very important for healthy living.

The role of exercise\textsuperscript{15} in the prevention of NIDDM may be considered at three levels: primary (avoiding disease occurrence), secondary (early detection and reversal), and tertiary (prevention or

\textsuperscript{15} http://www.lifescan.com/links/ada/exercise/ -
delay of complications). Metabolic studies suggest the major effect of exercise is at the level of insulin sensitivity and resistance. Therefore, exercise may have the greatest benefit in primary prevention and in the early stages of the disease. Recent epidemiological studies of active and inactive populations provides evidence that exercise reduced the development of NIDDM even after adjusting for body-mass index, smoking, hypertension, and other coronary risk factors. There is also evidence that exercise has a beneficial effect on patients with diagnosed NIDDM. After a 2 year follow-up to a community-based exercise trial in a Native-American population, diabetic participants in an exercise program compared with diabetic no participants experienced weight loss, drop in fasting blood glucose values, and reductions in the use of hypoglycemic medications. Thus, when performed on a regular basis, exercise may improve glycemic control. Exercise may also improve several risk factors for coronary heart disease including hypertriglyceridemia, hypertension, and hyperinsulinemia. Furthermore, exercise may be a useful adjunct to diet in producing weight loss. Infect, the combination of diet and exercise more be successful in reducing body fat than is either treatment alone. Exercise increases glucose control whereas diet treatment alone has little effect
on insulin resistance. Exercise may also have important psychological
effects in NIDDM by reducing psychological stress, increasing feelings
of well-being, and improving the quality of life.

When prescribing exercise for NIDDM primary prevention
several factors must be considered. These include the age of the
subjects, socioeconomic and demographic characteristics of the target
population, and whether exercise will be combined with diet. The latter
issue is particularly important because of the prevalence of obesity
among NIDDM patients. Another consideration is the extent to which
subjects require screening for coronary disease. In one exercise study
involving men aged 33 to 69 with Type II diabetes or glucose
intolerance, 22.9% had ischemic ECG changes during a symptom
limited exercise test. Thus, before diabetic or pre-diabetic individuals
begin a vigorous exercise, it is necessary to rule out contraindications
in order to prescribe exercise at safe levels. In addition to assessing
coronary artery disease, an exercise test would provide objective
measurement of physical fitness.

The exercise prescription must be individualized to reflect the
severity of diabetes and metabolic imbalance, coronary artery disease
status, fitness status, recreational interests of the subjects, and other
practical considerations such as patient acceptability, home based versus a facility based program, availability of equipment, time, and travel. To facilitate compliance and to avoid musculoskeletal injuries, the exercise prescription must be progressive starting with short durations and mild intensities that will be increased over time. Warm-up and cool-down periods must be included. The program should be primarily aerobic with some allowance for muscle strength and flexibility exercises. To assure patient acceptability and long-term compliance it may be necessary to prescribe or advise activity at levels less than what is thought necessary to improve maximal oxygen uptake and physical fitness. Beneficial changes in metabolic factors may occur at all physical activity levels. One strategy might be to encourage any increase in physical activity levels although levels associated with gains in fitness might be more desirable. Programs that emphasize activities such as brisk walking or cycling may achieve greater effectiveness than programs requiring vigorous efforts and marked lifestyle changes that are difficult to sustain over a long period of time.

Another issue is whether the effects of exercise are transient or cumulative. The effects of exercise on reducing insulin resistance appear to be short-lived, and frequent and regular exercise sessions are
necessary to maintain improvement. One study showed that when the intervening effects of the last exercise bout or body composition changes were controlled, exercise training per se leading to increased cardio respiratory fitness had no independent impact on insulin action and did not improve the insulin resistance in obese or diabetic men. Thus, the timing of metabolic testing relative to the last exercise session must be considered. However, there are other benefits to the patient including increased cardiovascular endurance, reductions in CV risk factors, and prevention or attenuation of diabetes -related CV complications.

But in India, medicines are the main line of treatment, because of lack of knowledge in the field of physical education & its role in the treatment of different diseases, which, have many adverse /negative effect on physical as well as mental health of the people. And also maximum work in this field was done by medical persons especially in foreign not in India. I.e. the scholar was interested to take this study, so that the adverse effect of diabetes may be minimized?
Statement of the Problem

The purpose of this study was to find out the effect of exercise on different age group patients with Diabetes. Diabetes is most profound health problem associated with Indians. Its prevalence is increasing day by day because of life style, unhealthy practices and faulty food habits etc.

Use of exercise therapy to treat and also as a preventive and control measure against diabetes, is increasingly accepted among medical fraternity. Though efficacy of exercises for diabetic patient is readily accepted a frequent dilemma was always faced in terms of prescribing an exercise regime or program. What kind of exercise to suggest what intensity, frequency and duration to recommend considering exact pathological status / severity of diabetic patient etc. Answer to such was always somewhat vague and ambiguous.

In actual practice too, the prevailing situation was a general recommendation of host of common exercises without any comprehensive detail. Neither doctor nor patient had clear understanding and adhered to exercise program and monitoring of it so exactly to know the therapeutic effect. Both remains contained with the
feel good factor of initial effect of exercises. Moreover there were no comprehensive suggestions to understand what exercise program to follow based on true experimentations of various degrees of ailment and corresponding benefit with a definite exercise program.

A dire need of individualized exercise program was often felt.

For this very reason scholar was interested to find out in minute detail about the effect of exercise therapy on diabetic patient and designed a comprehensive exercise program. Further another objective of study was also to recommend comprehensive guidelines to plan exercise program for varying level of diabetes mellitus.

**Delimitations**

The study was confined within following: -

1- the study was delimited to the Type-2 diabetes (NIDDM).

2- the study was further delimited to the male subjects only.

3- the study was further delimited to the following different age groups: - Below 40; 40 -50; above 50 to 60 years.
Limitations

Although research scholar tried every possible measure to conduct the investigation under control conditions, but there were possibilities such as the life style, food habits and daily routine that might affect insignificantly the result of the study.

Hypothesis

From the scholar's own understanding of the problem, on the basis of the knowledge reflected by the available literatures and based on research findings, it was hypothesized that:

1. There will be significant effect of exercise therapy on different age group patients with diabetes mellitus.

2. The exercise therapy will significantly reduce drug dependency among diabetic patients.

3. The effect of exercise therapy among different age group diabetic patients will not be significantly different.
DEFINITIONS AND EXPLANATION OF THE TERMS

Diabetes:

Diabetes\textsuperscript{16} is a heterogeneous chronic metabolic disorders characterized by hyperglycemia resulting from defect in insulin action and / or deficiency of insulin secretion.

Diabetes\textsuperscript{17} Mellitus is a group of metabolic disorders characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both.

Non-Insulin Dependent Diabetes Mellitus\textsuperscript{18} (NIDDM) / Type 2 Diabetes:

People with this diabetes produce insulin. But, the body does not respond to insulin’s action- it’s resistant – or there is just not enough insulin to go around – there’s too much body for the amount of insulin that’s made. Problem leads to the same outcome; insulin can’t deliver glucose to the cells that need it, and there’s too much glucose in the blood.

Fasting Blood Glucose Test: -

Fasting blood glucose test means measurement of blood glucose level, before any meal in the morning i.e. empty stomach.

Post Prandial (P.P.) Blood Glucose Test: -

P.P. blood glucose testing means measurement of glucose level after two hours of first proper meal, in the blood.

Glycated Hemoglobin Testing: -

HbA1c testing means measurement of the concentration of hemoglobin molecules, which are found in the red blood cells that have glucose attached to them. This tells what the average blood glucose level was over the past three to four months.

Significance of the Study

The result of the study will contribute in the promotion of exercise therapy in geriatric patients as well as fit people in the following ways:

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20 Ibid. p. 820.

i) The result of the study will help in formulating the exercise program for diabetes patients (NIDDM).

ii) The result of the study will also help to reduce the life shortening effects due to diabetes mellitus. (Such as heart problems, paralysis, coma, weakness of limbs joints & kidney problems etc.)

iii) Exercise therapy will also help in reducing the life shortening effect of old age such as decrease gastro – intestinal function, poor cardio-respiratory fitness, loss of bone mineral mass, decrease in liver & kidney function etc.

iv) As every body knows that almost all medicines have negative side effect on the body, especially in old age. Because their ability to metabolize drugs reduces, thus the result of the study might help to minimize the use of medicine.

v) After some modification in exercise program, might be used for any age & sex group.