# Prevalence And Etiology Of Diabetes Mellitus Among Tribes Of Shervaroy Hills

By

M. Kavitha

A THESIS SUBMITTED TO THE AVINASHILINGAM INSTITUTE FOR HOME SCIENCE AND HIGHER EDUCATION FOR WOMEN - DEEMED UNIVERSITY, COIMBATORE - 641 043

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

**MASTER OF SCIENCE IN FOOD SERVICE MANAGEMENT AND DIETETICS**

MAY - 1999

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CERTIFIED AS BONAFIDE RESEARCH WORK

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# Acknowledgement

## *ACKNOWLEDGEMENT*

*The investigator owes her reverential gratitude to* ***Dr.(Tmt.) Rajammal P.Devadas, M.A.,M.Sc.,Ph.D.,(Ohio state),D.Sc.,(Madras), Hon.D.H.L. (Oregon state),Hon.D.H.L. (Ohio state), Hon.D.Sc.,(C.Azad Agri University, Kanpur), Hon.D.Sc.,(University of Ulster, Northern Ireland),*** *Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women - Deemed University, Coimbatore, for facilitating the conduct of this study.*

*Heart felt gratitude is expressed to* ***Dr.(Tmt.) Lakshmi Santa Rajagopal, M.Sc.,(Tennesse), Ph.D.,(Madras),*** *Vice Chancellor, Avinashilingam Institute for Home Science and Higher Education for Women - Deemed University, Coimbatore for providing all the amenities required for the conduct of the study.*

*The researcher expresses her profound sense of gratitude and sincere thanks to* ***Dr.(Tmt.) Saroja Prabhakaran, M.A., Dip.Ed., (Madras), Ph.D., (Mother Teresa),*** *Registrar and Director, Hall of Residence, Avinashilingam Institute for Home Science and Higher Education for Women - Deemed University, Coimbatore, for extending all the help for the smooth conduct of the study.*

*The researcher expresses her reverential gratitude to* ***Dr.(Tmt.) Parvathi Eswaran M.S. (Columbia), Ph.D., (Madras),*** *Dean, Faculty of Home Science, Professor and Head of Department of Food Service Management and Dietetics, Avinashilingam Institute for Home Science and Higher Education for*

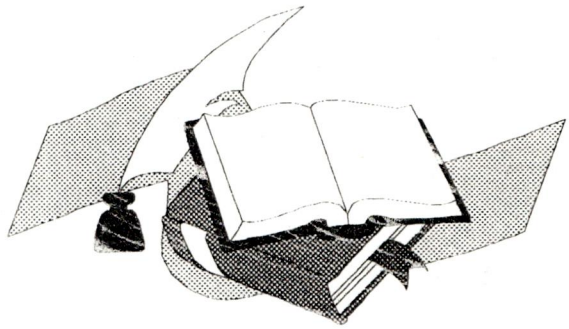
*Women - Deemed University, Coimbatore, for her encouragement and interest shown throughout the study.*

*The researcher acknowledges her sincere thanks to* ***(Tmt.) G.Vasanthamani, M.Sc.,Dip.Ed.,M.Phil.,(Madras),*** *Lecturer (Sele.Grade), Department of Food Service Management and Dietetics, Avinashilingam Institute for Home Science and Higher Education for Women - Deemed University, Coimbatore who is a vestibule store house of information and whose valuable guidance and constructive suggestions helped the research in an immeasurable way.*

*She is deeply thankful and happy to record her gratitude to her beloved parents and brother for their moral support and encouragement, support, co-operation and good wishes in carrying out the study successfully. Also she gratefully acknowledges the timely help and suggestions received from her friends and well wishers, who have made things work-out the best.*

*The investigator regards her sincere thanks to the subjects for their co-operation rendered throughout the study.*

*Finally she bows to the glory of god and his manifold mercies on her to carry out the study successfully.*



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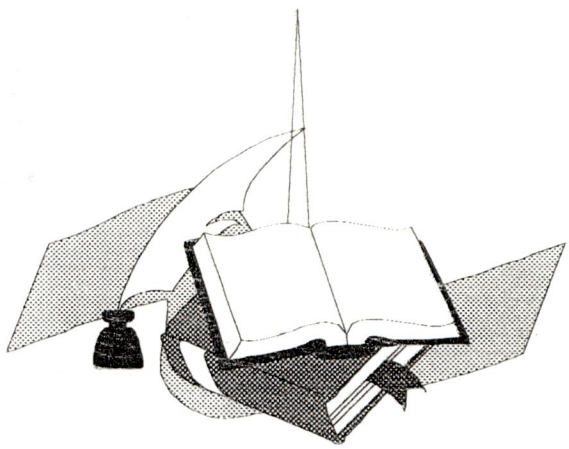


# Introduction

# I INTRODUCTION

"Health is mainly an issue of doctors, social services and hospitals. It is an issue of social justice" (Park, 1997).

Itagi (1998) has stated that "Health is not everything, but every thing is nothing without health".

Health is a common theme of all communities. The 30th World Health Assembly resolved that the main social target of government and World Health Organisation (WHO) in the coming decades should be "Health for all by 2000 A.D". Equity in health and health care must be placed higher on the public agenda (Mehta, 1998).

Health in the broad sense of the word does not merely mean the absence of disease or provision of diagnostic, curative and preventive services, but also the ability to lead a "Socially and economically productive life".

Health is multidimensional. Health and disease lie along a continuum, and there is no single cut-off point. The lowest point on the health disease spectrum is death and the highest point corresponds to optimum wellbeing (Jones, 1994).

Many current - day health problems especially in the developed countries (e.g., coronary heart disease, obesity, lung cancer, drug addiction) are associated with life style changes. In developing countries such as India where traditional life styles still persist, risks of illness and death are connected with lack of

sanitation, poor nutrition, personal hygiene, elementary human habits, customs and cultural patterns (Park, 1997).

Non communicable diseases such as cancer and heart disease account for about 19 million deaths or 36 per cent of the global total, divided more or less equally between the developing and the developed world (World Health Report, 1995).

Many epidemiological studies have shown that, lately there has been a sudden rise in the prevalence of diabetes mellitus along with heart disease and other ontological disorders. This rise has been particularly sharp during the past decade and it will be more appropriate to call it as epidemic.

Diabetes mellitus is gaining ground throughout the world, in both developed and developing countries. It is the most common endocrine disorder caused by inherited or acquired deficiency in the production of insulin by the pancreas, which results in an increased concentration of sugar in the blood. It is known to affect more than 50 million people and in extreme cases it may affect 30 to 40 per cent of adults, against 2 to 4 per cent in industrialised world (Hoet, 1991). World-wide prevalence of diabetes is 1.3 per cent (ICMR, 1993).

World Health Forum (1994) indicated that number of people with diabetes could exceed 100 million world wide by the end of the century compared with an estimated 60 million three years ago. Recently the World Health Report

(1997) stated that the number of people with diabetes is expected to more than double from 135 million now to 300 million by 2025.

In India the total diabetic population of four million or less given by ICMR in 1974, when compared to that of 18 millions as given by WHO in 1994, showed a four fold rise in diabetes in past 20 years. This figure is likely to increase to 28 million by the turn of this century (Raheja, 1995).

Washora (1992) reported that in India, the number of diabetics in 1990 was 1.5 crores and by the year 2000, it is going to be around 3.5 crores.

Gopalan (1993) has pointed out that about one third of India's population will be diabetic by 2000 A.D. Among them more than 90 per cent of all diabetics belong to the non-insulin dependent type (NIN, 1997).

Epidemiological studies have established prevalence of diabetes mellitus in India as 1 to 2 per cent (Park, 1994). Diabetes is one of the leading causes of death in the developed countries. In United States of America (USA) it is the fourth leading cause of death and in atleast 30 other developed countries it is a leading cause of death.

A survey conducted by the Diabetes Research Centre in a semi urban area in South India showed that the prevalence of diabetes among Indians is as high as 5 per cent (Vijay, 1998).

As per WHO (1997), as people live longer, the risk of non communicable disease grows and the doubling of the number of people with diabetes

forecast because of ageing of the population and a rise in unhealthy diets, obesity and sedentary lifestyle.

Diabetes mellitus is a multifactorial disease. The etiopathology of the disease are heredity, stress, infection, altered immune function and altered metabolic and physiological status (ICMR, 1993).

Unhealthy life styles leading to obesity, lack of exercise and inappropriate diet lie at the root of the disease.

Santiago (1994) indicated that obesity, is probably the most powerful risk factor, and even small weight losses are associated with a change in glucose levels towards normal in many persons with non-insulin dependent diabetes mellitus (NIDDM).

Antia (1997) has pointed out that heredity plays the most important role in conferring susceptibility to diabetes. The closer the relationship of a person to a diabetic, the greater are the chances of developing the disease. When both parents are diabetic, the chances of the children getting diabetes are considerably increased.

Shills **et al**., (1994) gave the symptoms of diabetes as polyuria, polydypsia, polyphagia, rapid weight loss, general weakness, blurred vision and recurrent infection.

The disease was often asymptomatic in its early stages, but the long term effects include severe neurological, cardiovascular, ocular, renal complications and gangrene of lower extremity.

Park (1997) has indicated that rates of disability are in general about two to three times as great in diabetics as in non-diabetics. The problem is of such great magnitude for appropriate measurements to prevent the onset of diabetes and/or delay its complications.

According to Bennette and Knowler (1990), it is widely believed that the frequency of diabetes is increasing in many parts of the world, especially in populations that have undergone rapid acculturation to a more 'Western' life style. The evidence to suggest such changes has come largely from the demonstration of unusually high prevalence rates of diabetes among many native populations who have adopted to a varying degree, western foods, whose dependence on physical activity has diminished as a result of increased mechanization and among whom it seems unlikely that diabetes has existed at its present frequency for prolonged periods of time.

Life expectancy in India has moved upwards from 41.2 in 1960-61 to 59 in 1990-91 and is expected to reach 64 by the turn of the century. Because of this progress, the number of persons who are potentially susceptible to diabetes by virtue of age, has increased considerably (Nair, 1996).

No published data are available about diabetes prevalence or incidence in specific populations using identical test procedures and criteria for the diagnosis of the disease.

On the other hand migrant studies or comparison of diabetes frequency in persons of the same genetic background living in an urban and rural environmental level credence to the view that some populations like tribes may indeed have undergone remarkable increases in the prevalence and incidence of diabetes over a relatively short time period.

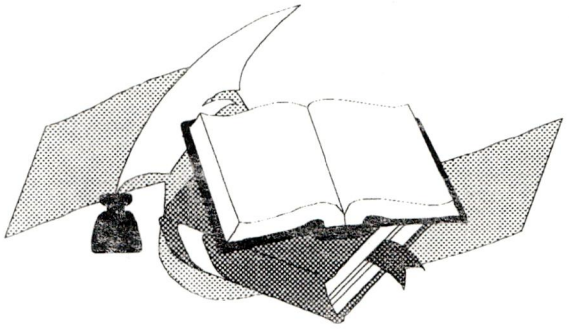
This statement makes it imperative to study the incidence of diabetes mellitus among various population groups, especially the tribal groups, who are slowly coming out of their traditional life style pattern to more modern practices. It is necessary to conduct health and nutritional studies on these vulnerable groups to take necessary steps towards improving the overall health status. Keeping this in view, the present investigation has been undertaken to study the prevalence of diabetes mellitus among the tribal population inhabiting the Shervaroy hill ranges located in Salem district of Tamil Nadu. Following are the objectives of the study.

A. Locate three hamlets inhabited by tribal groups in Shervaroy hills.

B. Find out the percentage prevalence of diabetes mellitus among this population.

C. To identify the etiological factors responsible for diabetes mellitus.

D. Impact and evaluate diet counselling on the tribal diabetics



# Review of Literature

# II. REVIEW OF LITERATURE

The review of literature pertaining to the present study entitled "Prevalence and etiology of diabetes mellitus among tribes of Shervaroy hills" is presented under the following headings:

A. Diabetes mellitus - Meaning of this sweet disease.

B. Global prevalence of diabetes mellitus.

C. Prevalence of diabetes mellitus in India.

D. Causative factors of diabetes mellitus.

E. Consequences of uncontrolled diabetes mellitus.

## A. DIABETES MELLITUS - MEANING OF THIS SWEET DISEASE.

The Indian Physician Sushruta in 500 A.D. described the disease as "Madhumeha" (rain of honey) with symptoms of foul breath, voracious appetite and languor (Morge, 1992). Araetus (A.D. 70) gave the name 'Diabetes' which in Greek means to 'run through' referring to polyuria. The name "Mellitus" was given by Thomas Willis in 1660 describing the sweetness of urine as honey - like. In 1859, Claude Bernard first recognised hyperglycaemia as a cardinal symptom of diabetes (Sachdev, 1993).

Diabetes mellitus is a clinical syndrome characterized by hyperglycaemia (high blood glucose levels) and glycosuria (excretion of abnormally large amount of glucose in urine), and occurs either because of relative deficiency or

diminished effectiveness of insulin - a hormone secreted by pancreas - which primarily regulates carbohydrate metabolism. It is one of the most common, chronic, and debilitating diseases that plague mankind (Kanwar, 1989).

Diabetes mellitus is a chronic heterogeneous group of disorders, characterized by a lack of insulin secretion and/or increased cellular resistance to insulin, resulting in hyperglycaemia and other metabolic disturbances (Williams, 1994).

Current classification of diabetes mellitus is given by the WHO study group (Diabetes care, 1995).

**1. Type I - Insulin Dependent Diabetes Mellitus (IDDM):**

This type is characterised by an absolute insulin deficiency with dependence on insulin for life, marked tendency to ketosis, onset usually below 30 years, absence of obesity and the presence of circulating islet cell antibodies. The prominent features include insulinopenia and weight loss (Ramachandran **et al.**, 1992).

**2. Type II - Non - Insulin Dependent Diabetes Mellitus (NIDDM):**

This is the most common type of diabetes. It sets in over the age of 40 , characterised by hyperglycaemia due to insulin resistance and relative insulin deficiency. Majority are overweight and ketosis resistant with autosomal dominant inheritance (Robinson **et al.**, 1990).

**3. Malnutrition Related Diabetes Mellitus (MRDM):**

This new category has been reported from India, Africa and the West Indies, found in the young and characterised by severe protein malnutrition and emaciation. The sub-classes include fibrocalculous pancreatic diabetes mellitus and protein deficient diabetes mellitus (Yajnik, 1992).

**4.Impaired Glucose Tolerance (IGT):**

It refers to an abnormality in carbohydrate homeostasis. When the glycemic response after the administration of a 75 g of oral glucose load is intermediate between normal and diabetic, the condition is described as IGT. Such individuals have the potential to develop diabetes at a later stage (Raghuram **et al.**, 1993).

**5. Gestational diabetes mellitus:**

Diabetes developed during pregnancy is described as gestational diabetes. It occurs in 3 per cent of pregnant women and usually remits after delivery (Dowse **et al.**, 1993).

**B. Global prevalence of diabetes mellitus.**

Incidence rate is defined by park and park (1986) as the number of cases occurring in a defined population during specified period of time. The term prevalence refers specifically to all current cases (old and new) existing at a given point in time over a period of time in a given population.

World-wide prevalence of diabetes is 1.3 per cent (ICMR, 1993) and a total of 100 million prevalent cases are anticipated by the end of the century (King, 1995).

Diabetes mellitus described as a third world disease with rates high in developing countries has a global incidence of 1.3 per cent (Kumanyika, 1995).

Ferris and Reece (1994) reported that diabetes mellitus is estimated to affect 1.5 million women of child bearing age in the united states.

World Health Report (1997) states that the number of people with diabetes is expected to more than double from 135 million now to 300 million by 2025.

Samraj (1996) points out that USA has about 16 million diabetics and about 700,000 people have type I or insulin dependent diabetes, and 15.3 million diabetics have type II or non-insulin dependent diabetes.

According to American Heart Association (1997), diabetes mellitus killed 55,390 Americans in 1944.

Posadas **et al.** (1995) and Stern **et al.**,(1990) studied the crude prevalence rate of non insulin dependent diabetes mellitus in Mexico city to be 8.7 per cent with age adjusted rate of 10.6 per cent for women and 6 per cent for men.

From 1986 to 1993, the prevalence of diabetes in Alaska Natives increased by 22 per cent from 15.7 to 19.2 1000 people (Schraer **et al.,** 1997 and Gohdes **et al.,** 1996) and it was found that nearly all were diagnosed with type II

diabetes. Non-insulin dependent diabetes mellitus is the most common form and comprises 85 to 90 per cent of all diabetics (King, 1995).

Devadas (1996) points out that diabetes has reached epidemic proportions among native Americans as more than 12 per cent of the population over the age of 19 have been diagnosed with type II diabetes. The highest rate of diabetes world wide occurs within one tribe, the pimas of Arizona. Approximately 50 per cent of the tribe members between the age of 30 and 64 have the disease.

As per Nelson (1995) the increased risk of diabetes among Pima Indians with a high birth weight is due to the presence of maternal diabetes during pregnancy.

Diabetes mellitus affects approximately 13 million Americans, about 5.2 per cent of the total population and 6.6 per cent of the population 20 to 74 years old. About 6.5 million people in the United States, almost 3 per cent have diagnosed diabetes and another 6.5 million are undiagnosed and therefore unreported. The prevalence of non-insulin dependent diabetes is higher in ethnic minorities in the United States such as the Hispanic populations (Cubans, Mexican Americans, and Puerto Ricans), Native Americans and African Americans. The incidence of insulin dependent diabetes is lowest in Asian and highest in Scandinavian countries (American Diabetes Association, 1993; Harris **et al.,** (1998)). Prevalence of diabetes in adult is about 30 per cent higher in blacks than in whites.

Lindeman **et al.,** (1998) showed that the elderly hispanics had twice the prevalence of type II diabetes compared with non - hispanic whites , but the prevalence of impaired glucose tolerance was not increased in hispanics.

Zeng **et al.,** (1997) concluded that South Carolina has a higher prevalence of diabetes compared to the national average. African Americans had a disproportionately higher prevalence of diabetes relative to white Americans in South Carolina. He also pointed out that compared to the standards of diabetes care recommended by the ADA (American Diabetes Association), health care practice by people with diabetes and health professionals still needs to be improved.

Non-insulin dependent diabetes mellitus is a major public health problem among polynesians in the south pacific (Tukuitonga, 1990).

King and Rewers (1991) indicate that the prevalence of glucose intolerance is stated to be greater than 10 per cent in almost all population.

WHO (1999) reports that China is estimated to have 37.6 million diabetes against 16 million in 1995 followed by the United States (21.9 million against 13.9 million), Indonesia (from 4.5 million to 12.4 million) and Japan (8.5 million against 6.3 million). There will be a 42 per cent increase - from 51 million to 72 million in developed countries, whereas the increase will be 170 per cent in developing countries - from 84 million to 228 million. The growth of such population is even higher in Pakistan - estimated to go up from 4.3 million to 14.5 million in that period.

Nakamura **et al.,** (1998) indicates that the prevalence of diabetic patients in Japan would be 1.7 million among males and 1.5 million among females in 2008.

Pan **et al.**,(1997) and Yang **et al.**,(1998) point out that the prevalence of diabetes in China is increasing with economic development and changes from traditional to modernized lifestyle, especially where people had lower level of education and socio economic development.

In Finland the incidence of Insulin dependent diabetes mellitus (IDDM) in the children aged < 15 years is the highest in the world with age - at - diagnosis of IDDM moving towards the younger ages (Tumilehto, 1995).

The crude prevalence of diabetes among Sri Lankan women was estimated as 3 per cent and impaired glucose tolerance as 5.2 per cent. Over all prevalence of gestational diabetes in all groups was 7.4 per cent (Aita **et al.**, 1996).

Rubinstein **et al.**, (1991) view that the prevalence of diabetes mellitus among new immigration Ethiopia Jews was found to be as low as 0.4 per cent immediately after their arrival to Israel. This low prevalence was attributed to travel accompanied by severe malnutrition which caused death to the old, weak and sick, leaving a selectively young and healthy population group.

There are geographical difference in the prevalence pattern of diabetes. The prevalence rate in Europe is 2 to 5 per cent (World Health Report, 1995), 1 - 2 per cent in U.K. (Govindiji, 1993) and 8 per cent in South Africa (Levitt, 1993).

As we enter the new millennium, diabetes continues to be a scourage of mankind as, globally every six out of hundred persons are affected with the disease (Madhu, 1999).

In the Hanoi area (Vietnam), the prevalence of diabetes was 1.2 per cent and of impaired glucose tolerance, 1.6 per cent. Diabetes appears to be a rare disease in the Hanoi area, affecting women twice as often as men mainly in the urban area (Phan et al., 1995).

Stock **et al.**, (1997) points out that the prevalence of impaired glucose tolerance and undetected diabetes mellitus, is common in the elderly population of Netherlands.

The crude prevalence of diabetes among rural Malays in kuala selangor was estimated as 14.6 per cent with increased with age. The prevalence of diabetes mellitus was significantly higher than in 1984, representing an increment of 212.8 per cent over 10 years (Khebir **et al.**, 1997).

It is obtained from the study conducted by Rangasami et al., (1997) that the average annual incidence for Scotland was 23.9/100,00 children and the prevalence rate was 1.5/1000 in 1993. The study also depicts that the incidence rates increased at a rate of 2 per each year and also rates increased with age.

Elbagir **et al.**, (1998) reported a high prevalence of diabetes mellitus (8.3 per cent) and impaired glucose tolerance (7.9 per cent) in the Danagla community

compared to other communities of northern Sudan. Varying environmental, nutritional, and genetic factors may contribute to this high prevalence.

Ebbesson **et al.**, (1998) view that the prevalence of diabetes are the highest yet reported among Eskimo populations and diabetes was more prevalent in women than men and the combined prevalence of diabetes and IGT in the population > or = 55 years of age was 30.4 per cent (diabetes 12.0 per cent ,IGT 18.4 per cent).

Al - Mahroos and Mckeigue (1998) pointed out a high prevalence of diabetes in Bahrainis and the prevalence rate of diabetes in Jaafari Arabs was 25 per cent, 48 per cent in Sunni Arabs and 23 per cent in Iranians. The high rates of diabetes in Bahrain and other Arabian peninsula populations appear to be part of a familial syndrome that includes raised plasma cholesterol levels.

Will **et al.**, (1997) also stated that NIDDM prevalence is 40 per cent higher than any previous age - standardized estimate for the Navajo and four times higher than the age - standardised U.S. estimate.

Stahn **et al.**, (1993) reported that the age - adjusted rates of diabetes and certain complications among the northern plain tribes (Winnebago, Omaha, Sioux) are greater than the U.S. rates.

The findings by Brosseau (1993) from a 1988 audit of medical record of the three affiliated tribes (the Mandan Arickara and Hidasta) at the Fort Berthold, indicated that the number of people diagnosed as having diabetes has increased by > 40 per cent.

Young **et al.**, (1992) pointed out that the prevalence of diagnosed diabetes in several genetically closely related indigenous populations in the circumpolar arctic and sub arctic regions of Russia, Alaska and Canada, are far below the extreme high prevalence reported from many North American Indian tribes.

Shamis **et al.** , (1997) stated that Israel is a country with low, intermediate, and high incidence of childhood IDDM. The highest incidence was among the Yemenite Jews, who reached an incidence of 18.5/10(5), followed by Ashkenazi Jews (10.0/10(5)), non Ashkenazi Jews, except Yemenites (7.3/10(5)), and Arabs (2.9/10(5)). The inter ethnic differences in incidence are probably due to genetic factors.

**C.Prevalence of diabetes mellitus in India.**

The World Science News (1995) projects that, about 5 - 10 per cent of the population in India suffer from diabetes and about 85 per cent of the diabetes fall in the category of type II diabetes with more than 100 million people likely to suffer from diabetes by the end of this century.

In India, the prevalence rate of diabetes is alarming. A country wide survey by ICMR shows a prevalence of 2 to 3 per cent among the urban and 1.5 per cent among the rural population (Medical Times, 1996 and Raheja **et al.**, 1991). A survey conducted in the city of Madras, South India, showed that the age standardized prevalence of diabetes has increased to 11.6 per cent from 8.2 per cent in

1989 and impaired glucose tolerance was 9.1 per cent, similar to 8.7 per cent in 1989 (Latha **et al.**, 1997) and Ramachandran , 1992 ).

A survey carried out by (Rao, **et al.**, 1990) in Eluru, a small town in South India and in four adjoining villages have shown that, the prevalence of known diabetes was 6.1 per cent in all subjects aged 40 years old or more and increased to 13.3 per cent in those 50 to 59 years old. The over all prevalence of know diabetes was 1.6 per cent.

According to Patandian (1994) in a considerable proportion (11.5 per cent) of the rural South Indian population aged 40 years or over, glucose intolerance is present.

Age specific prevalence between 45 and 64 years was 4.69 per cent in rural India, 23.39 per cent in Malaysia and 23.63 per cent in Guyana which was grossly elevated than the corresponding younger populations (Ahuja , 1996).

Singh (1995) in his study in rural areas of Haryana have found that diabetes mellitus and hypertension are more prevalent in higher age group.

In a study carried out to assess the prevalence of diabetes in Southern Indian women during pregnancy, the prevalence of total diabetes and gestational diabetes were 1 - 19 per cent and 0.5 per cent respectively (Shyamala, 1994).

Diabetic population is growing at the fastest pace in India and Pakistan, according to a report of the World Health Organisation (1999). The country which had 19.4 million diabetics in 1995, is expected to register a near three fold increase by

2025 when they would constitute 57.2 million, the report "global burden of diabetes" said.

Vijay (1998) reported that the incidence of diabetes and atherosclerosis have shown a five fold increase in the urban population in the last 2 decades to 8 - 10 per cent, but rural population is still more or less maintaining it prevalence rates to 2.5 per cent.

**D. Causative factors of diabetes mellitus.**

The ethiopathology of the disease include heredity, race, lifestyle, age, nutritional status, stress, infection, altered immune function, altered metabolic/physiological status, drugs, and hormones (Ramachandran **et al.**, 1992).

Haynes (1993) reported that, age above 40 years, previous episode of gestational diabetes in women, high calorie diet, obesity and lack of exercise increase the risk of diabetes mellitus.

**1.Family history.**

Hamiel **et al.**, (1996) report a striking and apparently continuing increase in the number of diagnosis of NIDDM among adolescent patients who are obese and pubertal and have a strong family history of NIDDM.

NIDDM has a very strong genetic basis. In monozygotic twins there is almost 100 per cent concordance for the development of NIDDM (Shah, 1991). The incidence of diabetes in the offspring of a single diabetic parent is 15 per cent and 60 to 70 per cent when both parents are diabetic (Lovegrone, 1995).

**2.Malnutrition.**

Malnutrition during foetal life followed by over nutrition in adult life could be one of the risk factors for diabetes (Yajnik, 1992).

**3.Diet**

Potential risk factors for the onset of NIDDM among hispanic and non hispanic subjects support the hypothesis that high fat, low carbohydrate diets are associated with the onset of NIDDM in humans (Marshall **et al.**, 1991).

Haffner **et al.**, (1992) reported that the development of glucose intolerance was related to the risk of hypertension in women and with diabetes mellitus.

Savilahti **et al.**, (1998), Yakota **et al.**, (1990) Scott (1990), shown a relationship between ingestion of cow's milk and diabetes. The result suggested by Virtanen **et al.**, (1994) in Finnish children have shown that young age at introduction of milk products and high milk consumption during childhood increases the levels of cow milk antibodies, and that high IgA antibodies to cow milk formulae are independently associated with increased risk of IDDM.

**4.Body fat and body weight.**

The relationship between body -fat distribution measured by the ratio of waist to hip circumferences and the two year incidence of diabetes mellitus examined showed that, women in the highest tertile of both waist hip ratio and body mass index has a 14.4 fold higher risk of diabetes than women in the lowest tertiles (Kaye **et al.**,

1991). Study relating obesity and diabetes again point out that, men in the top tertile for the ratio of abdominal circumference to hip breadth had a 2.4 fold greater risk of diabetes than did men in the lowest tertile (Carsno **et al.**, 1992).

Gopalan (1994) reported that recent epidemiological evidence points to a high level of association of abdominal obesity with hypertension, coronary heart disease and diabetes.

Dowse **et al.**, (1991) point out that there is a stranger association of glucose intolerance with waist hip ratio than with generalised obesity.

Colditz **et al.**, (1995) recommended that women whose weight decreased by > 5kg reduced their risk factor for diabetes mellitus by atleast 50 per cent and even modest and typical weight gain increased the risk of diabetes.

Singh (1995) indicated that obese persons are at increased risk of developing diabetes mellitus to a greater extent.

Body fat distribution is recognised by Kreiger **et al.**, (1988), Eggstein (1989), Gerber (1990) and Sunyer (1991) as an metabolic predictor of metabollic complications of obesity which is strongly linked with risk factors of diabetes mellitus and hypertension.

Colditz (1995) points out that body mass index as the dominant predictor of risk for diabetes mellitus, the risk increasing with greater body mass index.

**5. Smoking.**

Parish **et al.** ,(1995) point out that diabetes mellitus also due to dietary habits of smokers who consumed fewer vegetables and high fibre foods and more meat and alcohol.

Kawa Kami **et al.**, (1997) opines that there is relation between the number of cigarette smoked per day and incidence of diabetes mellitus.

Kujala **et al.**, (1994) indicate that smokers had a higher risk for diabetes mellitus compared with those who are never smokers.

**6. Alcohol.**

Hirata (1990) opines that alcohol aggravates blood glucose control in diabetic patients, increase the complications and tends to reduce the effects of diet and drug treatment increasing blood glucose and serum lipids.

Lin **et al.**, (1993) pointed out that alcohol consumption is a risk factor for diabetes mellitus.

**7.Exercise.**

Haapanen **et al.** , (1997) are of the view that for the women both a higher total amount of activity and weakly. vigorous activity had an inverse association with risk of diabetes.

**E. Consequences of uncontrolled diabetes mellitus.**

Non-insulin dependent diabetes mellitus is an important cause of morbidity and mortality. both in developed as we as in developing countries. The eye,

kidneys, and cardiovascular and neurological systems are predominantly affected by this chronic disease, leading to loss of employment and sometimes life (Misra, 1995).

History and duration of NIDDM and blood pressure are significant risk factors for poor cognitive performance. Hypertension people with NIDDM are at greater risk for poor performance on tests measuring visual organs and memory (Elias **et al.**, 1997).

Viswanathan (1999) indicated that diabetics have a 15 -fold higher risk of amputation when compared to non-diabetics upto 50 per cent of all non-traumatic lower limb amputations are performed on patients with diabetics.

According to Raghuram **et al.**, (1993) complications may be acute, intermittent or chronic. Acute complications include hypoglycaemia, ketoacidosis, infections of skin, urinary tract and foot. Chronic complications include predisposition to hypertension and cardiovascular disease due to dyslipidemia, nephropathy, peripheral neuropathy and retinopathy (Gupta, 1993; Jaspan, 1995; Mani, 1996).

During diabetes, increased metabolism of glucose by the sorbitol concentrations are high, facilitating the formation of cataracts (Shah, 1991; Schalin - Jantti, 1992; Rao, 1993).

Insulin deficiency or resistance leads to excess lipolysis and rapid metabolism of fatty acid from adipose tissue and production of ketone bodies in liver (Sinha, 1991). Fatty acid is taken up by liver as coA esters and oxidised to acetyl coA,

excess of which is converted to ketone bodies causing ketosis and ketonuria, eventually leading to diabetic coma (Rao, 1993).

During diabetic condition there is an increase in protein catabolism due to over activity of corticosteroids induced by insulin lack. The aminoacids are deaminated and the ketoacids are converted to carbohydrates, leading to increased gluconeogenesis. This result in increased excretion of urinary nitrogen and negative nitrogen balance which account for loss of weight (Shanmugam, 1992).

Bloom garden, (1995) have a view that in diabetic patients, magnesium deficiency may be due to renal loss in association with glycosuria.

Shills **et al.**, (1994) opines that hyperzincuria and hypozincemia also increase relatively with severity of the disease.

Bhat **et al.**, 1995 have shown that coronary heart disease mortality is 2 to 4 times higher in diabetic that in non-diabetic individuals.

Vijay **et al.**, (1996) is also of the view that the prevalence of retinopathy increases linearly with duration of diabetes.

Diabetes is associated with complications involving macro and micro vessels, e.g., neovascularization of the retina, loss of retinal pericytes, and proliferation of arterial smooth muscle cells (Green burg, 1995).

A study revealed that obesity exaggerates hepatic as well as extra hepatic insulin resistance in non-insulin dependent diabetes mellitus. The impaired

inhibition of pancreatic ß cell function by exogenous insulin contributes to exaggerated hyperinsulinaemia in obese NIDDM. (Perriello **et al.**, 1995).

Horita **et al.**, (1994) reported that apo E2 is associated with renal insufficiency in NIDDM and that apo E2 may be factor that aggravates lipid abnormalities in NIDDM with renal failure.

Stuhldreher **et al.**, (1994) revealed that waist hip ratio acts as a marker of risk for diabetes complications mainly through an influence on other complication risk factors.

A study conducted by Charles **et al.**, (1994) showed that Pima Indian women who have a high risk for NIDDM develop obesity and hyperinsulinaemia at an early age and that may be responsible for decreased fertility because of associated changes in sex hormones.

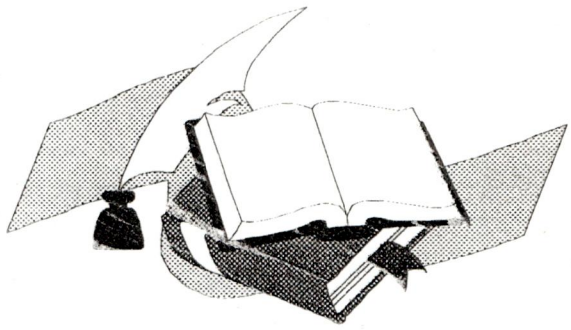
Morishita **et al.**, (1996) indicate that impaired haemostatic balance in diabetics may cause hypercoagulability and may thus contribute to increased cardiovascular mortality in diabetes.

A study by Tinker (1994) points out that women with diabetes are at risk for developing endometrial cancer.

Chittar **et al.**, (1994) indicated that increased peroxidative stress may be an important risk factor in the development of micro angiopathy and macro angiopathy in diabetics.

Lewis and Steiner (1996) reported that hypertriglyceridemia and its metabolic consequences as a risk factor for atherosclerotic cardiovascular disease in non-insulin dependent diabetes mellitus.

Collin **et al.**, (1989) indicated a high frequency of coeliac disease in adult patients (4.1 per cent) with type I diabetes. The patients had no signs of malabsorption or of significant abdominal complaints.



# Methodology

# III METHODOLOGY

The methodology pertaining to the present study on "Prevalence and etiology of diabetes mellitus among tribes of Shervaroy hills" is described under the following headings.

A. Selection of the study area
B. Selection of the sample
C. Formulation of the schedules
D. Eliciting the general data
E. Collection of data from the diabetics
F. Imparting diet counselling and its evaluation

## A. SELECTION OF THE STUDY AREA

Tribal villages of Shervaroy hills, in Salem district of Tamil Nadu were selected for conducting the study. In these hills totally there were about 67 villages inhabited by the tribes called Malayalee tribes covering an area of 382.71 Sq.km. These tribal villages in Shervaroy hills were selected for the study because

1. No study has been so far conducted among these tribes on diabetes mellitus.
2. Availability of adequate number of samples and curiosity of the investigator to explore the habits of tribes.
3. The enthusiasm and over whelming co-operation extended by the local leaders and
4. Easy proximity for the investigator as she is a resident of Salem.

Three villages from the total of 67 villages were selected based on convenience sampling. These three selected villages had proper transport and other

facilities like primary health care centre, schools, co-operative stores and water and electricity supply.

The method of convenience sampling is also called a chunk. Chunk is a convenient slice of a population which is commonly referred to as a sample. It is obtained by selecting convenient population units (Pillai and Bhagavathi, 1993).

**B. Selection of the sample**

By using systematic random sampling technique, thirty families from each of the three villages (totally 90 families) were selected for inclusion in the study.

Random sampling from a finite population refers to that method of sample selection which gives each possible sample combination an equal probability of being picked up and each item in the entire population to have an equal chance of being included in the sample (Kothari, 1997). In a randomly selected sample there is minimum personal bias (Gupta, 1997).

Both the male and female members between 20 and 80 years of age in each of the selected family served as sample for the study. Thus a total number of 300 adult subjects 157 males and 143 females were available from the selected 90 families.

**C. Formulation of the schedules**

For the purpose of data collection, two structured interview schedules were developed by the investigator. Interview schedules are perhaps the most frequently used method of socio-economic and dietary assessment. A schedule is a list of questions which helps to collect data from the field. This is generally filled in

by the enumerator, or the researcher or the interviewer himself. He sits with the informant face to face and fills up the data sheet by asking him the questions (Rao, 1995).

Interview schedule No.I was developed by the investigator to collect socio- economic and other general data from all the 300 selected subjects. It contained questions on the aspects like socio economic background, educational status, life style pattern and food consumption pattern. The interview schedule No.I, is presented in Appendix - I. The interview schedule No.II was formulated to elicit the information from the diabetics regarding the disease condition, type of treatment undertaken, prevalence of clinical symptoms, special dietary pattern, life style pattern and to record the height and weight. The second schedule was designed mainly to find out the risk factors predisposing to high blood glucose level and is given in Appendix -II.

Direct personal interview method was used to collect data as most of the population selected were illiterates.

**D. Eliciting the general data**

The investigator with the help of the local leaders, school teachers and village level workers established a good rapport with the families before proceeding with the study. Using the interview schedule No.I, the investigator collected the data from the selected adults through personal interview by house visits and by meeting them at common places. Plate I depicts the collection of data by the investigator.

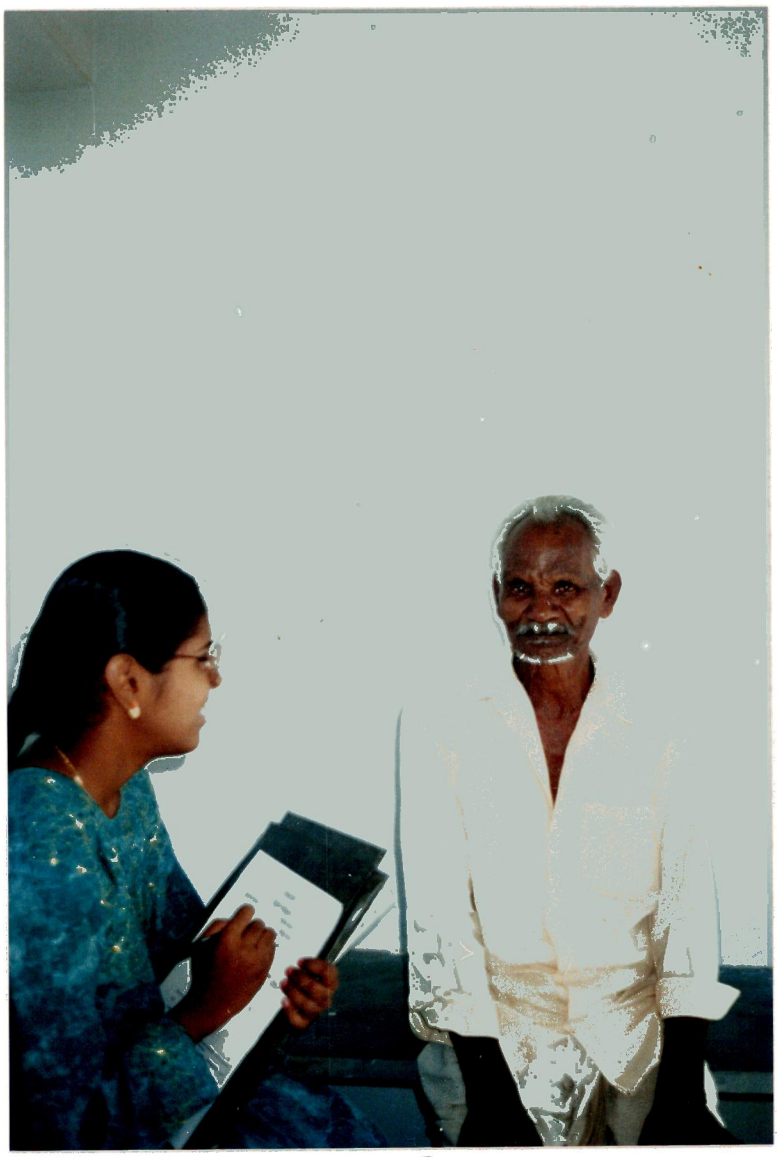


PLATE - I

COLLECTION OF DATA BY THE INVESTIGATOR

All the selected adults were screened for the prevalence of diabetes mellitus by measuring post-prondial blood glucose level using glucometer.

Glucometer is a self blood glucose monitoring instrument. It accurately measures the peripheral blood glucose level within 40 seconds. Principle followed in the blood glucose estimation is presented in Appendix -III.

**E. Collection of data from the diabetics**

A 24 hour dietary recall method was conducted for three consecutive days for all the diagnosed diabetic subjects in order to quantify the actual food intake. From the amount of food consumed, the raw equivalents of foods were calculated. From the raw equivalents, the food and nutrient intake were calculated using Nutritive Value of Indian Foods, ICMR (1998).

The etiological factors were collected from the diabetics using the interview schedule No.II.

The height and weight of the diabetic subjects were recorded using standard procedures suggested by Jelliffe (1989). Plates II and III depict the measurement of height and weight of the diabetics by the investigator.

**F. Imparting diet counselling and its evaluation**

After assessing the etiology, food and nutrient intake, the subjects were given diet counselling by meeting them at common places for a period of one week. Diet counselling is the process by which people are helped to deal with their dietary and nutritional problems (Robinson, et al., 1990). Before diet counselling a

PLATE - II

MEASUREMENT OF HEIGHT

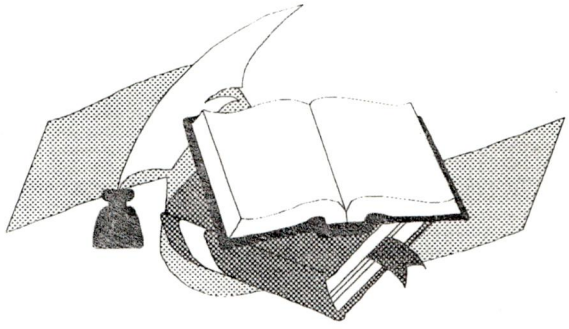
PLATE - III

MEASUREMENT OF WEIGHT

questionnaire was administered to each subject to assess their previous knowledge regarding the disease which is given in Appendix - IV. The questionnaire consisted of a number of questions typed in a definite order on a form (Kothari, 1997). Based on their initial knowledge the subjects were educated by lecture method using aids like menu card, charts and posters on the nature of the disease, its etiology and possible complications.

Diet counselling also included lessons on correct choice of food stuff, amount of food to be consumed to adjust the energy intake according to their body weight, foods to be included, restricted and avoided and importance of fibre rich diet.

After a period of one month the impact of diet counselling imparted to the samples was evaluated by giving them the same questionnaire which was given before diet counselling.



# Results and Discussion

# IV RESULTS AND DISCUSSION

The results pertaining to present study entitled "Prevalence and etiology of diabetes mellitus among the tribes of Shervaroy hills" are presented and discussed under the following headings:

A. Demographic picture of the selected tribal villages

B. Socio-economic background of the selected subjects

C. Life style pattern of the selected tribal subjects

D. Dietary pattern of the selected tribal population

E. Incidence and etiology of diabetes mellitus in the selected tribal population

F. Food and nutrient intake of the diabetics

G. Impact of diet counselling.

## A. DEMOGRAPHIC PICTURE OF THE SELECTED TRIBAL VILLAGES.

The study was conducted in three tribal villages situated at the height of 1500 meters above sea level. They are situated at a distance of about one kilometre from each other. Each village consisted of 69, 50 and 45 families with a total population size of 1157 members.

Table I presents the classification of the total population of the selected tribal village according to age and sex.

TABLE I

TOTAL POPULATION OF THE SELECTED VILLAGE

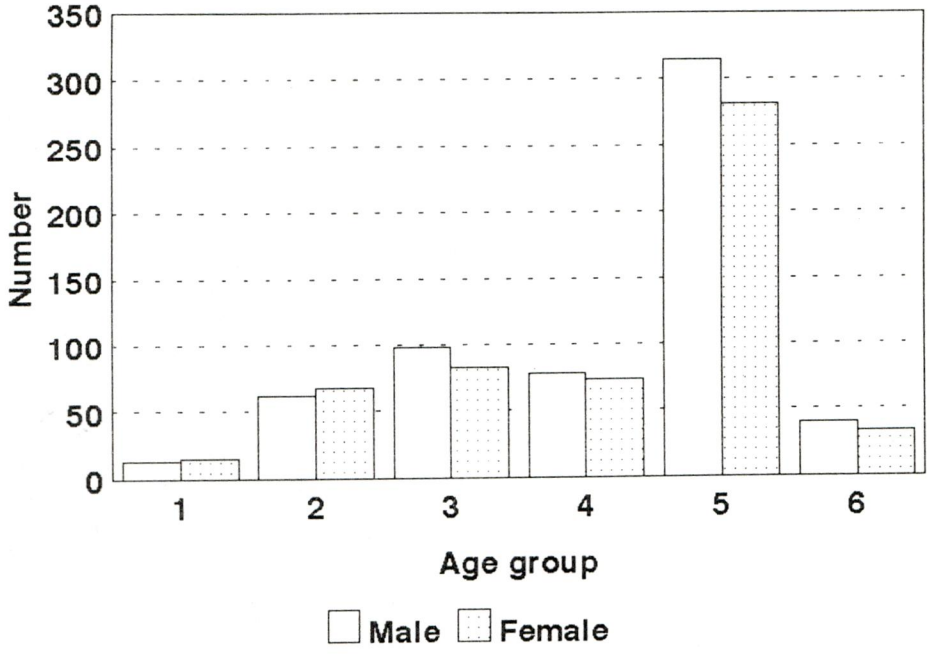
n = 1157

| Age group | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| 0-12months (Infants) | 13 | 1.1 | 15 | 2.7 | 28 | 2.4 |
| 1-6 years (Pre-school children) | 62 | 10.2 | 67 | 12.1 | 129 | 11.1 |
| 7-12 years (School going children) | 98 | 16.2 | 83 | 15 | 181 | 15.6 |
| 13-19 years (Adolescence) | 78 | 12.9 | 73 | 13.2 | 151 | 13.1 |
| 20-60 years (Adult) | 314 | 51.9 | 281 | 51.9 | 595 | 51.4 |
| 61-85 years (Senior adults) | 40 | 6.6 | 33 | 5.9 | 73 | 6.3 |

From table I it is clear that the total population of the village selected was 1157. Out of this 28 were infants, 129 were pre school children, 181 were school going children and 151 were adolescents. The number of adult subjects were more compared to other age groups. There were 595 adults consisting of 314 males and 281 females. Except pre-school children in all the other age groups there was a male preponderance over females. There were 73 senior citizens. Due to the increased prevalence of health services, the life span has increased and hence there are more old people (Fig. 1).

**B.SOCIO-ECONOMIC BACK GROUND OF THE SELECTED SUBJECTS**

Out of the 668 adult subjects 300 adults were selected for the study. This consisted of 157 males and 143 females. The number of adult males and females selected for the study was proportion to the total number of subjects present.




**Total population of the selected villageS**

**Fig. 1**

1. Infants
2. Pre-school children
3. School going children
4. Adolescence
5. Adults
6. Senior adults

**1.Age of the Selected Subjects**

Table II depicts the age of the selected subjects.

TABLE II

DISTRIBUTION OF THE SELECTED SUBJECTS

ACCORDING TO AGE AND SEX

n=300

| Age in years | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| 20-30 | 72 | 46 | 71 | 50 | 143 | 48 |
| 30-40 | 33 | 20 | 34 | 24 | 67 | 22 |
| 40-50 | 25 | 16 | 17 | 12 | 42 | 14 |
| 50-60 | 12 | 8 | 15 | 10 | 27 | 9 |
| 60-70 | 12 | 8 | 4 | 3 | 16 | 5 |
| 70-80 | 3 | 2 | 2 | 1 | 6 | 2 |

As presented in Table II both in male and female population, maximum number of subjects were in 20 to 30 years of age. As the age increased the number of adults decreased resulting in only three in 70 to 80 years. Distribution of male and female subjects was almost similar in different age groups. There were only 15 males and six females in the senior adult group, representing only seven per cent of the total number.

**2.Educational status of the selected subjects**

Table III gives the educational status of the selected adult subjects.

TABLE III

EDUCATIONAL STATUS OF THE ADULT SUBJECTS

n=300

| Education | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| **Illiterate** | 85 | 54 | 110 | 77 | 195 | 65 |
| **Literate:** | | | | | | |
| Primary | 61 | 39 | 30 | 21 | 91 | 30.3 |
| High school | 7 | 4 | 3 | 2 | 10 | 3.3 |
| Higher Secondary | 4 | 3 | 0 | 0 | 4 | 1.3 |

This selected tribal area has only one school situated at a distance of one kilometre. As indicated in Table III there were more than 50 per cent illiteracy in the selected subjects. Illiteracy was more prevalent among females (77 per cent) than males (54 per cent). Among the subjects only 21 per cent of females and 39 per cent of males had primary education. Nearly two per cent of females and four per cent of males had high school education. Only three per cent of the males had higher secondary education while none of the female had this. In general the educational status of the males was better than the female subjects. Literacy level is essential for the success of any developmental programme.

**3.Occupational Status**

The details regarding the occupational status of the selected population are presented in Table IV

TABLE IV

OCCUPATIONAL STATUS OF THE SELECTED SUBJECTS

n=300

| Occupation | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| **Heavy work** | Number | % | Number | % | Number | % |
| Agriculture labourer | 33 | 21 | 60 | 42 | 93 | 31 |
| Labourer | 52 | 33.1 | 35 | 24.5 | 87 | 29 |
| **Moderate work**: | | | | | | |
| Timber merchant | 12 | 7.6 | - | - | 12 | 4 |
| Electrician and fitters | 3 | 1.9 | - | - | 3 | 1 |
| **Sedentary Work**: | | | | | | |
| Land holder | 22 | 14.0 | - | - | 22 | 7 |
| Cattle rearing | 5 | 3.2 | 10 | 7.0 | 15 | 5 |
| Employed in Government offices | 10 | 6.4 | 8 | 6.0 | 18 | 6 |
| Small petty shops | 7 | 4.5 | 4 | 2.8 | 11 | 4 |
| Unemployed | 13 | 8.2 | 26 | 18.1 | 39 | 13 |

The type of occupation can indicate the income level of the selected subjects. Majority of the subjects were in very low income group. It is clear from the table that, sixty per cent of the subjects were doing heavy work. Most of these subjects work in the coffee plantations. Out of this 60 per cent, 31 per cent worked in coffee estates as agricultural labourers. The rest (29 per cent) were doing other heavy activities like digging wells, cutting trees, mine works, coffee curing and contract works.

These labourers got just enough money to meet their daily living and were very poor. Under moderate working group, timber merchant and electrician and fitters constituted four per cent and one per cent respectively. Sedentary working group consisted of land holders (7 per cent) and those who did cattle rearing (5 per cent). Four per cent of the subjects were engaged in business in the form of small petty shops or selling the produce from kitchen garden in the weekly market. Sedentary working group also included six per cent of the subjects who were government employees.

It is also clear from the table that 13 per cent of the selected subjects were unemployed. Comparatively unemployed female subjects (18.1 per cent) were more than the unemployed male subjects because of family back situation such as pregnancy or looking after the small children and maintenance of house hold activities.

**4.Family income per month**

Table V presents the distribution of families according to monthly income.

TABLE V

INCOME LEVEL OF THE SELECTED FAMILIES

n=90

| Income in rupees | Number | % |
|---|---|---|
| 500-1000 | 50 | 56 |
| 1000-1500 | 30 | 33 |
| 1500-2000 | 7 | 8 |
| 2000-2500 | 3 | 3 |

In the selected families majority (56 per cent) of the families earned only rupees 500 to 1000 per month. this shows that most of the families studied belonged to low income group. Only three per cent of the families earned between rupees 2000 to 2500 per month. The proportion of families earning per month. The proportion of families earning rupees 500 to 1000 was much higher. This illiteracy and ignorance are the main reasons for their backwardness and for the poor socio-cultural developments. The present result are in line with results of (Nagda, 1996) who has stated that about 42 per cent of the population in India are below the poverty line.

**C.LIFE STYLE PATTERN OF THE SELECTED SUBJECTS**

Table VI gives the information on the life style pattern of the selected samples.

TABLE VI

LIFE STYLE PATTERN OF THE SELECTED SUBJECTS

n=300

| Life style pattern | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % |
| Betal nut | 63 | 33 | 72 | 34 | 150 | 50 |
| Alcohol consumption | 97 | 51 | 23 | 11 | 120 | 40 |
| Tobacco chewing | 42 | 22 | 51 | 24 | 93 | 31 |
| Smoking | 70 | 37 | - | - | 70 | 23 |
| Exercise undertaken | | | | | | |
| Walking | 1 | 0.5 | - | - | 1 | 0.3 |

From table VI it is clear that 40 per cent of the subjects had the habit of consuming alcohol which is much lesser than the betal nut (50 per cent) consumption. The habit of tobacco chewing was prevalent both among male and female subjects, whereas the habit of smoking was prevalent only among male subjects which accounted for 23 per cent respectively and also it is evident from the table that only one male subject had the habit of doing exercise, while none of the female subjects did any exercise.

**D. DIETARY PATTERN OF THE SELECTED TRIBAL POPULATION.**

**1. Type of diet consumed.**

Table VII depicts the distribution of subjects according to the type of diet consumed by the selected subjects.

TABLE VII

TYPE OF DIET CONSUMED BY THE SELECTED SUBJECTS

n=30

| Type of diet consumed | Number | % |
|---|---|---|
| Non vegetarian | 278 | 93 |
| Vegetarian | 18 | 6 |
| Ova vegetarian | 4 | 1 |

From the table VII it is clear that 93 per cent (278) of the population were non vegetarian consuming pork, chicken, mutton, beef and fish. Out of the 300 subjects only 18 subjects were vegetarians, while the remaining four subjects were ova vegetarians. The main non-vegetarian food consumed was pork. They consider pork

as a special non-vegetarian food and prepare this on all festive day. The other non-vegetarian items like fish was consumed rarely because of their unavailability.

**2. Daily meal pattern**

In the majority of the selected houses, three meal pattern was followed. The menu was not planned in advance, but depended on the availability of food stuffs. For break-fast, the left over rice, from the previous night was taken with the addition of water and onion/chillies. Apart from rice, the other common millets used were ragi and varagu. Varagu is cultivated locally and from the time of harvest till the stock is over varagu is consumed. It was also noticeable that seasonal variations had an impact on the food intake of the tribal population. Regarding dhals, vegetables, fruits and milk etc. were consumed at varied frequency depending on their availability and cost.

**3.Frequency of consumption of beverages**

Table VIII gives the information regarding the frequency of consumption of beverages by the selected tribal subjects.

TABLE VIII

FREQUENCY OF CONSUMPTION OF BEVERAGES BY THE SELECTED SUBJECTS

n=300

| Beverages | Number | % | Frequency of consumption | | | |
|---|---|---|---|---|---|---|
| | | | Once a day | Twice a day | Thrice a day | Four times a day |
| Tea | 30 | 10 | 10 | 20 | - | - |
| Coffee | 190 | 63 | 17 | 154 | 19 | - |
| Both | 80 | 27 | 70 | 10 | - | - |
| Others | NIL | - | - | - | - | - |

Table VII reveals the fact that both coffee and tea were consumed to a larger extent by the subject. Yet coffee is the most popular drink among the samples consumed twice a day by majority coffee drinkers.

**4.Frequency of consumption of varied food items.**

Table IX gives the details regarding the frequency of consumption of varied food items by the selected subjects.

TABLE IX

FREQUENCY OF CONSUMPTION OF VARIED FOOD ITEMS BY THE SELECTED SUBJECTS

n=300

| Food Items | Number | Frequency of consumption | | | | |
|---|---|---|---|---|---|---|
| | | Daily | Twice a week | Thrice a week | weekly | Occasionally |
| **Cereals** | | | | | | |
| Rice | 300 | 300 | | | | |
| Ragi | 280 | | 60 | 200 | 20 | |
| Varagu | 270 | | 38 | 52 | 130 | 50 |
| Wheat flour | 200 | | | | 52 | 148 |
| Maida flour | 250 | | | | | 250 |
| semolina | 125 | | | | 125 | |
| vermicelli | 60 | | | | | 60 |
| White bread | 280 | | | | | 280 |
| **Pulses** | | | | | | |
| Red gram dhal | 300 | | 200 | 78 | 22 | |
| Bengal gram dhal | 300 | | | 205 | 95 | |
| Black gram dhal | 300 | | | | 200 | 100 |

| Food Items | Number | Frequency of consumption | | | | |
|---|---|---|---|---|---|---|
| | | Daily | Twice a week | Thrice a week | weekly | Occasio nally |
| Green gram whole | 300 | | | | 250 | 50 |
| Green gram dhal | 180 | | | | | 180 |
| Green peas | 150 | | | | | 150 |
| Dry peas | 150 | | | | | 150 |
| Cow pea | 100 | | | | | 100 |
| Whole Bengal gram | 50 | | | | | 50 |
| **Vegetables** | | | | | | |
| **Roots and Tubers** | | | | | | |
| Onion | 300 | 300 | | | | |
| Carrot | 285 | | | | 95 | 190 |
| Turnip | 277 | | 10 | | 207 | 60 |
| Raddish | 270 | | 15 | | 225 | 30 |
| Potato | 250 | | 40 | 10 | 190 | 10 |
| Beetroot | 180 | | | | 70 | 110 |
| Yam | 150 | | | | | 150 |
| **Leafy vegetables** | | | | | | |
| Cabbage | 290 | | | | 270 | 20 |
| Araikeerai | 270 | 15 | 30 | 200 | 25 | |
| Sirukeerai | 250 | 15 | 20 | 200 | 25 | |
| Manathakkali leaves | 220 | | | 150 | 20 | 50 |
| Spinach | 212 | | | | | |
| Amaranth tender | 120 | | | | 90 | 30 |
| Agathi | 20 | | | | | 20 |
| **Other vegetables** | | | | | | |
| Drumstick | 300 | | 45 | 26 | 150 | 79 |
| Gourd vegetables | 300 | | | | 250 | 50 |

| Food Items | Number | Frequency of consumption | | | | |
|---|---|---|---|---|---|---|
| | | Daily | Twice a week | Thrice a week | weekly | Occasio nally |
| Pumpkin | 295 | | | | 20 | 275 |
| Ladies finger | 290 | | 25 | 70 | 150 | 45 |
| Beans | 280 | | | | 20 | 200 |
| Brinjal | 250 | | 10 | 30 | 210 | |
| Cauliflower | 100 | | | | 30 | 70 |
| **Fruits** | | | | | | |
| Lemon | 300 | | | | | 300 |
| Tomato | 300 | 280 | | 20 | | |
| Orange | 280 | | 45 | 92 | 79 | 64 |
| Banana | 250 | | 20 | | 150 | 80 |
| Guava | 250 | | | | | 250 |
| Mango | 250 | | | | | 250 |
| Jack fruit | 230 | | | | | 230 |
| Grapes | 225 | | | | 10 | 215 |
| Pineapple | 210 | | | | | 210 |
| Pomegranate | 150 | | | | | 150 |
| Apple | 200 | | | | | 200 |
| **Fleshy foods** | | | | | | |
| Pork | 250 | | | | 195 | 55 |
| Chicken | 175 | | | | 20 | 155 |
| Mutton | 170 | | | | | 170 |
| Beef | 120 | | | | | 120 |
| Fish | 70 | | | | | 70 |
| **Milk and Milk Products** | | | | | | |
| Butter milk | 280 | 225 | 16 | 39 | | |
| Curd | 50 | 15 | 5 | 30 | | |
| Ghee | 30 | | | | | 30 |

| Food Items | Number | Frequency of consumption | | | | |
|---|---|---|---|---|---|---|
| | | Daily | Twice a week | Thrice a week | weekly | Occasionally |
| Milk | 25 | 12 | | | | 13 |
| Butter | 10 | 10 | | | 10 | |
| **Fats and Oils** | | | | | | |
| Groundnut oil | 278 | 278 | | | | |
| Gnigelly oil | 27 | | | | | 27 |
| Refined oil | 22 | 22 | | | | |
| **Sugar and Jaggery** | | | | | | |
| Sugar | 299 | 299 | | | | |
| Jaggery | 135 | | | | | 135 |

From Table IX it is evident that the food habits of the subjects varied depending on seasonal availability of food materials. There was no regular menu for their daily diet.

All the samples belonging to malayalee tribes consumed larger proportion of cereals than any other food. Though rice was the staple diet of the tribal subjects, millets were also consumed in a larger proportion. Among the millets, ragi and varagu were more frequently consumed as they are the main dry land crops cultivated locally. They consumed rice and varagu with vegetable curry and with butter milk. Whereas ragi was consumed in the form of porridge by 280 samples in various frequency. The other cereal products like wheat flour and maida flour was consumed by the subjects in the form of chappathi and dosai. Occasionally semolina

and vermicelli were also consumed in the form of uppma. Bread was consumed only during illness.

They purchased pulses like red gram dhal, black gram dhal, green gram dhal and Bengal gram dhal and adopted boiling method for cooking them and was consumed with the cereal preparations in the form of sambar.

Greens that were locally available like cabbage, araikeerai, sirukeerai, spinach were consumed once in a week by majority. Agathi and drumstick leaves were consumed occasionally due to their bitter taste and unavailability.

Roots and tubers like potato, turnip and raddish were consumed more frequently by the subjects because of their availability in the hill. They just boiled the vegetables with a little salt and seasoned with mustard and consumed.

Mostly all the families possessed kitchen gardens. So vegetables like cabbage, raddish, cauliflower, ladies finger and drumstick, were grown in the kitchen garden. They took the produce from the kitchen garden to the weekly market for sale. Only a meagre amount of the produce was used for family consumption. The vegetables like pumpkin, ashgourd, bitter gourd, clusterbeans were rarely purchased from the local market and consumed by them.

Table IX also depicts that most of the fruits were taken occasionally except tomato, orange and banana. Seasonal fruits like jack fruit, orange and banana were collected from the coffee estates either at low cost or sometimes free of cost.

More fruits were consumed more in number during the seasonal period. Raw jack fruits was used for the preparation of curry for rice.

From Table IX it is clear that pork was the main fleshy food consumed more frequently by about 250 samples followed by chicken by 175 samples. Mutton, fish and beef were reserved for festive occasions only. All the samples surveyed were non-vegetarians. They adopted boiling and roasting method for cooking the fleshy foods.

Table IX also gives the information regarding the frequency of consumption of milk and milk products by the samples. Though some of them owned cows for producing milk, only 25 samples consumed milk. Other sold their milk to increase their income. About 280 samples consumed butter milk daily when compared to other products like curd, ghee and butter which were consumed rarely or not at all consumed.

Fats and oils were purchased from the local grocery shops. The oils available were gingelly, mustard and groundnut oils. Consumption of fats and oils and milk and milk products were restricted owing to the economic stress. Mainly groundnut oil was used by the samples for cooking foods because of low cost compared to other oils.

Table IX also reveals the fact that sugar was used daily by almost all the samples for preparing beverages. Use of jaggery in their preparation was very low.

## E. INCIDENCE AND ETIOLOGY OF DIABETES MELLITUS IN THE SELECTED TRIBAL POPULATION.

### 1. Prevalence of diabetes mellitus among the selected subjects

The total number of diabetics diagnosed from the selected subjects and the rate of prevalence of diabetes are presented in Table X.

TABLE X

PREVALENCE OF DIABETES MELLITUS IN THE SELECTED SUBJECTS

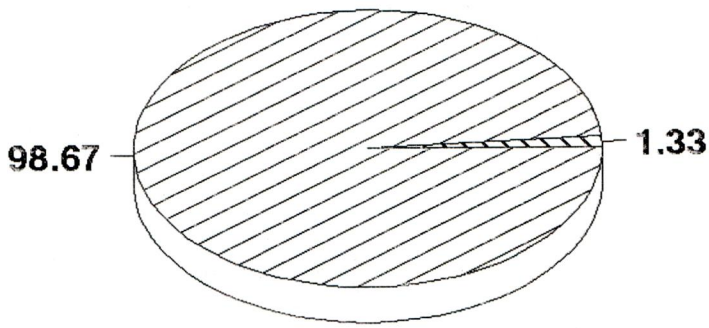
n=300

| Total number of subjects selected | Number of Diabetics present | Percentage of diabetics |
|---|---|---|
| Male - 157 | 2 | 1.27 |
| Female - 143 | 2 | 1.39 |
| Total - 300 | 4 | 1.33 |

As indicated in Table X out of the 300 tribal subjects tested for blood glucose, four subjects had hyperglycaemia and hence were classified as diabetics. There were two male diabetics out of 157 males and two female diabetics out of 143 females. The percentage prevalence of diabetics among males was 1.27 and among females 1.39. Thus on the whole, the rate prevalence of diabetes in the selected tribal group was 1.33 (4/300). The results of the present study on tribals, show a lesser rate of prevalence compared to the results of Ramachandran (1992) who has reported a rate of incidence of diabetes in rural area as 2.4 percentage (Fig. 2).

### 2. Socio economic background of the selected subjects

After diagnosing the number of diabetics in the selected tribal area, further study was conducted to find out the socio economic background of the selected




**Prevalane of diabetes mellitus in the selected subjects**
**Fig. 2**

subjects. Table XI gives the result of the socio economic status of the diagnosed diabetics.

TABLE XI

SOCIO ECONOMIC STATUS OF THE DIABETICS

n=4

| Subjects | Age in years | Education | Occupation | Income in rupees |
|---|---|---|---|---|
| Male | | | | |
| Subject I | 65 | VIII Std | Coolie work | 1600 |
| Subject II | 45 | VII Std | Agriculture Labourer | 2500 |
| Female | | | | |
| Subject III | 60 | Illiterate | Agriculture Labourer | 800 |
| Subject IV | 65 | Illiterate | Agriculture Labourer | 1000 |

Table XI shows that all the diabetic subjects were above 45 years of age. The incidence of the disease was high among the age groups between 45 to 65 years, which is in accordance to the study by Laakso (1985) who has stated that the prevalence of diabetics increased from the fourth decade onwards. In the present study as the onset is after 45, all the subjects are hoped to be NIDDM subjects. Both the male subjects had high school education, while the two female subjects were illiterates which is in line with the study by Wagstaff (1991) that educational level is generally lower in those cultures that have the highest incidence of diabetes.

All the four subjects were doing heavy activities like Coolie and Agriculture labour work, for their livelihood. Khaltaev (1991) has indicated that lack

of physical activity by a sedentary individual runs the risk of diabetes mellitus. But in the present study, though all the diabetic subjects were doing heavy activity, they were diagnosed as diabetics because of strong family history of the disease. The family income of all the diabetic subjects ranged between rupees 800 to rupees 2500 which indicate that all of them belonged to low income group.

**3. Diabetic traits in the family**

The incidence of diabetes in the families showed that among the four diabetic subjects, only subject I and subject II had previous history of the disease. Both of them indicated that their mother had the disease. Hence in their condition, genetic predisposition is the cause for the development of diabetes. This observation is in accordance with the statement by Lovegrone(1995), that NIDDM has a strong genetic basis and appears to be inherited.

Subject III and subject IV did not know whether anybody in their family had the disease. Prevalence of diabetes in the families of subject III and IV might not have been diagnosed because of the backwardness of the tribal groups.

**4. Prevalence of clinical symptoms of diabetes mellitus**

The prevalence of symptoms of diabetes mellitus revealed that all of the diabetic subjects suffered from fatigue and subjects I, II, and III had dizziness, headache, weight loss, polyuria, polyphagia and body ache which are the classic symptoms of diabetes mellitus. Subject II and III had complaints of sweating, blurred vision and delayed wound healing. But they did not bother to go to the near by town

and consult the doctor to get any treatment. So they were advised by the investigator to consult the doctor to find whether they suffer from any other complications and to undergo treatment to maintain the correct blood glucose levels.

**5. Presence of other disease**

Besides diabetes, subject I was suffering from hypertension and gall stone formation and the treatment undertaken by him was dietary restriction to maintain the blood pressure and surgery to remove the gall stone. Apart from that, subject III had complaints of weakness of limbs, ulcer and asthmatic trouble, for which she was on homeopathy treatment.

**6. Life style pattern**

Table XII gives the life style pattern of the diabetics.

TABLE XII

LIFE STYLE PATTERN OF THE DIABETIC SUBJECTS

n=4

| Subjects | Smoking | Alcohol | Exercise undertaken |
|---|---|---|---|
| Subject I | - | ✔ | ✔ |
| Subject II | ✔ | - | - |
| Subject III | - | - | - |
| Subject IV | - | - | - |

Table XII depicts that subject I was an alcoholic, with the amount consumed varying from 60 ml to 360 ml everyday, but he stopped consuming after knowing that he was suffering from diabetes and heart disease. Sadikot (1988) opines

that in diabetic, excess alcohol consumption lead to neuropathy and liver damage. Apart from that one of the diabetics (Subject II) had the habit of cigarette smoking four times a day. According to Vardan (1995) the risk of developing heart disease and diabetes mellitus and their complication is directly proportional to the number of cigarettes smoked per day. In the present study only one subject smoked.

Taking into account the exercise pattern of the diabetics, only subject I performed walking, while none of the other subjects performed it. Since all the subjects were engaged in doing heavy work, lack of exercise may not be the reason for the diabetes in these subjects. But the intake of alcohol and habit of smoking along with genetic predisposition may be the reason for the development of disease in the selected population.

**7. Type of diet consumed**

- Mostly all the diabetic subjects consumed non vegetarian diet either weekly or occasionally. Mainly they consumed pork and chicken as they owned them. The other fleshy foods like mutton, beef, fish were consumed occasionally depending on cost and availability.

**8. Type of beverages consumed**

Table XIII shows type of beverages consumed by the diabetics.

TABLE XIII

TYPE OF BEVERAGES CONSUMED BY THE DIABETICS

n=4

| Subjects | Beverages | | | |
|---|---|---|---|---|
| | Tea | Coffee | Both Tea and Coffee | No drinks |
| Subject I | - | - | - | ✔ |
| Subject II | - | ✔ | - | - |
| Subject III | - | ✔ | - | - |
| Subject IV | - | - | ✔ | - |

From Table XIII it is evident that subject II and III had the habit of consuming coffee twice or trice a day and subject IV consumed both tea and coffee once a day, while subject I consumed no drinks at all, as he dislikes them.

**9. Body mass indices of the diabetics**

Table XIV presents the body mass indices of the diabetics.

TABLE XIV

BODY MASS INDICES OF THE DIABETICS

n=4

| Subject | Under weight<18.5 | Normal 18.5-20.0 | Normal 20.1-25.0 | Over weight 25.1-30 | Obese>30 |
|---|---|---|---|---|---|
| Subject I | - | - | ✔ | - | - |
| Subject II | - | - | ✔ | - | - |
| Subject III | - | - | ✔ | - | - |
| Subject IV | - | ✔ | - | - | - |

From the Table XIV it is observed that the body mass index of all the diabetics were within the normal range according to the standards given by Garrow (1993). Subject I, II and III were between 20.1 and 25.0, while subject IV had the body mass index between 18.5 and 20.0. None of the diabetics were over weight or obese or underweight. Since all the subjects were engaged in active physical work and consumed an adequate diet, they had normal body weight. So the incidence of diabetes among the subjects were not because of obesity or malnutrition. This fact strengthen the belief that in these subjects diabetes might have developed due to genetic predisposition (Fig. 3).

**12. Blood glucose level of the diabetics**

Table XV shows the blood glucose level of the diabetics.

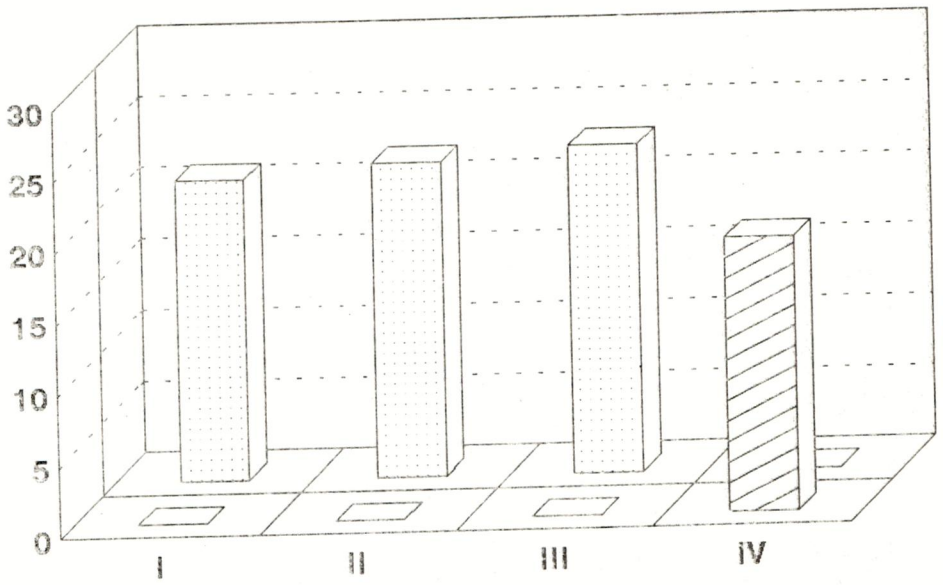
TABLE XV

BLOOD GLUCOSE LEVEL OF THE DIABETICS

n=4

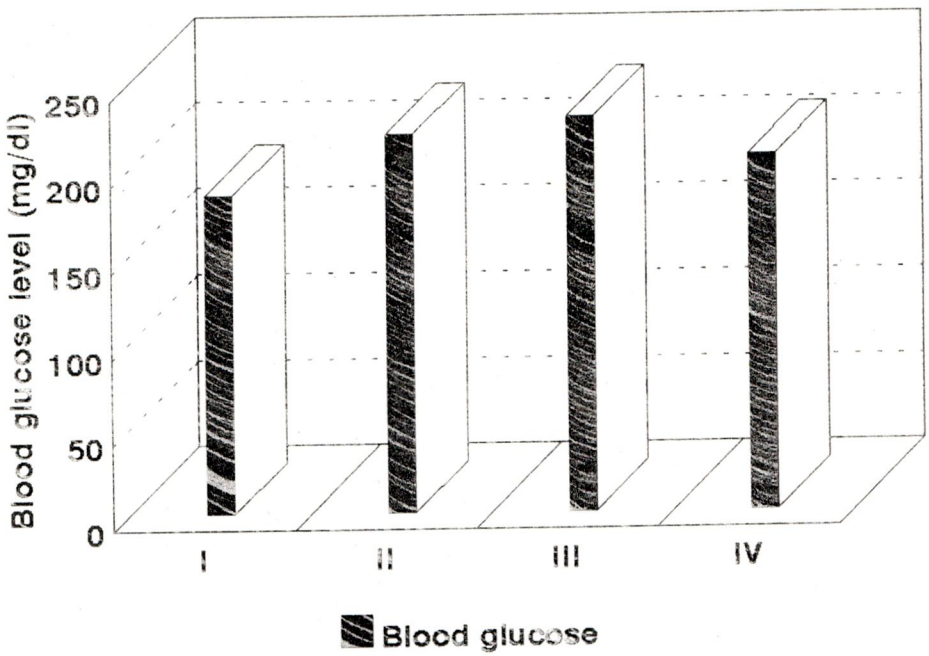
| Subjects | Blood glucose level mg/dl |
|---|---|
| Subject I | 185 |
| Subject II | 220 |
| Subject III | 230 |
| Subject IV | 207 |

Table XV shows that subject I who know that he had diabetes, had blood glucose level of 185 mg/dl even after taking oral hypoglycaemic drugs and following dietary restrictions. The other three subjects II,III and IV who were not aware of the disease previously had the blood glucose levels of 220 mg, 230 mg and




Body mass indices of the diabetics

Fig. 3




Blood glucose level of the diabetics

Fig. 4

207 mg/dl respectively. Probably these three diabetic subjects must be mild diabetics. Their blood sugar is below 250 mg/dl.

Only subject I was aware of the duration of the disease as five years, while others had no idea about the duration of the disease as they were currently diagnosed as diabetics by the investigator. The newly diagnosed diabetic subjects were advised to consult doctor for the treatment to be undertaken by them (Fig. 4).

**F. Food and nutrient intake of the diabetics**

Table XVI presents the mean food intake of the diabetic subjects compared with ICMR (1989) Recommended allowances for adults.

TABLE XVI

MEAN FOOD INTAKE OF THE DIABETICS

| Food groups | Suggested allowance (Heavy worker) male (g/ day) | Mean Intake of the two male (g/ day) | Suggested allowance (Heavy worker) Female (g/ day) | Mean Intake of the two female (g/ day) |
|---|---|---|---|---|
| Cereals | 500 | 334 | 400 | 225 |
| Pulses | 70 | 50 | 60 | 39 |
| Green leafy vegetables | 75 | 70 | 100 | 53 |
| Other vegetables | 75 | 59 | 50 | 63 |
| Roots and Tubers | 75 | 60 | 50 | 53 |
| Fruits | 100 | 22 | 100 | 44 |
| Meat and Poultry | 30 | 50 | 30 | 42 |
| Milk and Milk products | 200 | 233 | 200 | 329 |
| Fats and Oils | 20 | 15 | 15 | 16 |
| Sugar and Jaggery | 20 | 12 | 20 | 29 |

The results of three days dietary recall method disclosed the fact that the quantity of foods consumed by both the groups (male and female diabetic subjects) varied with different foods. The consumption of cereals, pulses, green leafy vegetables and fruits were found to be inadequate both among male and female subjects when compared to the allowances suggested by ICMR (1989). The intake of meat and poultry and milk and milk products showed an appreciable excess over the RDA values for these food items in the group studied respectively. The excess consumption of milk and milk products is due to availability of cow's milk in the villages studied. However the water added to milk and milk products could not be accounted for. The intake of other vegetables, roots and tubers and fats and oils among female subjects was adequate compared with the RDA, due to the consumption of vegetables that are available from the surrounding estates. Similarly the intake of sugar and jaggery was also more among female subjects when compared to RDA values of ICMR 1989.

Table XVII presents the mean nutrient intake of the diabetic subjects

TABLE XVII

MEAN NUTRIENT INTAKE OF THE DIABETICS

| Nutrients | RDA for Male ICMR (1996) | Mean intake Male | RDA for Female ICMR (1996) | Mean intake Female |
|---|---|---|---|---|
| Energy (K cal) | 3800 | 1942 | 2925 | 1632 |
| Protein (g) | 60 | 56 | 50 | 47 |
| Fat (g) | 20 | 37 | 20 | 37 |
| Fibre (g) | | 9 | | 9 |
| CHO (g) | | 313 | | 280 |
| Calcium (mg) | 400 | 912 | 400 | 699 |
| Phosphorus (mg) | | 1178 | | 1093 |
| Iron (mg) | 28 | 22 | 28 | 13 |
| Carotene (µ g) | 2400 | 2758 | 2400 | 1425 |
| Vit A (mg) | 600 | 736 | 600 | 439 |
| Thiamine (mg) | 1.6 | 1.5 | 1.2 | 1.67 |
| Riboflavin (mg) | 1.9 | 1.33 | 1.5 | 0.92 |
| Niacin (mg) | 21 | 15.8 | 16 | 12.6 |
| Pyridoxin (µ g) | 2 | 0.6 | 2 | 0.5 |
| Folicacid (µ g) | 100 | 74.3 | 100 | 50.1 |
| Vit C (mg) | 40 | 73 | 40 | 89 |

The nutrient intake of the subjects revealed a deficit in most of the nutrients. Both carlic and iron intake was lower than the recommended level both in male and female subjects. The intake of protein and niacin by both the groups (male and female subjects) was found to be some what adequate while fat, calcium, thiamine and vitamin C intakes were more than the RDA values. The protein intake was

adequate because of consumption of pulses, milk and meat and poultry. Similarly the excess consumption of milk and milk products, and other vegetables by female subjects and green leafy vegetables by male subjects had led to the excess of calcium and vitamin C intake both among male and female subjects. The intake of fat was also more in both groups due to consumption of milk and meat products. Beta carotene intake was more in males than the female subjects. This is due to the less consumption of green leafy vegetables by the female subjects. Even though more milk is consumed by the female subjects, the intake of the vitamin A is deficient in the diet of the female subjects because of less consumption of meat and poultry.

The intake of riboflavin, pyridoxin and folic acid were found to be deficient in the diets of both the groups.

It can be recalled that the intake of cereals, pulses and fats and oils were deficient among the subjects and it had resulted in energy deficit. Similarly inadequacies in the intake of green leafy vegetables had resulted in the deficit intake of iron.

From Table XVII it is also clear that the intake of fibre is 9 g of crude fibre. This may be equal to about 27 g of dietary fibre. The study by Raghuram **et al.,** (1993) declares that 25 g of dietary fibre in considered to be optimum for a diabetic.

**G. Impact of diet counselling**

The diet counselling was given to each diabetic subject by meeting them at a common place for a period of one week. Aids like menu card and pamphlets were

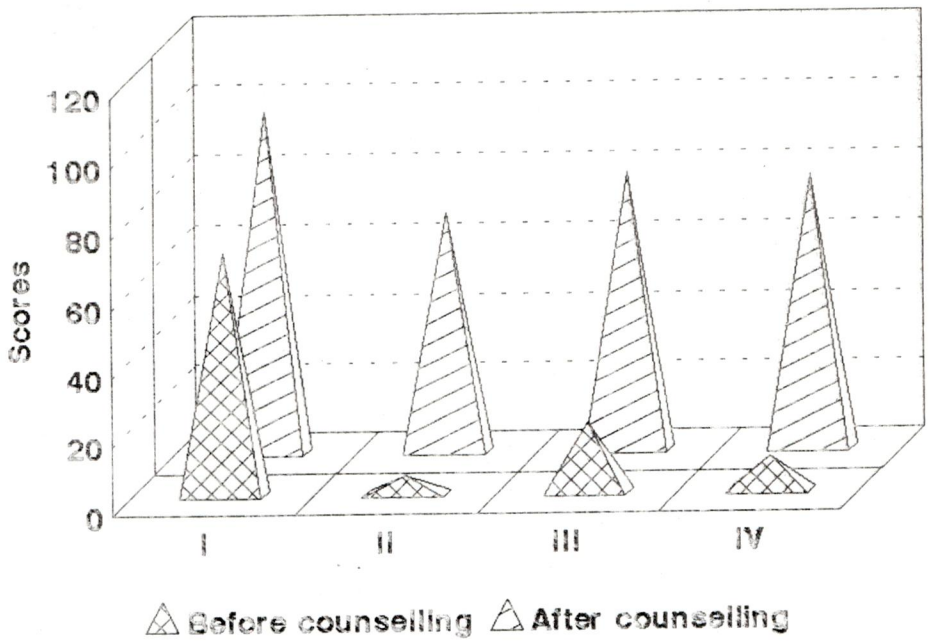
used during the period of diet counselling. Only subject I was already aware of the diet to be consumed during diabetes, as he was diagnosed as diabetic five years before. The remaining three subjects had no idea about the diet to be followed before diet counselling as they were newly diagnosed as diabetics by the investigator during the study. Table XVIII gives the result of diet counselling of the diabetics.

TABLE XVIII

SCORES OBTAINED BY THE DIABETICS BEFORE AND AFTER DIET COUNSELLING

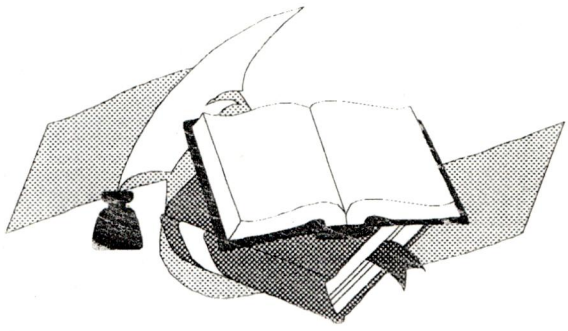
| Subjects | Percentage | |
|---|---|---|
| | Before counselling | After counselling |
| Subject I | 70 | 98 |
| Subject II | 5 | 69 |
| Subject III | 20 | 80 |
| subject IV | 10 | 79 |

From Table XVIII it is heart warming to note that after diet counselling the awareness regarding meaning of diabetes and its complications, foods to be included and avoided was increased. Except subject I all the other subjects had scored only a mean of 11.6 before diet counselling, whereas after diet counselling the mean score of the three subjects rose to about 76. This increase in awareness showed the interest of the subject to know about the disorder and to have a strict control over the disease and correction of faulty dietary habits (Fig. 5).




Scores obtained by the diabetics before and after diet counselling

Fig. 5



# Summary and Conclusion

# V SUMMARY AND CONCLUSION

The present study on the "Prevalence and etiology of diabetes mellitus among tribes of Shervaroy hills" was carried out in three tribal villages situated at a distance of one kilometre from each other in Shervaroy hills of Salem district. There were totally 164 families in these three villages, out of which 90 families were randomly selected for the study. From these families 300 adult members between 20 to 80 years of age were selected. There were 157 males and 143 females. Socio-economic background, educational status, lifestyle pattern and food consumption pattern of the selected subjects were collected by means of a specially formulated interview schedule. All the selected adult subjects were screened for the prevalence of diabetes mellitus by measuring the post-prandial blood glucose level using glucometer. Two adult males and two females were diabetics in the selected population.

A 24 hour dietary recall method was conducted for three consecutive days for all the four diabetic subjects. Etiological factors were analysed from the diabetics using the interview schedule. Since the tribal diabetics were ignorant about the do's and dont's of diabetes mellitus, diet counselling was undertaken for a period of seven days. The impact of diet counselling was evaluated after a period of one month. The results of the study revealed the following.

1. The total population picture of the three villages showed that adults between 20 to 60 years (51.4 per cent) and school going children between 7 to 12 years

(15.6 per cent) constituted a greater percentage of the total population. There were 13.1 percentage of adolescents and 6.3 percentage of old people.

2. Among the selected adults there were more subjects between 20 to 30 years of age.

3. Sixty five per cent of the subjects were illiterates. Only 35 per cent had education.

4. Majority of the subjects were employed in coffee plantations, digging pits and wells, cutting trees, mine works and coffee curing works. They were coolies and weekly wage earning labourers and this depicts the low socio-economic status of the villagers.

5. All the families selected for the study had an income level ranging between 500 to 2500 rupees per month, which again confirmed the fact that they were in the low socio-economic group.

6. Ninety three per cent of the subjects were non vegetarians. The main non vegetarian food consumed were pork and chicken. Other fleshy foods were consumed occasionally.

7. In the majority of the selected houses, cooking was done only once a day and the same was consumed for the other two meals of the day. In almost all houses breakfast was the left over rice from the previous night with addition of water.

8. All the tribal subjects consumed larger proportion of cereals. Rice was a staple diet of the tribes. Millets like ragi and varagu were also consumed during the

harvest season. Red gram dhal was used more commonly than the other pulses. Green leafy vegetables which were locally available were consumed.

9. Roots and tubers like potato, turnip and raddish which were locally produced were consumed in a greater proportion. Other vegetables consumption was very less. Rarely these were purchased from the local markets and consumed.

10. Fruits were consumed in excess as they were the inter crop in coffee estates. Fats and oils, milk and milk products consumption was limited as it was not possible with the low income. All the subjects used sugar for preparing beverages.

11. Coffee was the beverage consumed by a large number of subjects. Coffee powder was available at a very cheap rate.

12. Among the 300 adult subjects, 50 per cent consumed alcohol and 40 per cent consumed betal nut, while 23 per cent of the male had the habit of cigarette smoking. Only one subject underwent exercise. 13. Out of the 300 tribal subjects tested for blood glucose, four subjects had hyperglycaemia and were classified as diabetics. There were two male and two female diabetics. On the whole the rate of prevalence of diabetes was 1.33 per cent.

14. All the diabetic subjects were above 45 years of age. Hence they must be non-insulin dependent diabetics. All of them were doing heavy activity and belonged to low income group. Though all the diabetic subjects were involved

in heavy physical work, they were diagnosed as diabetics. This may be because of an existing family history of the disease.

15. Two of the diabetics indicated that their mothers had diabetes. So genetic predisposition was the cause for the development of the disease.

16. All the diabetics showed classic symptoms of diabetes mellitus like dizziness, headache, weight loss, polyuria, polydypsia, polyphagia and bodyache.

17. Besides diabetes, one subject was suffering from hypertension and gall stone formation. Another one subject had complaints of ulcer, asthma and weakness of limbs.

18. The lifestyle pattern of the diabetics indicated that only one subject consumed alcohol and one smoked. Except one person, none of the subjects performed any special exercise.

19. All the diabetic subjects consumed non vegetarian diet either weekly or occasionally. Except one all the diabetic subjects consumed coffee and tea as beverages.

20. All the subjects had registered a normal body mass index.

21. All the diabetics had the blood glucose level below 250 mg/dl. So they must be non insulin dependent mild diabetics.

22. Comparison of the food intake of the diabetics with recommended allowances indicated a maximum deficit among cereals, pulses and green leafy vegetables

in both male and female diabetics. The intake of fats and oils among male subjects were deficient.

23. With regard to nutrients a maximum deficit was observed for calorie and iron among both the groups (male and female diabetics) and a maximum deficit for beta carotene was observed in female diabetics. The intake of vitamins like riboflavin, pyridoxin and folic acid was found to be lower than the ICMR recommended allowances among both the groups. The intake of fibre was optimum for both male and female diabetics.

24. After diet counselling the knowledge of the diabetics regarding diabetes mellitus, the foods to be avoided, restricted had increased significantly.

The rate of prevalence of diabetes among the tribes was 1.33 per cent which co-incides with the findings of several diabetologists. Poor socio-economic status and genetic factors were found to be the main reasons for the incidence of the disease. In general, B complex vitamins.

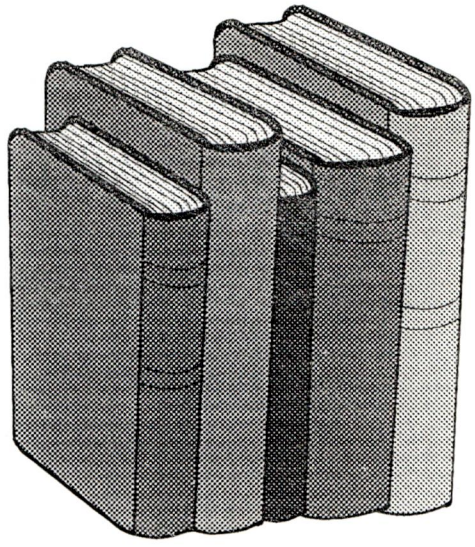
It may be concluded that the rate of prevalence of diabetes mellitus among the tribal population is low compared to the results of developed countries and the well developed urban areas of our country. Pollution free life away from the stress and strain of tension filled urban life, full of physical activity and fibre rich diet are the factors that may be listed for the low incidence of diabetes mellitus among the tribes of Shervaroy hills.

The following recommendations are made for further research.

1. Income generating projects could be started to the tribal families to increase their per capita income.

2. Mass literacy programme should be undertaken in the tribal areas to eradicate illiteracy.

3. Nutrition and health education programmes should be conducted to uplift the nutritional status of the tribes.



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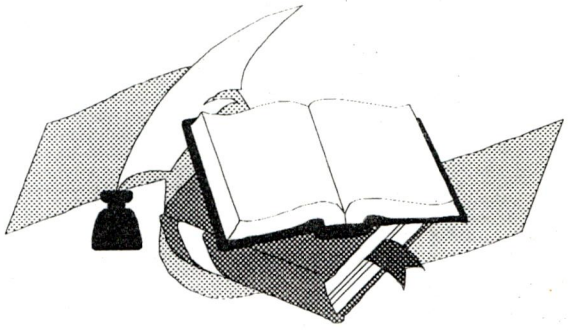

# Appendices

# APPENDIX-1

## AVINASHILINGAM UNIVERSITY, COIMBATORE.
## SCHEDULE TO COLLECT BACKGROUND INFORMATION
## FROM TRIBES OF SHERVAROY HILLS

1.Name of the interviewee :

2.Address :

3.Age :

4.Sex :

5.Education :

6.Occupation :

7.Income of the interviewee :

8.Total income of the family :

LIFE STYLE PATTERN:

9.Do you have the habit of smoking?

a. Yes ☐ b.No ☐

If yes indicate frequency and number/day.

10.Are you an alcoholic?

a.yes ☐ b.no ☐

If yes indicate type of alcohol.

Frequency of consumption and quantity /drink.

11.Do you have the habit of chewing pan?

a. Yes ☐ b.No ☐

If yes, indicate the frequency of chewing.

12.Do you have the habit of chewing tobacco?

a. Yes ☐ b. No ☐

13.Do you chew pan with betal nut?

a. Yes ☐ b.No ☐

If yes, indicate the frequency of chewing.

14.Do you have the habit of exercise?

a. Yes ☐ b. No ☐

If yes indicate the exercise

(i) Walking

(ii)Cycling

(iii)Yoga

(iv)Jogging

(v)Other exercise

DIETARY PATTERN

15. Are you a vegetarian or non-vegetarian or ova-vegetarian?

16. Meal pattern

a. 2 meals/day b. 3 meals/day c. 4 meals/day

17. Do you have the habit of drinking coffee or tea?

Yes ☐ No ☐

a. If yes indicate the quantity and frequency of consumption/day.

18. Mention the frequency of the consumption of the following:

| Food items | Daily | Twice a week | Thrice a week | Weekly | Occasionally |
|---|---|---|---|---|---|
| I. Cereals: | | | | | |
| Rice | | | | | |
| Ragi | | | | | |
| Varagu | | | | | |
| Wheatflour | | | | | |
| Maida flour | | | | | |
| Semolina | | | | | |
| Vermicilli | | | | | |
| Bread | | | | | |
| II Pulses: | | | | | |
| Whole bengal gram | | | | | |
| Bengal gram dhal | | | | | |
| Black gram dhal | | | | | |
| Red gram dhal | | | | | |
| Green gram | | | | | |

| Food items | Daily | Twice a week | Thrice a week | Weekly | Occasionally |
|---|---|---|---|---|---|
| dhal | | | | | |
| Green peas | | | | | |
| Horse gram | | | | | |
| Cow pea | | | | | |
| Dry Peas | | | | | |
| III.Leafy Vegetables: | | | | | |
| Agathi | | | | | |
| Amaranth | | | | | |
| Sirukeerai | | | | | |
| Araikeerai | | | | | |
| Cabbage | | | | | |
| Drumstick leaves | | | | | |
| Manathakkali leaves | | | | | |
| IV.Roots and Tubers: | | | | | |
| Beet root | | | | | |
| Carrot | | | | | |
| Onion (big) | | | | | |
| Onion (small) | | | | | |
| Raddish | | | | | |
| Turnip | | | | | |
| Potato | | | | | |
| Yam | | | | | |
| V.Other Vegetables: | | | | | |
| Gourd vegetables | | | | | |
| Beans | | | | | |
| Brinjal | | | | | |
| Cauliflower | | | | | |
| Drumstick | | | | | |
| Ladies finger | | | | | |

| Food items | Daily | Twice a week | Thrice a week | Weekly | Occasionally |
|---|---|---|---|---|---|
| VI.Fruits: | | | | | |
| Orange | | | | | |
| Banana | | | | | |
| Guava | | | | | |
| Lemon | | | | | |
| Tomato | | | | | |
| Pineapple | | | | | |
| Apple | | | | | |
| Grapes | | | | | |
| Pomegranate | | | | | |
| Mango | | | | | |
| VII.Fleshy Foods | | | | | |
| Mutton | | | | | |
| Pork | | | | | |
| Beef | | | | | |
| Chicken | | | | | |
| Fish | | | | | |
| VIII.Milk and Milk products | | | | | |
| Milk | | | | | |
| Curd | | | | | |
| Buttermilk | | | | | |
| Butter | | | | | |
| Ghee | | | | | |
| IX.Fats and Oils | | | | | |
| Groundnut oil | | | | | |
| Refined oil | | | | | |
| Vegetable oil | | | | | |
| Gingelly oil | | | | | |
| coconut oil | | | | | |
| X.Sugar and Jaggery | | | | | |

| Food items | Daily | Twice a week | Thrice a week | Weekly | Occasionally |
|---|---|---|---|---|---|
| Sugar | | | | | |
| Jaggery | | | | | |

# APPENDIX-II

## SCHEDULE TO FIND THE ETIOLOGY OF DIABETES MELLITUS AMONG THE TRIBES OF SHERVAROY HILLS

1.Name of the Inteviewer :

2.Name of the Interviewee :

3.Address :

4.Age :

5.Sex :

6.Education :

7.Occupation :

8.Total family income :

9.Family back ground :

| Name | Relation to HOF | Sex | Age | Marital Status | Education | Income |
|---|---|---|---|---|---|---|
| | | | | | | |

10.a. Weight(kg):

b. Height(cm):

c. Body Mass Index: $\frac{\text{Weight in kgs}}{\text{Height in m}^2} =$

d. Blood glucose value:

11.a. Familial tendency of the disease:

| Incidence in the family | Type IDDM/NIDDM |
|---|---|
| Grand Father | |
| Grand Mother | |
| Father | |
| Mother | |
| Others | |

b.Mention age of onset of diabetes:

c.Mention for how many years you have been diabetic:

12.Mention the symptoms experienced by you while diagnosing Diabetes mellitus?a.Fatique

b.Dizziness

c.Headache

d.Weight loss

e.Polyuria

f.Polydypsia

g.Polyphagia

h.Sweating

i.Body ache

j.Blurred vision

k.Delay wound healing

l.Numbness

m.Gangrene n.Other complications

(i)Retinopathy

(ii)Neuropathy

(iii)Nephropathy

13.Mention the treatment undertaken by you.

a. Allopathy

-Insulin

-Hypoglycemic drugs

b.Ayurvedic

c.Homeopathy

d.Sidha

e.Naturopathy

f.Others

If so give details

14.Are you under dietary Treatment?

a.Yes ☐ b.No ☐

If yes mention the

Foods Included:

Foods Avoided:

Foods Restricted:

15.Total amount of sugar/jaggery used everyday?

16.Mention your 3 days dietary intake pattern:

| Meal timings | First day | Second day | Third day |
|---|---|---|---|
| Early Morning | | | |
| Break Fast | | | |
| Mid Morning | | | |
| Lunch | | | |
| Tea | | | |
| Dinner | | | |

17.Are you a vegetarian or non-vegetarian or ova vegetarian?

18.Do you have the habit of drinking coffee or tea?

coffee ☐ tea ☐

a.If yes indicate with or without sugar.

b.Quantity and frequency of consumption/day.

LIFE STYLE PATTERN:

19.Do you have the habit of smoking?

a.Yes ☐ b.No ☐ If yes indicate frequency and number/day

20.Are you an Alcoholic?

a. Yes ☐ b.No ☐

If yes indicate type of alcohol,

Frequency of consumption and quantity/drink.

21.Do you have the habit of exercising?

a.Yes ☐ b.No ☐

If yes indicate the exercise

(i)Walking

(ii)Cycling

(iii)Yoga

(iv)Jogging

(v)Other exercises

22. Are you suffering from any other disease?

a.Yes ☐ b.No ☐

If yes mention the disease.

(i)Mention the age of onset of disease.

(ii)Mention whether the onset is before or after becoming diabetic.

(iii)If after-Mention after how many years of being diabetic, the second disease occurred.

(iv)Mention the treatment undertaken by you

# APPENDIX -III

## ESTIMATION OF BLOOD GLUCOSE VALUE BY GLUCOSE OXIDASE METHOD USING GLUCOMETER

PRINCIPLE:B-D glucose $+H_{20}$----> $O_2$ ----> gluconic acid $+H_2O_2$

The aldehyde group of B-D glucose is oxidised by glucose oxidase to give gluconic acid and hydrogen peroxide. If an oxygen acceptor is present, it will be converted to a coloured compound which can be measured

**Procedure:**

1. Turn the glucometer on, press the control button once andall the legends will appear briefly. This indicates that all the legends and digits are functioning
2. One to three seconds later, a program number will appear in the display. This should match the program number on the glucostix bottle lable.
3. After that, open the test slide by moving it to the left.
4. Prick the finger with the glucolet device and then obtain a large drop of blood on the end of the finger. Avoid squeezing excessively.
5. Press the button. The three bars will blink once and a short deep will sound
6. After 4-5 seconds a number 50 will appear in the display along with a long beep. 7.Immediatly when this beep sounds, apply the drop of blood to the glucostix pads which contain glucose oxidase reagent, completely cover the reagent pads with blood. Keep the strip level to avoid spilling the blood.
8. After a number 20 appear in the display along with a long beep, immediately blot the test pads (reagent pads) with the folded tissue.
9. After blotting, immediately insert the reagent strip into the test slot and close the test slide before the count down reaches one second
10. After the count down reaches one second, three bars (---)appear briefly, followed by the test result and a long beep.

# APPENDIX-IV

## QUESTIONNAIRE TO ANALYSE THE KNOWLEDGE OF DIABETICS

1.What is diabetes mellitus?

2.Is diabetes curable?

3.What will happen if diabetes mellitus is uncontrolled?

4.What is the treatment for diabetics?

5.Do you know that diet control is the main treatment for diabetes mellitus?

Yes / No

6.If yes,indicate what sould be controlled?

Control of carbohydrate: Yes / No

Control of Fat : Yes / No

7.What are the foods that can be eaten without restriction in diabetes millitus?

Boiled rice:Yes / No

Plain roti:Yes /No

Salads:Yes / No

Potato:Yes /No

Other Vegetables:Yes /No

Grilled or Baked foods: Yes / No

Plain tea /coffee with sugar:Yes / No

Plain tea/coffee without sugar:Yes / No

Lemon juice with sugar:Yes / No

Lemon juice without sugar:Yes / No

8.Indicate whether the following foods can be eatern during diabetes mellitus?

Sugar:Yes/No

Jaggery:Yes/No

Sweets:Yes/No

Soft drinks:Yes/No Pastries:Yes/No

Jam:Yes/No

Jelly:yes/No

Oily Pickles:Yes/No

Sherbets:Yes/No

Honey:Yes/No

Sweet wines:Yes/No

Chocolates:Yes/No

Syrup:Yes/No

Wheat bread:Yes/No

Carbonated beverages:Yes/No

Dried fruits:Yes/No

Preserved fruits:yes/No

Fried foods:Yes/No

Whole fruit:yes/No

Fruit juices:Yes/No

Alcohol:Yes/No

Roots and tubers:Yes/No

Refined grains:Yes/No

Bakery products:Yes/No

White bread:Yes/No

Refined cereal products:Yes/No

Glucose:Yes/NO

9.What are the contributing factors to diabetes mellitus?

Genetic factors:Yes/No

Obesity:Yes/No

Dietary restriction:Yes/No

Sugar intake:Yes/NO

Dietary fibre:Yes/NO

Infections:Yes/No

Acute stress:Yes/No

Under nutrition:Yes/No

10.Indicate whether the following foods are included in daily diet ?

Butter milk:Yes/NO

Plain coffee / tea without sugar:Yes/No

Salads:Yes/No

Other Vegetables:Yes/No

11.What are the foods rich in fibre?

Whole wheat:Yes/No

Mint:Yes/No

Coriander:Yes/No

Vegetable salads:Yes/No

White bread:Yes/No

Wheat bread:Yes/No

Maize:Yes/No

Roots and tubers:Yes/No

Fruit juices:Yes/No

Whole legumes:Yes/No

peas:Yes/NO Beans:Yes/No

Groundnut:Yes/No

Whole fruit:Yes/No

Refined grains and Cereal products:Yes/No

12.What is a food exchange list?

Yes/No

13.If yes indicate whether you follow the food exchange?

Yes/No

14.What is dietary fibre?

15.What is the role of fibre in a diabetic patient?

16.Do you know that foot care is essential in a diabetics?

17.Indicate whether exercise has beneficial effect on health of dibetics?

Yes/No

18.What are the exercise to be undertaken during diabetes mellitus?

Walking:Yes/No

yoga:Yes/No

Cycling:Yes/No

Swimming:Yes/No

Jogging:Yes/No