582

STUDY OF MARRIAGE TYPES AND DIABETES IN A HOSPITAL POPULATION

A Dissertation Submitted in the Partial Fulfilment of the Requirements for The degree of Master of Philosophy In Human Genetics

By

Shazia Ashraf

M.Sc.

DEPARTMENT OF BIOLOGICAL SCIENCES

QUAID-I-AZAM UNIVERSITY

ISLAMABAD

1997

CERTIFICATE

*This thesis by **Shazia Ashraf** is accepted in its present form by the Department of Biological Sciences, Quaid-i-Azam University, Islamabad, satisfying the thesis requirements for the degree of Master of Philosophy in Human Genetics.*

Internal Examiner _____

External Examiner _____
(PROF M. ASLAM)

Chairman _____

Dated 20-11-1997

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNWOLEDGEMENTS

Extreme of my regards are to *"Almighty Allah"* and The Holy Prophet (Peace be Upon Him) who endowed me with potential and ability to complete this research work.

I express my sincere and heartiest gratitude to my Supervisor, Dr. S. A. **Shami** for the guidance and encouragement during the course of study on all aspects of this work.

I am indebted to **Dr. Samina Jalali** for her moral support and co-operation during my research work.

My thanks are due to the administration of the Rawalpindi General Hospital, Holy Family Hospital, Polyclinic and Pakistan Institute of Medical Sciences for their well behaviour and great help in my data collection.

I owe my gratitude to my friends, Raazia, Shumaila, Shaheen, Ambreen, Behjat, Quratul-Ain for their physical and moral support during this period.

I wish to express my cordial thanks and gratitude to the support, educated guidance and encouragement of Mahmood Akhtar Kayani, without which this study could have been a mere dream.

Deep indebtness and thanks to my sister Farhana Naveed and my cousin Sadia Javeed for their help in my statistical works.

I gratefully acknowledge the moral support of my parents, blessing of my brothers which help a lot in the completion of my research work.

Shazia Ashraf

Dedicated to my

Affectionate Parents

ABSTRACT

Analyses for population study and effects of consanguinity were carried out on 1007 diabetic patients. Patients were classified into two types of diabetes mellitus i.e. Insulin-dependent diabetes mellitus (IDDM) and Non-insulin-dependent diabetes mellitus(NIDDM).

IDDM patients show significantly earlier ($P<<0.001$) onset of disease than that of NIDDM-patients.

Female patients in both (IDDM and NIDDM) show significantly higher BMI level than males.

Patients diagnosed for diabetes show that females have significantly ($p< 0.1$) earlier onset of disease than that of male patients. Female patients in both IDDM and NIDDM show significantly higher obesity level than males.

In IDDM patients maximum percentage of patients is seen in <35 years age group, where as in NIDDM, highest frequency is seen in 45-54 years.

Education seems to have significant effect on the infliction of diabetes. In IDDM and NIDDM, highest percentage of paternal education in first cousin and unrelated is of those who attained education up to school level.

In IDDM and NIDDM the highest percentage is of those patients who have maternal education at none level in first cousin and in

unrelated at school level. A high percentage of patients in IDDM and NIDDM is of those holding clerical jobs and are engaged in business.

Smoking doesn't seem to have any effect on infliction of diabetes. The percentage of smokers is higher in diabetes than in the controls, but the difference between the two is not significant.

In IDDM the highest percentage of patients was observed to be inflicted with hypertension in first cousins (29.16%) and in unrelated patients (54.54%) Similarly, in NIDDM, the highest percentage of patients is of those who are inflicted with hypertension in first cousins (54.66%) and in unrelated (53.62%).

In IDDM, first cousins and unrelated patients have the highest percentage of diabetic fathers (33.33% ; 27.77% respectively). Similarly, in NIDDM, first cousins and unrelated patients have high percentage of diabetic fathers (36.77% ; 42.46%) respectively.

Calculated co-efficient of inbreeding (F) is 0.028 for both type diabetics. Co-efficient of inbreeding (F) calculated for males is 0.0293 which is higher than that of females(0.026).

Distribution of diabetes patients showed highest percentage in Malik (11.31%) and lowest in Kashmiri (2.18%). While highest co-efficient of in breeding calculated was in Mughal (0.03906) and lowest in Abbasi (0.01934).

INTRODUCTION

The Term 'diabetes mellitus' is used to describe a group of disease that have in common hyperglycemia caused by some fault in the production or utilization of insulin. The name diabetes comes from the Greek language for a Siphon and refers to the Polyuria, common in both diabetes mellitus and in diabetes insipidus. Mellitus is from the Latin, and means sweetened with honey, referring to the sweet taste of glycosuric urine.

In most instances, diabetes mellitus results from diminished secretion of insulin by the beta cells of langerhans. The widely accepted classification of diabetes mellitus, recommended by the WHO (1985) was based primary on clinical descriptive criteria.

1. INSULIN DEPENDENT DIABETES MELLITUS (IDDM)

IDDM is characterized by absolute insulin deficiency, abrupt onset of severe symptoms, proneness to ketosis and dependence on exogenous insulin to sustain life. The age at clinical onset or diagnosis is usually below 30 years, although the disorder may occur at any stage. It is commonest form of diabetes among children and adults in populations of European origin. Glucose concentrations are unequivocally elevated in Fasting blood (> 120 mg/dl or > 6.7 mmol/L) or Plasma $\geq$ 140 mg/dl or $\geq$7.8 mmol/L), and glucose and ketones are usually present in the urine. Patients with IDDM can present with diabetic ketoacidosis , a serious and potentially fatal condition.

2. NON INSULIN DEPENDENT DIABETES MELLITUS (NIDDM)

NIDDM tends to be familial. NIDDM is often asymptomatic for many years, and patients may present as a result of complications of diabetes or incidentally with an abnormal blood or urine glucose test. NIDDM can present at any age, although it does so most commonly in adults.

3. IMPAIRED GLUCOSE TOLERANCE (IGT)

The category of impaired glucose tolerance includes those whose glucose tolerance test is beyond the boundaries of normality. As a group such people have a higher likelihood of progression and may ultimately develop and meet the criteria for diabetes mellitus.

4. GESTATIONAL DIABETES MELLITUS (GDM)

GDM is defined as diabetes first recognized during pregnancy. Following parturition some women with glucose intolerance first recognized in pregnancy will revert to normal glucose tolerance, whereas, others may continue with IGT or diabetes, which can then be classified more specifically as IDDM or NIDDM. Many other complications are associated with diabetes mellitus such as hypoglycemia, diabetic ketoacidosis, Artherosclrosis, Retinopathy, Neuropathy, Nephropathy, foot ulceration and amputation.

Malins (1972) reported that diabetes mellitus is a very common disease by being present by conventional criteria of glucose intolerance in between 2% and 6% of the prosperous populations of the world. Diabetes mellitus can be found in almost all populations throughout the world, but

the incidence and prevalence of IDDM and NIDDM and relative distribution of these two major types of diabetes show major differences between countries and between different ethnic groups within individual countries (Rewers et al 1988; King and Zimmet 1988 ; King and Rewers 1993).

Population based studies of the incidence of IDDM in children using comparable methods show that there is a 20 to 60 fold difference between the countries with the higher incidence rates and those with the lowest.

Recent studies have not only identified new high risk areas for IDDM, but also have suggested an increasing incidence of IDDM, particularly in Europe but also elsewhere (Green et al., 1992; WHO 1992). Incidence of IDDM varies geographically. In Europe, a north-to-south gradient exists such that the incidence of IDDM is highest in Finland and lowest along the Mediterranean coast (except Sardinia, which has the second highest incidence rate in the world). (Karavonen et al., 1993).

Incidence and prevalence of IDDM in children in Japan are significantly lower than in the United States and European countries (Kitagawa et al., 1983). The overall annual IDDM incidence rates by area in Japan for 1985 - 1989 for children 0 -14 years of age at diagnosis were from 1.65 to 2.07 per 100,000. The incidence in males and females did not show any temporal trends during the periods between 1980-89. The prevalence of IDDM was about 1 per 10,000. (Kitagawa et al., 1994). Two Canadian centers that participated in the Diabetes Epidemiology Research International Study had different incidence rates in IDDM, 25.5/100,000, IN Prince Edward Island (PEL) and 9.2/100,000 in Montreal (Tan 1995). IDDM constitutes about 85% of all cases of diabetes in developed

countries and the majority of cases in some developing countries especially those with high prevalence of diabetes. (Glatthaar, et al., 1988). The incidence of IDDM in Slovak children (0-14 years) is similar to what has been found in other central European countries. In children younger than 4 years of age in 2 years (1991-92) more patients with diabetes were found than in any period during the preceding 6 years. (Michalkova et al., 1995). Among non-aboriginal children, the prevalence of diabetes in the age group zero to 14 years was 0.59/1000 children and the incidences 12.3/100,000 children/years. These rates are somewhat lower than those that have been reported from the United Kingdom and North America and substantially lower than the rates that were reported from Scandinavia (Glatthaar et al., 1988).

It was observed that the overall prevalence of diabetes mellitus was 29.1% and of impaired glucose tolerance was 15% in England. Furthermore, the data support an increased frequency of diabetes mellitus (65% Previously undiagnosed) and impaired glucose tolerance in the elderly, whereas the population's susceptibility seems to decline in the older groups for both sexes. (Papazogloes et al, 1995). The higher incidence occurs in 10-14 years age group, with male sex predominance. (Grzywa, 1995). In developing countries type II (NIDDM) diabetes appears to be the most common form, but tropical malnutrition diabetes also occurs in many regions of the globe. (Zimmet, 1983). Approximately, two million older Americans are known diabetics and another remain undiagnosed. Still another group may be over diagnosed, and are merely showing signs of age. (Bennett, 1984). Incidence of IDDM in Denmark in the years (1970-76) was 13.3 per 1,00,000 in the age of group 0-29 years. This incidence is almost identical to that found in 1924 in Denmark in the same age group. The prevalence of insulin consumers was 3.2 per 1,000 (Christy et al.,1979).

Prevalence of diabetes mellitus displays a considerable variation between different populations and also between various age groups among these populations (Knowler et al., 1978). Prevalence of diabetes mellitus was reported to be over 17% for people over 65 years in USA. On the contrary a decline in the number of new (NIDDM) diabetic patients has been observed especially after the age of 60. (Bennet et al., 1984 and Zimmet et al., 1984).

Prevalence increases with physical idleness and with obesity but is less evident among those who regularly exert themselves. The prevalence is, therefore, changing in most parts of the world and may even be expected to fall in societies which adopt a revisable attitude to the need for exercise and weight control. (Malins, 1972). One of the most important risk factors for developing diabetes mellitus or impaired glucose tolerance (IGT) is obesity (WHO study group, 1985, (Mykkanen et al., 1990). The association between obesity and NIDDM may vary in strength between populations and between the sexes. (Zimmet et al., 1985), Two variables most strongly related to the incidence of NIDDM are age and degree of obesity, although there is emerging evidence of an independent association with fat distribution. (Jarrett, 1989). A direct correlation with dairy product consumption, factors that may play a role in beta cell damage include viral infections, environmental toxin, nutrients and stress factors. (Drash et al., 1989). The release of catecholamines caused by stress can cause a diabetic response in a normal person (Ritchie, 1990). The risk of IDDM increases in children independently with, breast feeding shorter than 3 months, feeding with cow's milk instead of breast feeding, early introducing of solid diet in babies, or high consumption of cow's milk in later years (Grzywa et al., 1995). In one study, it was found that the proportion of diabetic children who received no breast milk

tended to be higher. A higher proportion of non diabetic children reported. Non-specific infections and the number of stressful life events was higher in diabetic children aged 10-14 years. (Soltesz et al., 1994).

Diabetes mellitus increases with the increase in age. Only 0.2% of children have diabetes mellitus, in young people the disease tends to be severe. In the old, it is mild and usually asymptomatic (Ricthie, 1990). IDDM usually becomes evident when the patient is less than 40 years old, often in adolescence or childhood, men and women are affected equally (Ritchie, 1990). Most patients with NIDDM are over 40 years old when the disease first becomes evident. As age increases, the likelihood of developing non-insulin dependent diabetes increases, and 50% of people over 80 years age have diabetes, usually mild diabetes. Maturity onset diabetes in the young may become evident in childhood. (Ritchie, 1990). Diabetes is comparatively uncommon below the age of 45, and screening this section of the population would not be worth while. Over the age of 70, mild glucose intolerance is very common, the prevalence being as high as 25% in England. (Working Party of College of General Practitioners, 1963). It is doubtful whether the diagnosis of such a condition which has no more than long term implications is of any value in the old age, though the frequency of severe diabetes at this age has to be remembered in all clinical examinations. It is most profitable to concentrate on the age range of 45-70 years in which the prevalence of diabetes is around 5%. The prevalence of diabetes increases gradually with age. Prevalence rates commonly exceeded 10% in those over the age of 60 years. (Wilson et al., 1986). Chen et al. (1986) analyzing the data from 8,000 adults in the United States, found that adult diabetes is highly associated with age but not with sex. It was found that the age of onset of diabetes mellitus was significantly younger in females than males (Mason et al., 1987). The onset of the disease occurred most frequently between 10-14 years of age and a

small peak of incidence could be seen between 5 and 7 years of age. (Christau et al., 1977: Streaky et al., 1978; Bloom et al., 1975 and Durrutty et al., 1979). The overall annual IDDM incidence rates by area in Japan for 1985-89 for children 0-14 years of age at diagnosis were from 1.65 to 2.07 per 100,000. The incidence in male and females did not show any temporal trends during the period between 1980-89. The prevalence of IDDM was about 1 per 100,000 (Kitagawa et al., 1994). The distribution of age at diagnosis showed a small peak between 4 and 6 years of age and a main peak between 12 and 14 years. In girls, the main peak appeared between 10 and 12 years in boys .A significant difference was not seen between two sexes. (Kandemir et al., 1994).

Through a diabetic survey of the adult population, aged 15 years and above, carried out in 1975, shows that the prevalence of diabetes is 1.99%. It is higher in males 2.36%, than in females 1.64%. It occurs mainly in the age group 40 years and above(5.08%) and is uncommon in the age group 15-39 years (0.40%). In males the highest prevalence of diabetes (7.0%) is in the age group 45-49 years while in females the highest prevalence (7.2%) is in the age group of 55-59 years. 43.3% of the diabetics are of normal weight while 44.3% are overweight and12.4% are under weight (Cheah, 1985).

Studies relating the incidence of the disease to age among juveniles suggest that an initiating factor, probably viral in origin, is operative in early childhood and that after a latent period, a precipitating factor may then uncover the disease. This might explain the peak of juvenile diabetes which appears at age of 11, in Britain Studies on families in which diabetes has appeared almost simultaneously in two or more members, lends some support to the view that the disease may be precipitated by some ineffective process (Gamble et al., 1976). Approximately 6% of the

population over the age of 35 years has been diagnosed with diabetes. By the seventh decade, the rate of diagnosed diabetes is close to 10% (National Centre for Health Statistics 1985; Philips et al., 1990). It was observed that patients attending diabetes clinics are younger and more likely to have IDDM and complications than individuals with diabetes in the community (Melton III et al.,1984). It is reported that it is not unusual to see NIDDM cases present in the second decade of a child's development in Japan, whereas in Caucasian countries, where IDDM is prevalent in children, NIDDM is usually present in the 5th decade of life, thereafter. (Owada et al., 1990 and Zimmet, 1979).

The siblings of children who developed diabetes before the age of 16 years were 26 times more likely to develop diabetes than other children of all siblings surveyed. It was estimated that 5.6% became diabetic by the age of 16. These results further suggest that age at onset is determined by non-genetic factors and that, in atleast some cases, etiologic environmental factors may lead to the development of diabetes mellitus within a period of a few months. (Gamble, 1980). Akerblom et al. (1985) observed that as in many studies for other countries, the following characteristics were observed in the IDDM epidemiology in children and adolescents; a steady rise of incidence throughout childhood until puberty, the peak occurring earlier in girls than in boys, a male excess in young children and adolescents, a seasonal variation, and a secular trend.

The highest incidence of IDDM occurs in 10-14 age group, with male sex pre-dominance (Grzywa,1995).

There proved to be no significant relationship between the incidence of diabetes mellitus and sex.(Khanina, 1977). Mortality among diabetics at all ages is excessive (Haywords et al.,1970). But women are

less fortunate than men and almost lose the greater expectation of life, enjoyed by non-diabetic women (Pell and Alonzo, 1970).

Pregnancy is complicated by diabetes more often than was previously believed (Engelgau et al., 1995). Women who have large babies are likely to become obese and to develop diabetes in later life. (Fitzgerald et al., 1961). Unexplained still births are often associated with gestational diabetes which may disappear after delivery, but calls for particular vigilance in a further pregnancy. (Pedersen, 1967). Women who have produced large families have an increased risk of diabetes, directly related to the number of children, those who have six children being six times more likely to develop diabetes than those who have had none. (Pyke, 1956). It was observed that the intensive treatment of a pregnant woman with gestational diabetes (GD) allows the achievement of results similar in terms of maternal and fetal health, to those observable in non-diabetic pregnant woman. GD, moreover seems highly foreseeable for the appearance of diabetes mellitus and it is therefore, advisable, after pregnancy, to perform a long term follow-up for preventive purposes. (Miselli et al., 1994). Stoving et al. (1994) found that about 20% of all women with IDDM have menstrual irregularities.

Generally a higher incidence of IDDM has been observed in whites. There are differences between migrating populations ethnically homogenous. (Grzywa et al., 1995). The average annual incidence rate (IR) of IDDM among the black children was less than half that observed in the white children. Among the 134 whites, age specific annual IR blacks were highest in the 5 to 9 and 10 to 14 years age groups. Little variation was observed in the age-specific rates among the 41 black subjects. (Wagenknecht et al., 1989). Diabetes is rare in Melanesians, and also in Polynesians, Micronesians and Australians aboriginal who have adopted

a western life-style. Along with the Pima Indians, the Micronesian populations of Naura have the highest diabetes prevalence yet reported, 40% of people aged 20 yrs and over. As diabetes is rare in traditional living Polynesians and Micronesians, yet high in westernized populations of these ethnic groups. It appears that these people may have a 'diabetic genotype' that is unmasked by the change in life-style (Zimmet, 1979).

No association between the incidence of diabetes and income level was found among white or black children. (Wagenknecht et al.,1989).

Approximately one third of the elderly male Finns have diabetes mellitus (mainly type II) (Tuomilento et al., 1986). Katsilamabros et al., (1993) in Greece reported an increasing prevalence rate of established diabetes in elderly Greek people living in a suburb in Athens. There is an increased overall prevalence of diabetes mellitus about 36-38% in Finns aged 65-74 years. (Tuomilento et al., 1986). Prevalence of known diabetes in UK is 9.3%(Cromme et al., 1987 and Croxson et al.,1991).In Japan the prevalence of diabetes was more than 10% in the elderly (Masaki et al.,1992).

French et al., (1990) observed in a population study an overall prevalence of diabetes mellitus of 20.7% in people over 60. While prevalence of entire population (adults and children) is closer to 1.5% (Dyck et al., 1993). National center for Health Statistics (1985) reported that the incidence rates for NIDDM for persons aged 25-44 years and over 44 years, are estimated to be two to five per thousand persons per year, respectively. It is estimated that in the United States 2% of the population have diabetes mellitus or will develop it. The prevalence is probably similar in other countries, though juvenile diabetes mellitus is unusual in

Africa and in the East especially in Japan. Throughout the world 30,000,000 people have diabetes mellitus (Ritchie, 1990).

The prevalence rate of diabetes mellitus among people 65-74 years was 19% for whites and 25% for blacks. (Harris , 1985).

The variation in seasonal onset and the age distribution probably reflect the effects of factors that precipitate clinical manifestations of the disease rather than those that are directly responsible for initiating pancreatic beta cell destruction(Bennet, 1985).A seasonal trend was evident in both white and black races, with fewest cases of IDDM diagnosed in the months of April through June (Wagenknecht et al., 1989). Seasonality is a characteristic feature of IDDM incidence. The lowest incidence is observed in summer, whereas the higher in winter autumn. (Grzywa et al., 1995). The incidence of IDDM in winter was higher than in summer. However, there was no significant winter peak in diagnosis. When monthly incidence rates were combined, the increased evidence of IDDM in winter versus summer was evident in males but not in females (MacDonald et al., 1989).Whereas Mason (1987) observed a seasonal variation in incidence for males, with peaks in late autumn and mid-winter. The earlier seasonal incidence studies indicated that Juvenile diabetes is acquired mainly in the autumn and winter months, and more recent and extensive studies conducted further throughout Great Britain have confirmed these earlier findings (Gamble et al., 1976).

Positive associations are reported between excess energy consumption, obesity, dietary fat intake, and urban factors in relation to prevalence of diabetes. A negative association is seen in some studies between (complex) carbohydrate intake and mortality from diabetes. (Welborn, 1984). For younger adults diabetes is associated with body

mass and blood pressure but not with physical activity level. For older adults diabetes is not associated with blood pressure, but is highly associated with physical activity level and a measure of body mass based on maximum reported weight. (Chen et al., 1986). Using a BMI $\geq 29(kg/m^2)$ as the limit for considering obesity in the elderly, it was found that the prevalence rate for new cases of diabetes in obese people was significantly higher compared to non-obese (34.9% versus 21.5%) (Horton,1990). Body mass index is positively associated with increased risk of NIDDM in both sexes in many ethnic groups (Haffner , 1986; Ohlson , 1988; Dowse , 1991).

About 80% of patients with non-insulin dependent diabetes mellitus are over weight and many are obese. It was found by Ritchie (1990) that the obesity causes resistance to the action of insulin that can often be corrected if the patient loses weight. Obesity, a high calorie western diet, and reduced physical activity may be the major precipitating factor for diabetes mellitus (Zimmet,1979). Obesity remains a risk factor for DM and IGT particularly among the younger groups although its role has been found to decline with age (Papazoglou et al., 1995).

Determinants of Waist to hip-ratio (WHR) are varied and include genetic variables, hormonal variables and behavioral factors such as smoking and exercise (Barrett et al., 1989).

After adjusting for body mass Index (BMI) WHR (waist to hip ratio) in men was correlated with higher levels of depressive symptomatology and greater anxiety. While in women, WHR was significantly correlated with higher levels of depressive symptoatology, greater stress and alcohol consumption. For both sexes, smokers had a

significantly greater mean WHR than non-smokers. For men, multiple regression analysis adjusted for BMI and age, demonstrated that smoking, lower income, less exercise and lower type A scores were the most significant variables associated with WHR. In women, the independent predictors of WHR were a history of smoking, lower educational level, and depressive symptomalogy (Lioyd et al., 1996).

In the USA among whites, the overall risk of developing diabetes mellitus is about 5% while offspring of diabetic parents have 2-3% risk if the mother has the disease, and 5-6% risk if the father has the disease. (Skyler,1993). According to Rimoin (1971) the genetic mechanism of diabetic heredity is disputed, but the disease does run in families, and screening the relatives of known cases is the most productive of selection programmes. Such relationships should be identified in case records, so that the possibility of diabetes is remembered whenever a relative of diabetic is ill for no obvious case. Evidence for genetic predisposition comes from studies in twins that demonstrate a higher concordance rate for type I (IDDM) in monozygatic twins (25-30%) than in dizygotic (5-10%). The empirical risk of type I diabetes is increased in first degree relatives of patients with the diabetes (Skyler - 1993).

Kandemir et al. (1994) observed that the consanguinity between parents was 23.9% and 10.3% of the patients had IDDM in first degree relatives. The diabetes was found to be more prevalent in subjects with a positive family history (Verrillo et al., 1983). Children in the US are almost 20 times more likely to develop (IDDM) than children in Japan. In addition, the risk to first degree relatives in Japan appeared to be somewhat lower than in the US although this may have been the results of difference in ascertainment (Tajima et al., 1985). It was observed from epidemiological survey of Juvenile - onset diabetics, that 10% of diabetics

have a first-degree relative who is insulin dependent. (West et al., 1979). Oakley et al (1968) found that 13% of children had a history of diabetes in a first degree relative. Bloom et al. (1975) found that 11% of children had a history of diabetes in a first degree relative.

Patients with diabetes are at very high risk for complications, which are associated with extreme morbidity and mortality. (Jacobs et al., 1991). In longitudinal studies, background retinopathy develops in over 90% of patients after 20 years.(Palmberg et al.,1981). Nephropathy develops in 35-45% of IDDM and 20% of NIDDM patients. (Andersen et al., 1983). Autonomic neuropathy occurs in approximately 30% of Insulin treated diabetic patients after 10-15 years. (Dyck et al., 1993 and Maser et al., 1990).The cumulative incidence rates of complications in IDDM are 16% for blindness, 22% for renal failure, 10% for stroke and 21% for myocardial infraction (Deckert et al., 1978).Barrett et al., (1989) found that individuals with IDDM are at an increased risk of developing cardiovascular disease.

The present study was carried out to collect the base line data from hospital populations to find out age at diagnosis, effects of cousin marriages on prevalence of diabetes, inheritance of diabetes, its familial occurrence and association with other diseases. It was also tried to find any correlation between diabetes occurrence and other non-biological factors like economic status, education or life-style of the diabetics.

MATERIAL AND METHODS

DATA COLLECTION

For the collection of data a large number of diabetic patents were contacted by visiting different hospitals. Some data were also collected by visiting patients at their homes.

The data were collected from main hospitals in the Punjab Province especially from Rawalpindi / Islamabad. For this purpose the hospitals were visited during the period of Sep. 1995 to May, 1997. The hospitals visited are:

1. Rawalpindi General Hospital, Rawalpindi.
2. Holy Family Hospital, Rawalpindi.
3. Armed Forces Institute of Pathology, Rawalpindi.
4. Pakistan Institute of Medical Sciences, Islamabad
5. Federal Govt. Services Hospital, Islamabad.

A total of 1007 patients were interviewed for data collection, of Which 486 were males and 521 were females.

The questionnaire included a variety of questions such as name, age at present, age at diagnosis, age at marriage, relationship between husband and wife and of their parents. Information about family history having the same or any other disease was also recorded. Questions were also asked about the economic status, education of the couples and also the life style of the patients.

Occupations were grouped into following categories after Population and Growth Survey, Federal Bureau of Statistics, Statistics Division, Government of Pakistan, Islamabad (1988).

C-I Professional & Management.
C-II Intermediate
C-III Skilled Non-manual
C-IV Skilled manual
C-V Partially Skilled
C-VI Unskilled

The data collected was analyzed in two ways firstly, the sample was analyzed as a whole to obtain information about the hospital population, and secondly, the sample was analyzed for the study of consanguinity.

Genetic relationships in marriages were classified as:

- First cousins (IC)
- First cousins once removed ($1^{1/2}$ C)
- Second cousins (2C)
- Distant Relations (DR)
- Braderi (B)
- Not related (U)

MEASUREMENTS

Different parameters were taken to check and study their link with disease prevalence and incidence.

The parameters were:

a) Height
b) Weight
c) Blood Glucose Levels (Fasting and Random)
d) Skin Thickness
e) Spoons of sugar taken daily

a. HEIGHT

Height of the patient was measured by scale in metres.

b. WEIGHT

Weight was measured in kg . The weight of the patients was taken without their shoes.

OBESITY

The definition of obesity was based on body mass index. Men with a body mass index greater than 27 or women with a body mass index greater than 25 were considered obese. (Bennet, 1979).

c. BLOOD GLUCOSE LEVELS

The glucose oxides strip test was used for this purpose. First, the Fasting blood sugar was measured and then Random blood sugar was measured 2 hours after the breakfast.

d. SKIN THICKNESS

Skin thickness of the patients in terms of diameter of arm was taken with the help of tape running in centimeters, as far as no other facilities are available in this regard.

CONTROLS

167 normal subjects were also interviewed for comparison between diabetics and controls. These controls were normal, only from the diabetes point of view.

STATISTICAL ANALYSIS

The statistical analyses carried out for this study include percentages, mean, standard error, chi - square test and t-test. Mean coefficients of inbreeding were calculated by Wright's (1992) method.

RESULTS

GENERAL POPULATION STUDY

Present study is based on 1007 patients diagnosed for 2 different types of diabetes, Insulin dependent diabetes mellitus (IDDM) and Non Insulin dependent diabetes mellitus (NIDDM). Out of total 1007 diabetics examined 521 (51.73%) were females and 486 (48.26%) were males. A total of 167 normal subjects were also interviewed as controls.

The data were analysed for IDDM and NIDDM patients separately.

Table 1 shows the number and percentage distribution of males and females in IDDM and NIDDM diabetics. Of the total diabetics examined 202(20.50%) were IDDM and 805(79.94%) were NIDDM. Among IDDM Patients 100 (49.50%) were females and 102(50.49%) were males, while in NIDDM 421 (52.29%) were females and 384(47.70%) were males. The male and female patients are evenly distributed in two types of diabetes. ($X^2_{(1)} = 0.50$ $P>0.30$). The sex ratio calculated for IDDM was 100:102 and for NIDDM 100:91.21 (female to male ratio) which for the total study sample is 100:93.2 (female to male ratio).

Table 2 shows mean age at diagnosis (years) and Bio-mass index (BMI) (kg/m^2) of males and females in IDDM and NIDDM patients. The age at diagnosis, disregarding the types of diabetes in this sample is 40.47 $\pm$ 0.32 years. Female and male show age at diagnosis as 40.28 $\pm$ 0.41 years and 40.67 $\pm$ 0.48 years, respectively.

In the case of IDDM patients the age at diagnosis for female patients is 31.5 $\pm$ 0.91 years and for males is 30.38 $\pm$ 0.97 years. Sexes combined show age at diagnosis as 30.93 $\pm$ 0.67 years.

Patients diagnosed for NIDDM in this sample show age at diagnosis as 42.8 $\pm$ 0.30 years. For female patients age at diagnosis observed is 42.43 $\pm$ 0.40 years and for male patients is 43.35 $\pm$ o.46 years.

The insulin dependent diabetes mellitus patients show early age at diagnosis compared to non insulin dependent diabetes mellitus patients. The difference is highly significant ($t_{(1005)} = 16.35$; $P << 0.001$). Males from IDDM type show significantly earlier age at diagnosis ($t_{(484)} = 12.12$; $P << 0.001$) compared to males from NIDDM type. Similarly females also show significantly earlier age at diagnosis in IDDM type compared to those diagnosed for NIDDM type diabetes ($t_{(519)} = 11.04$; $P << 0.001$)

Bio - Mass index (BMI)(kg/m^2) of the total diabetics in this sample is 26.44 $\pm$ 0.41 kg/m^2. Females and males show BMI as 28.10 $\pm$ 0.21 and 24.67 $\pm$ 0.16 kg/m^2 respectively. In IDDM, BMI in the female patients is 28.38 $\pm$ 0.54 kg/m^2 and in males BMI is 23.93 $\pm$ 0.35 kg/m^2. The difference is highly significant ($t_{(200)} = 7.67$; $P << 0.001$). In sexes combined BMI is 26.14 $\pm$ 0.35 kg/m^2.

Patients in NIDDM Type diabetes show BMI 26.51 $\pm$ 0.16 kg/m^2. For female patients the same is 28.03 $\pm$ 0.23 kg/m^2, and for male patients it is 24.86 $\pm$ 0.18 kg/m^2. The difference is highly significant ($t_{(803)} = 9.91$; $P<< 0.001$). IDDM and NIDDM patients show BMI somewhat similar. Males from NIDDM type show higher BMI than IDDM type, the difference is significant. ($t_{(484)} = 2.44$; $P<0.02$). The females of IDDM type show slightly higher BMI than those of NIDDM type.

Table.3. shows mean height and weight of IDDM and NIDDM Patients. Mean height of all diabetics irrespective of diabetes type is 1.61 ± 0.003 m. Females and males show mean height as 1.54 ± 0.003m and 1.70 ± 0.003 m respectively.

In case of IDDM Patients mean height for female and male patients in 1.53 ± 0.009 m and 1.67 ± 0.009 m respectively. Sexes combined show mean height as 1.69 ± 0.009m respectively.

NIDDM Patients show mean height as 1.62 ± 0.003 m . In females, mean height is 1.54 ± 0.003 m and in males is 1.71 ± 0.004m.

Females of IDDM type when compared with NIDDM typed show slightly smaller height.

Similarly males of IDDM type are shorter than NIDDM males but the difference between the two is not significant.

Weight of all the Patients in this sample is 68.69 ± 0.28 kg. Mean weight of females and males is 66.38 ± 0.39 kg and 71.15 ± 0.37 kg respectively.

In case of IDDM patients the mean weight of females is 65.64 ± 0.98 kg and of males in 69.09 ± 1.07 kg. The difference between the two sexes for weight is significant ($t_{(200)} = 2.38$; $P < 0.02$).

In NIDDM type diabetics, mean weight is 69.01 ± 0.56 kg. Mean weight is females and males is 66.55 ± 0.43 kg and 71.72 ± 0.38 kg respectively. Difference in mean weight of males and females is highly significant ($t_{(803)} = 18.42$; $P << 0.001$)

However, when IDDM and NIDDM patients were compared for weight, there was no significant difference in the mean weight of males and females.

Table 4. Shows mean blood glucose levels (fasting and random mg /dl). Blood glucose fasting level for total sample is 178 ± 1.63 mg /dl and blood glucose random level is 225.97 ± 2.08 mg /dI. In females fasting blood glucose level is 179.22 ± 2.33 mg /dI and random as 227 ± 2.85. In male. fasting and random blood glucose levels are 176.86 ± 2.29 mg /dI and 223 .84 ± 3.23 mg /dI respectively.

In IDDM Patients, fasting and random blood glucose levels in females are 183.93 ± 5.19 mg /dI and 236.55 ± 6.24 mg /dI. In males, fasting and random blood glucose levels are 181.46 ± 4.89 mg /dI and 227.03 ± 5.876 mg /dI respectively.

The difference in mean fasting blood glucose level in males and females is not appreciable ($t_{(200)} = 0.34$; $P > 0.7$).

Similarly, the difference in mean random blood glucose level in the two sexes is not significant ($t_{(200)} = 1.05$, $P > 0.20$).

In NIDDM type diabetic patients, mean fasting blood glucose level and random blood glucose level in females are 178.13 ± 2.60 mg /dI and 225.87 ± 3.19 mg /dI. These are slightly higher than those in males, 175.60 ± 2.61 mg /dI(fasting) and 223.05 ± 3.23 mg /dI (random). Females and males differ non-significantly for fasting blood glucose levels. ($t_{(803)} = 0.71$; $P > 0.7$).

Insulin dependent diabetes mellitus (IDDM) have higher fasting and random blood glucose levels in males and females as compared with NIDDM patients. However, in females difference for fasting blood glucose level ($t_{(519)} = 0.99$; $P > 0.20$) and random blood glucose level is not-significant in a comparison between IDDM and NIDDM patients.

The difference in mean fasting blooding glucose level in males of IDDM and NIDDM categories, when compared is not significant ($t_{(484)} = 1.04$; $P > 0.20$). Similar results are seen in the case of random blood glucose level ($t_{(484)} = 0.57$; $P > 0.50$) when IDDM and NIDDM males were compared.

Table 5. Shows mean skin thickness (cm) and sugar (spoons) in females and males in IDDM and NIDDM types.

Means skin thickness in all diabetics is 27.38 ± 0.089 cm. In females, mean skin thickness is 27.39±0.012and in males is 27.36 ± 0.14 cm.

In IDDM patients, mean skin thickness is 27.11 ± 0.22 cm. In female patients mean skin thickness is 27.44 ± 0.29 cm and in male patients is 26.78 ± 0.34 cm. The difference between the two sexes is negligible. In the sexes combined mean skin thickness is 27.11 ± 0.22cm.

In non-insulin dependent diabetes mellitus (NIDDM) mean skin thickness is 27.45 ± 0.097 cm . In females and males, mean skin thickness is 27.39 ± 0.13 cm and 27.51 ± 0.15 cm respectively. There is not appreciable difference in skin thickness in the two sexes. In sexes combined, mean skin thickness is 27.45 ± 0.097 cm.

IDDM and NIDDM patients show slight difference in their skin thickness.

Mean spoons of sugar / day consumed by diabetic patients is 4.39 ± 0.076 . Mean spoons of sugar / day consumed by females is 4.28 ± 0.11 and in males 4.51 ± 0.11 .

In IDDM patients, average sugar consumption is 4.52 ± 0.17 spoons /day. Female and male patients show mean sugar consumption as 4.63 ± 0.27 and 4.42 ± 0.23 respectively.

NIDDM patients on the average 4.35 ± 0.08 spoons of sugar/day. In females , the consumption of sugar is 4.19 ± 0.12 and in males it is 4.53 ± 0.12 spoons /day. IDDM and NIDDM patients don't differ significantly in the mean consumption of sugar spoons/day.

Table 6. Shows the number and percentage distribution of males and females into various age- groups.

In IDDM, highest percentage of male and female patients is seen in age-group < 35 (41.18 % and 37 % respectively) while in NIDDM type, highest percentage of male patients is seen in age-group 45 - 49 years (20.83 %) and of female patients is seen in 50-54 years (22.33%)

In total sample, the highest percentage of diabetic patients is seen in age groups 45-49 years (18.96%) and 50-54 years (17.48%)

Table 7. Shows the number and percentage distribution of paternal education in different education levels for IDDM and NIDDM patients. In both IDDM and NIDDM diabetics, the highest percentage, of patients

have attained school and college level of education. The difference in levels of education in IDDM and NIDDM patients, is significant when paternal education is compared in two group of diabetics ($X^2_{(3)} = 11.49$; $P << 0.01$).

Table 8 shows attainment of education levels in the case of mothers. Both IDDM and NIDDM show higher percentage where mothers have None level of education and school level of education . The difference in levels of education in the two diabetes types is non-significant ($X^2_{(3)} = 5.79$ $P< 0.20$).

Table 9 shows the distribution of a IDDM and NIDDM patients in different occupational categories. The highest percentage is of clerks (37.12%) and businessman (shopkeepers and salesman) (32.17%) inflicted with IDDM type of diabetes

In NIDDM type also , patients are in highest percentage who occupy clerical jobs(37.14%) and are in business(shopkeepers and salesman) 25.59%).

Table 10 indicates the number and percentage distribution of smoking habit in males and females in IDDM and NIDDM type of diabetes. In IDDM (33.16%) are smokers, of which 5.9% are females and 94.1% are males. In NIDDM 28.19% are smokers of which 3.96% are females and 94.7% are males.

Difference in smoking habit between IDDM and NIDDM is non-significant ($X^2_{(1)}=2.22$;$P<0.20$).

Table 11 shows the number and percentage distribution of other diseases in male and female diabetic patients. A total of 111 patients are

inflicted with other diseases in IDDM patients. Highest percentage of males (50.81%) and of females (24%) is afflicted with hypertension. Other common diseases present are heart diseases and kidney diseases.

IN NIDDM, a total of 320 (39.75%) patients are afflicted with other diseases, hypertension being most common in males (58.58%) than in females (44.26%) In the IDDM and NIDDM types 49.42% of patients suffer from hypertension. While 12.06% are cardiac patients and kidney patients are 7.19%.

Tracing diabetes back into close relatives of patients show that a total of 412 relatives of patients are affected with diabetes, of which 21.11% are relatives of IDDM patients and 78.88% are relatives of NIDDM patients. The highest percentage is of fathers (34.95%) showing diabetes, followed by mothers (29.13%)of patients.

In IDDM 24.13% diabetic fathers are from paternal family and 32.75% of diabetic fathers are from maternal family. In paternal family, 17.24% are diabetic mothers and 22.41% diabetic mothers are form maternal family. In NIDDM, 37.56% diabetic fathers are from paternal family and 34.16% from paternal family. .A total of 34.16% diabetic mothers are from paternal family and 32.5% from maternal family. (Table 12)

Table 1. Percentage distribution of males and females in IDDM and NIDDM.

DIABETES TYPE		Females		Males		Total
IDDM	%	49.50%		50.49%		20.50%
	(n)	100		102		202
NIDDM	%	52.29%		47.70%		79.94%
	(n)	421		384		805
Total		521	51.73%	486	48.26%	1007

($X^2_{(1)}$=0.50,P>0.30)

Table 2. Mean age at diagnosis and Bio-mass Index of males and females in IDDM and NIDDM diabetics

Items	IDDM	NIDDM	TOTAL
Age at diagnosis	31.5 ± 0.91	42.43 ± 0.40	40.28 ± 0.41
females (BMI)	28.38 ± 0.54	28.03 ± 0.23	28.10 ± 0.21
Age at diagnosis	30.38 ± 0.97	43.35 ± 0.46	40.67 ± 0.48
Males (BMI)	23.93 ± 0.35	24.86 ± 0.18	24.67 ± 0.16
Age at diagnosis	30.93 ± 0.67	42.87 ± 0.30	40.47 ± 0.32
Sexes combined (BMI)	26.14 ± 0.35	26.51 ± 0.16	26.44 ± 0.14

Table 3. Mean height and weight of diabetic males and females in IDDM and NIDDM diabetics

	Items	IDDM	NIDDM	Total
Females	Height	153 ± 0.009	1.54 ± 0.003	1.54 ± 0.003
	Weight	65.64 ± 0.98	66.55 ± 0.43	66.38 ± o.39
Males	Height	1.69 ± 0.009	1.71 ± 0.004	1.70 ± 0.003
	Weight	69.09 ± 1.07	71.72 ± 0.38	71.15 ± 0.37
Sexes	Height	1.61 ± 0.009	1.62 ± 0.003	161 ± 0.003
combined	Weight	67.38 ± 0.73	69.01 ± 0.560	68.69 ± 0.28

Table 4. Mean blood glucose levels (Fasting and random) of females and males in IDDM and NIDDM diabetics.

Sex	Item	IDDM	NIDDM	TOTAL
Females	Blood glucose (Fasting) level	183.93 ± 5.19	178.13 ± 2.60	179.22 ± 2.33
	Blood glucose level (random)	236.55 ± 6.24	225.87 ± 3.19	227 ± 2.85
Males	Blood glucose (Fasting) level	181.46 ± 4.89	175.60 ± 2.61	176.86 ± 2.29
	Blood glucose (Random) level	227.03 ± 5.86	223.05 ± 3.23	223.84 ± 3.23
Sexes combined	Blood glucose level (fasting)	182.68 ± 3.55	176.92 ± 1.84	178.7 ± 1.63
	blood glucose level (random)	231.74 ± 4.28	224.525 ± 2.27	225.97 ± 2.08

Table 5. Mean skin thickness (cm) and sugar (spoons) of females and males in two diabetes types i.e. IDDM and NIDDM.

Sex	Item	IDDM	NIDDM	TOTAL
Females	Skin thickness	27.44 ± 0.29	27.39 ± 0.13	27.39 ± 0.12
	Sugar	4.63 ± 0.27	4.19 ± 0.12	4.28 ± 0.11
Males	Skin thickness	26.78 ± 0.34	27.51 ± 0.15	27.36 ± 0.14
	sugar	4.42 ± 0.23	4.53 ± 0.12	4.51 ± 0.11
Sexes combined	Skin thickness	27.11 ± 0.22	27.45 ± 0.097	27.38 ± 0.089
	Sugar	4.52 ± 0.17	4.35 ± 0.08	4.39 ± 0.076

Table 6. Percentage distribution of female and male diabetics of IDDM and NIDDM type in various age-groups.

Age-groups	IDDM				NIDDM				TOTAL	
	Female	%	Male	%	Female	%	Male	%		%
< 35	37	37%	42	41.18%	19	4.51%	26	6.77%	124	12.3%
35 - 39	22	22%	24	23.5 %	49	11.6%	35	9.11%	130	12.90%
40 - 44	11	11%	14	13.7%	59	14.0%	44	11.45%	128	12.71%
45 - 49	12	12 %	7	6.86%	92	21.8%	80	20.83%	191	18.96%
50 - 54	7	7%	3	2.94%	94	22.33%	72	18.756%	176	17.48%
55 - 59	9	9%	8	7.84%	51	12.11%	51	13.28%	119	11.8%
60 +	2	2%	4	3.92%	57	13.5%	76	19.79%	139	13.80%
Total	100		102		421		384		1007	

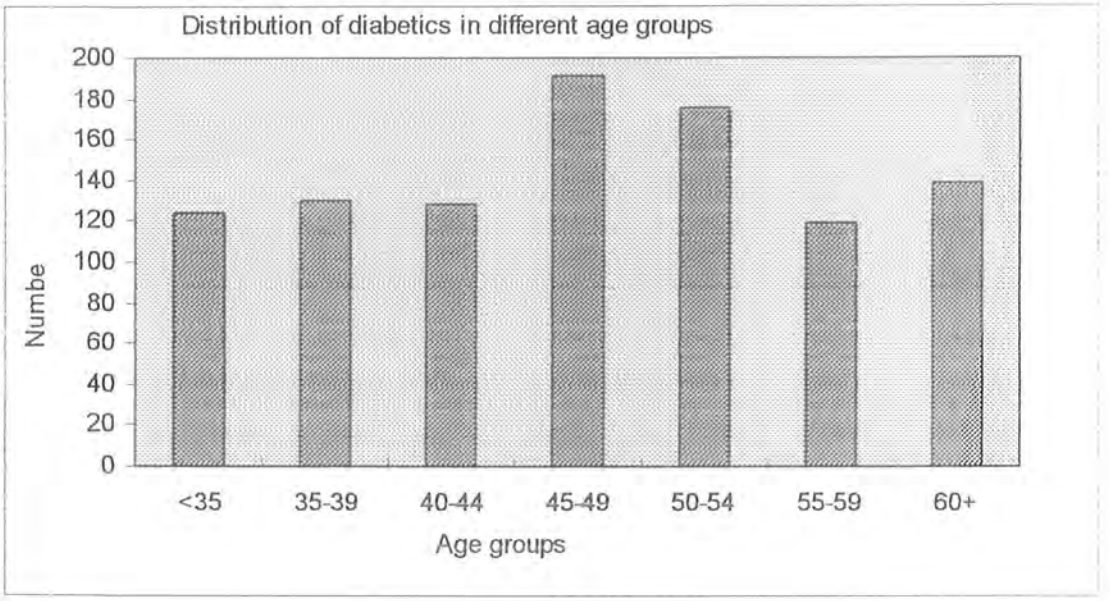

Distribution of diabetics in different age groups
200
180
160
140
120
100
80
60
40
20
0
Numbe
<35
35-39
40-44
45-49
50-54
55-59
60+
Age groups

Table 7. Percentage distribution of paternal education in different education levels in IDDM and NIDDM type diabetics.

Education		IDDM	NIDDM	TOTAL
None	%	23.76%	21.36%	21.84%
	(n)	48	172	220
School	%	38.11%	43.97%	42.80%
	(n)	77	354	431
College	%	32.17%	29.43%	30.38%
	(n)	65	241	306
University	%	5.94%	4.72%	4.97%
	(n)	12	38	60
	%	20.5%	79.94%	
Total	(n)	202	805	1007

($X^2_{(3)}$=11.49;P<<0.01)

Table 8. Percentage distribution of maternal education in different education levels in IDDM and NIDDM type diabetics

Education		IDDM	NIDDM	TOTAL
None	%	42.07%	41.36%	41.5%
	(n)	85	3334	418
School	%	40.09%	36.77%	37.43%
	(n)	81	296	377
College	%	16.83%	19.00%	18.57%
	(n)	34	153	187
University	%	0.99%	2.85%	2.48%
	(n)	2	23	25
	%	20.5%	79.94%	
Total	(n)	202	805	1007

($X^2_{(3)}$=5.79;P<<0.20)

Table 9. Percentage distribution of diabetic patients into several Occupational categories in IDDM and NIDDM type diabetics.

	IDDM		NIDDM		TOTAL	
Professional & managerial.	6.43%	13	4.47%	36	4.86%	49
Intermediate.	37.12%	75	37.14%	299	37.14%	374
Skilled -non manual.	0.99%	2	3.10%	25	2.68%	27
Skilled manual.	6.93%	14	13.16%	106	11.92%	120
Partly skilled.	32.17%	65	25.59%	206	26.91%	271
UN skilled.	16.33%	33	16.52%	133	16.48%	166
Total	20.5%	202	79.94%	805	1007	

Table 10. Percentage distribution of smoking habit in males and females in IDDM and NIDDM type diabetics

	LIFE STYLE	FEMALES	MALES	TOTAL
IDDM	N.S	71.1%	28.8%	66.8%
		96	39	135
	S	5.9%	94.1%	33.16%
		4	63	67
NIDDM		88.5%	29.33%	71.8%
	N.S	412	169	581
		3.96	94.03%	28.19%
	S	9	215	224
	Total	521	486	1007

($X^2_{(1)}$=2.22;P<0.20)

Table 11. Percentage distribution of other diseases present ...

in IDDM and NIDDM -patients

Diseases	IDDM Males	%	IDDM Females	%	NIDDM Males	%	NIDDM Female	%	Total	%
Hypertension	31	50.81	12	24	116	58.58	54	44.26	213	49.42
Heart diseases	8	13.11	5	10	30	15.15	9	7.50	52	12.06
Kidney disease	3	4.91	4	8	16	8.08	8	6.55	31	7.19
Asthma	34.	91	6	12	8	4.04	14	11.47	31	7.19
Cataract	4	6.55	3	6	5	2.52	3	2.45	15	3.48
Ulcer	2	3.27	6	12	3	1.51	7	5.73	18	4.17
Rheumatism	2	3.27	2	4	4	2.02	8	6.55	16	3.71
Stomach Pb.	2	3.27	4	8	5	2.52	7	5.72	18	4.17
Paralysis	3	4.91	1	2	3	1.51	-	-	7	1.62
Weak eye sight	2	3.27	5	10	7	3.53	8	6.55	22	5.10
Thyroid	-		1	2	-		2	1.63	3	0.69
Miscellaneous	1	1.63	1	2	1	0.50	2	1.63	5	1.16
Total	61		50		198		122		431	

Table 12. Percentage distribution of diabetes presence in paternal and maternal families in IDDM and NIDDM

Relative	IDDM Paternal family	%	IDDM Maternal family	%	NIDDM Paternal family	%	NIDDM Maternal family	%	Total	%
F	7	24.13	19	32.75	77	37.56	41	34.16	144	34.95
M	5	17.24	13	22.41	63	30.73	39	32.5	120	29.13
F+M	4	13.79	7	12.06	26	12.68	18	15	55	13.35
G.F	2	6.89	3	5.17	10	4.87	2	1.66	17	4.12
G.M	1	3.44	2	3.44	7	3.41	5	4.16	15	3.64
F+S	-		4	6.89	6	2.92	6	5	16	3.88
F+B	-		2	3.14	2	0.97	2	1.66	7	1.69
M+S	2	6.89	1	1.72	1	0.48	1	0.83	5	1.21
Uncle	7	24.13	6	10.34	10	4.87	4	3.33	27	6.5
M+B	1	3.44	1	1.72	2	0.97	2	1.66	6	1.45
Total	296		58		205		120		412	

F+M = Father and mother
G.F = Grand father
G.M = Grand mother
F+S = Father and Sister
F+B = Father and brother
M+S = Mother and sister
M+B = Mother and brother

CONSANGUINITY AND DIABETES

Present study sample is analysed in accordance with the genetic relationships. The main genetic relationships identified are couples marrying first cousin (1c), first cousin once removed (1½), second cousin (2c) distant relations (Dr), braderi and unrelated spouses (u).

The study sample is divided in two diabetes types IDDM and NIDDM and then each sub-sample is analysed according to different genetic relationships of the patients.

Table 13 shows the number and percentage distribution of IDDM and NIDDM. males and females in various genetic relationships. In IDDM first cousin relations are 53.46% and 46.54% patients are in unrelated relations.

Table 14 shows mean age at diagnosis (years) height (m), weight (kg), BMI (kg/m^2) skin thickness (cm) Blood glucose levels (mg/dI) (fasting and Random) and sugar consumption (spoons /day) in IDDM female patients in various genetic relationships, females of first cousins show an earlier onset of diabetes (30.68 ± 1.33) years, than unrelated diabetes (33.04 ± 2.38) years, however this difference is not significant ($t_{(68)} = 1.25$; $P>0.20$).

Fasting and random blood glucose levels for first cousin females are 194.38 ± 9.10 mg /dI respectively. These are higher compared to fasting blood glucose level 169.96 ± 10.64mg /dI and random blood glucose level 214.04 ± 12.13 mg /dI in unrelated patients. However, the difference for fasting blood glucose level ($t (68) = 1.83$; $P> 0.05$) and for

random blood glucose level($t(68)=1.98; P>0.05$) between first cousin and unrelated females is not significant.

Table. 15 shows mean age at diagnosis (years), height (m), weight (kg), BMI (kg/m^2), skin thickness (cm), Blood glucose levels (mg/dl) and sugar (spoons/day) for IDDM males in their various genetic relationships.

Mean weight of first cousin patients is higher than unrelated patients, but the difference between these two relations is not significant ($t_{(74)} = 1.80$; $P>0.05$). Fasting and random blood glucose levels of first cousin males(183.5 ± 6.40 mg/dl and 229.5 ± 7.44 mg/dl) respectively are higher than those of unrelated males(170.88 ± 14.06 and 227.03 ± 5.86 mg/dl respectively. The difference in fasting ($t_{(74)} = 0.82$; $P>0.40$) and random ($t_{(74)}$ 1.02; $P> 0.30$) blood glucose levels in the two genetic relationships in not significant.

Table. 16 shows mean age at diagnosis (years), height (m), weight (kg), BMI (kg/m^2), fasting and random blood glucose levels (mg/dl), sugar (spoons/ day) in NIDDM females and males respectively. There is an appreciable difference in different variables between first cousins and unrelated female. The unrelated females take more spoons of sugar (4.27 ± 0.22) than first cousin females (3.98 ± 0.18) but the difference between the two is not significant ($t_{(280)} = 0.45$; $P> 0.60$).

Table:17 shows mean age at diagnosis (years), height (m), weight (kg) BMI (kg/m^2), Skin thickness (cm) and sugar (spoons/ day) in NIDDM males. First cousin males show higher value for fasting blood glucose level (177.01 ± 3.99 mg/dl) than unrelated males (175.60 ± 2.61) mg/dl but the difference between the two is not significant ($t_{(255)} = 0.20$; $P> 0.80$). Similarly, random blood glucose level in first cousin males

(226.63 ± 4.78) mg/dl is higher than unrelated males (219.32 ± 6.91) mg/dl, but the difference between the two is not significant ($t_{(255)} = 0.68$; P>0.40) . The other variables shown in the table do not show any appreciable differences in first cousin males compared to unrelated males. Table. 18 shows in NIDDM patients mean BMI(kg/m^2), fasting and random blood glucose levels (mg/dl) and skin thickness (cm), in different age groups in first cousin females.

Mean BMI (kg/m^2), blood glucose level, both fasting and random, (mg/dl) and skin thickness (cm) increase as the age advances.

In table-19 mean BMI (kg/m^2), fasting and random blood glucose levels (mg/dl) and skin thickness (cm) of NIDDM patients are shown in first cousin males. Unlike females, mean BMI, blood glucose levels and skin thickness show decrease as the age advances.

Table 20 and 21 show mean BMI (kg/m^2) ,fasting and random blood glucose levels (mg/dl) and skin thickness (cm) in unrelated NIDDM females and males.

In females, as the age increases there is increase in the four variables as observed in this sample. However, in males BMI and skin thickness decreases as the age increases whereas, fasting and random blood glucose levels increase as the age advances.

Table 22 and 23 show mean BMI (kg/m^2), and skin thickness (cm) in first cousin IDDM females and males.

In females, BMI shows decrease with age but a higher value is seen in 55-59 years age group. In age group 50-54 years mean skin thickness is

less than in other age groups, otherwise the skin thickness remains fairly consistent. Fasting and random blood glucose levels show trends towards increase in the advancing age groups.

Table 24 and 25 show the mean BMI (kg/m^2), fasting and random blood glucose levels (mg/dl) and skin thickness (cm) in unrelated IDDM females and males.

In females, there is a decrease in mean BMI with the increase in age, whereas mean fasting and random blood glucose levels and skin thickness increases as the age advances. In unrelated IDDM males ,there is an increase in mean fasting and random blood glucose levels and skin thickness.

Mean BMI is high in 40-44 years age group but in other age groups there is appreciable change in its value.

Table 26 and table 27 shows the number and percentage distribution of paternal and maternal education of IDDM patients in various genetic-relationships.

Highest percentage of patients is seen in first cousin category who attained school level education (33.33%). Similarly, in unrelated patients higher percentage has attained up to school level education (39.02%) and up to college level (29.26%) (table 26).

A highly significant difference in the distribution of IDDM patients among different education levels is seen ($X^{(2)}_{(12)} = 38.11$; $P << 0.01$).

Table 27 shows distribution of IDDM patients in different parental relations where maternal education was taken into consideration. Higher percentage of patients is from none education level (44.76%) and school level (41.90%) in first cousin category.

In unrelated relations a high percentage of patients is from mothers with education up to school level (46.34%) and none education (43.90%). The distribution of patients in different education levels is highly significant ($X^2_{(12)} = 50.27$; $P << 0.001$).

Table 28 shows the distribution of NIDDM patients in different genetic relationships of paternal education. Highest number of first cousins have paternal education up to school level (43.32%), higher percentage of patients in this level is seen in unrelated patients as well. The distribution of patients is significantly different in the different education levels ($X^2_{(15)} = 36.93$; $P << 0.001$).Patients are in higher percentage in first cousins, where they have maternal none education level (41.83%) and school education level (36.49%). Unrelated patients show higher percentage of maternal education up to school level (41.08%) followed by none education (38.11%) (Table 28).

The distribution of patients in education levels is significantly different in NIDDM patients ($X^2_{(15)} = 92.98$; $P << 0.001$).

Table 30 and 31 show distribution of NIDDM and IDDM patients in relation to occupation. In NIDDM diabetics, first cousin patients are higher in percentage where paternal occupation is a government job (33.82%) or they are engaged in business (25.81%). Similarly in unrelated patients, the higher number of patients are having government jobs or business type socio-economic status. The difference in the distribution of

patients in occupational categories is highly significant ($\chi^2_{(25)} = 55.4$; $P << 0.001$).

In IDDM patients, first cousin and unrelated marriage types, show the same pattern of patient distribution in relation to occupation as we see in NIDDM patients. The difference in the distribution of IDDM patients is not significant in relation to occupation ($X^2_{(20)}=26.13$; $P>0.20$).

Distribution of smoker and non-smoker patients in IDDM and NIDDM types is shown in tables 32 and 33.In IDDM type patients smokers are higher in percentage (26.67%) in first cousins, whereas in unrelated smokers are 21.95%.The difference in smoking habit between first cousin and unrelated patients is non-significant.

In NIDDM type patients, smokers are higher in percentage (24.92%) in first cousins , whereas in unrelated smokers are 24.26%.

Table 34 and table 35 show diseases other than diabetes in NIDDM and IDDM type diabetics in various genetic relationships. Of 320 other diseases present in NIDDM type diabetics 46.88% are present in first cousins. While in unrelated these are 21.56%. Most common disease present is hypertension, 54.66% in first cousin and 53.62% in unrelated patients.

In IDDM type diabetics, a total of 111 patients were also inflicted with diseases than diabetes. Out of all other diseases present 43 .24% were present in first cousins and 19.32% in unrelated patients. Most common disease observed in diabetics was hypertension (53.12%). There are 29.16% hypertensives in first cousin patients but in the unrelated patients 54.54% are hypertensives also.

Table 36 and 37 show the distribution of close relatives of patients inflicted with NIDDM and IDDM type of diabetes. In both NIDDM and IDDM type of diabetic fathers (36.77%,33.33% respectively) of the first cousin patients are inflicted with diabetes. In the unrelated patients, diabetic father (42.346%; 27.77%, for IDDM and NIDDM respectively) and mothers (26.02%; 22.22% for IDDM and NIDDM respectively) are inflicted with diabetes.

Table 13. Number and Percentage distribution of IDDM and NIDDM males and females, into different genetic relationships.

	1C	1½ C	2C	Dr	B	U	Total
IDDM							
Females % (n)	47% 47	3% 3	- -	3% 3	24% 24	23% 23	- 100
Males % (n)	56.86% 58	- -	- -	4.9% 5	20.5% 21	17.6% 18	- 102
NIDDM							
Females % (n)	40.6% 171	1.18% 5	1.66% 7	8.78% 37	21.3% 90	26.3% 111	- 421
Males % (n)	43.2% 166	1.56% 6	0.52% 2	8.3% 32	22.6% 87	23.69% 91	- 384
Total	442	14	9	77	222	243	1007

Table 14. Mean age at diagnosis, height, Weight, BMI, Skin thickness, Blood glucose levels (Fasting and Random),Sugar (spoons) of IDDM Females in various genetic relationships.

	1C	1½ C	Dr	B	U	Total
Age at diagnosis	30.68±1.33	25.66±1.20	43.66±4.25	30.83±1.18	33.04±2.28	31.5±0.91
Height	1.51 ± 0.01	1.61± 0.03	1.47±0.07	1.55±0.02	1.52±0.02	1.53±0.89
Weight	64.02±1.62	78.33±3.30	72.66±2.72	66.16±1.54	65.82±1.47	65.64±0.98
BMI	27.96±0.76	29.42±9.27	33.93±3.56	27.77±1.01	28.98±1.26	28.38±0.54
Skin Thickness	27.31±0.51	30.33±1.45	27.66±0.88	27.54±0.5	27.13±0.47	27.44±0.29
Blood glucose(fasting)	194.08±8	130±32.1	198.33±18.16	181.79±8.96	169.96±10.6	183.93±5.19
Blood glucose(random)	248 ± 9.10	181±35.55	230.66±29.16	239.54±13.12	218.04±12.2	236.55±6.24
Sugar (spoons)	4.72 ± 0.35	5.33±1.76	5.5± 1.23	4.33± 0.49	4.64±0.71	4.63±0.27

Table 15. Mean age at diagnosis, height, weight, BMI, Skin thickness, Blood glucose levels (Fasting Random) of IDDM males in various genetic relationship.

	1C	1½ C	2C	Dr	B	U	Total
Age at diagnosis	30.75± 1.30	-	-	31.8±1.88	33.19±2.28	25.5±2.07	30.38±0.97
Height	1.70±0.01	-	-	1.74±0.019	1.71±0.01	1.65±0.02	1.69±0.009
Weight	70.29±1.45	-	-	72.6±4.32	69.14±1.75	64.22±2.07	69.09±1.07
BMI	24.05±0.41	-	-	24.06±1.67	23.75±0.65	23.75±2.94	23.93±0.35
Skin Thickness	27± 0.48	-	-	25.41±1.89	26.85±0.55	26.38±0.81	26.78±0.34
Blood glucose (fasting)	183.5±6.40	-	-	186.6±17.54	183.66±9.90	170.88±14.06	181.46±4.89
Blood glucose (random)	229.5±7.44	-	-	247.6±19.60	221.33±12.23	220.05±17.59	227.03±5.86
Sugar (spoons)	4.37±0.31	-	-	4.6±0.87	5.07±0.51	3.77±0.51	4.42±0.23

Table 16: Mean age at diagnosis, height, weight, BMI, Skin thickness, Blood glucose levels (fasting and random), Sugar (spoons) of NIDDM females in various genetic relationships.

	1C	1½ C	2C	Dr	B	U	Total
Age at diagnosis	42.39±0.56	42.4±3.69	43.86±4.47	40.24±.1.33	42.9±0.96	42.75±0.81	42.43±0.40
Height	1.54±0.005	1.53±0.03	1.52±0.01	1.54±0.01	1.55±0.006	1.55±0.06	154±0.003
Weight	66.62±0.66	76±6.33	62.28±1.91	67.46±1.20	66.9±0.27	66.90±0.87	66.55±0.43
BMI	28.19±0.36	32.62±3.21	27.11±1.13	28.67±0.80	27.33±0.43	27.9±0.45	78.03±0.93
Skin Thickness	27.21±0.20	25.2±2.55	26.28±1.10	27.7±0.40	27.58±0.29	27.5±0.25	27.39±0.13
Blood glucose(fasting)	178.41±4.21	152.6±17.65	182.71±10.38	174.10±6.95	167.08±5.02	188.75±5.53	178.13±2.59.
Blood glucose(random)	228.40±4.95	240.±29.83	257±17.18	208.11±8.69	214.33±6.85	234.79±6.63	225.87±3.1
Sugar (spoons)	3.98±0.18	2±0.63	3.71±0.52	4.71±0.41	4.49±0.22	427±0.22	4.19±.12

Table 17. Mean age at diagnosis, height, Weight, BMI, Skin thickness, Blood glucose levels (Fasting and random), sugar (spoons/day) in NIDDM males in various genetic relationships.

	1C	1½ C	2C	Dr	B	U	Total
Age at diagnosis	43.39±0.69	4.4±3.08	51.5±8.5	43.16±1.64	43.40±1.06	43.07±0.88	43.34±0.46
Height	1.69±0.006	1.68±0.05	1.72±0.05	1.71±0.02	1.71±0.07	1.70±0.008	170±0.004
Weight	71.27±0.62	73.83±3.31	70±2	71.56±1.04	72.39±0.71	71.87±0.78	71.72±0.51
BMI	24.81±0.22	26.30±1.56	23.5±0.69	24.76±0.99	24.78±0.30	24.98±0.36	24.86±0.18
Skin Thickness	27.62±0.21	29.16±0.79	24.5±0.5	27.15±0.40	27.78±0.31	27.14±0.32	27.51±0.15
Blood glucose (fasting)	177.1±3.99	186.1±25.2	178.5±1.5	169.78±7.78	173.86±5.6	175.99±5.55	175.60±2.61
Blood glucose (random)	226.03±4.8	252.83±26.2	225.5±16.5	211.56±11.3	222.24±6.9	219.32±6.91	223.05±3.23
Sugar (spoons)	4.41±0.19	5 ± 0.82	8±0	456±0.47	4.6±0.24	4.51±0.24	4.52±0.12

Table 18. Mean BMI, Blood glucose levels (Fasting and Random) and skin thickness in first cousin NIDDM females.

Age Group	BMI	Blood Glucose Fasting level	Blood Glucose Random level	Skin thickness
<35	27.02±0.35	142.56±8.76	203.66±21.00	26.44±0.83
30-34	26.28±1.64	148±10.29	204±27.49	26±-0.56
35-39	28.56±1.3	1.69±10.43	219.43±14.06	27.28±-0.79
40-44	27.35±1.02	187.49±13.11	241.82±16.29	26.01±-0.34
45-49	26.74±0.58	188.05±12.01	232.26±12.49	27.07±-0.35
50-54	28.29±0.73	176.02±7.04	226.28±8.62	27.59±0.37
55-59	29.83±1.30	184.37±11.55	229.16±13.92	27.29±0.64
60+	30.53±1.26	167.5±11.26	226.44±16.45	28.12±0.85
Total	28.19±0.36	178.41±4.21	228.40±4.95	27.21±0.20

Table 19: Mean BMI, Blood glucose levels (Fasting and Random) and skin thickness in first cousin NIDDM males.

Age Group	BMI	Blood Glucose Fasting level	Blood Glucose Random level	Skin thickness
<35	24.84±0.67	207.1±25.12	248.7±28.98	277±0.73
35-39	25.08±1.09	186.06±10.53	248.76±14.63	27±0.60
40-44	24.2±0.75	182.83±19.32	226.67±20.75	28.±0.43
45-49	26.07± 0.68	161.67±6.94	210.64±8.95	28.63±0.40
50-54	24.73±0.46	176.27±9.46	225.67±10.21	28.06±0.53
55-59	24.47±0.61	194.24±11.58	234.32±11.75	27.12±0.66
60+	24.06±0.62	166.44±6.36	221.52±10.34	26.72±0.49
Total	24.81±0.27	177.01±3.99	226.63±4.78	27.62±0.21

Table 20: Mean BMI Blood glucose levels (fasting and Random) and Skin thickness in Unrelated NIDDM females.

Age Group	BMI	Blood Glucose Fasting level	Blood Glucose Random level	Skin thickness
<35	26.55±3.59	172±4.40	215.75±4.03	26.25±1.93
35-39	28.27±0.98	172.78±10.31	210.28±15.01	21.71±0.47
40-44	27.32±0.59	209±17.75	251.08±17.92	27.82±0.53
45-49	27.54±0.88	177.12±8.97	216.33±9.02	26.87±0.58
50-54	29.58±1.46	195.13±15.04	244.04±17.69	28±0.57
55-59	28.38±1.04	180.36±14.32	248.07±19.06	28.57±0.63
60+	26.78±1.11	201.43±13.46	246.19±20.64	27.06±0.73
Total	28.03±0.23	178.13±2.60	225.87±3.19	27.39±0.13

Table 21. Mean BMI Blood glucose levels (fasting and Random) and Skin thickness in Unrelated NIDDM males.

Age Group	BMI	Blood Glucose Fasting level	Blood Glucose Random level	Skin thickness
<35	27.16±1.53	152.5±12.48	175±13.67	28±0.77
35-39	24.83±1.06	148.66±14.35	175±11.82	27.83±1.16
40-44	23.72±0.47	190.19±17.32	243.31±21.67	26.93±0.67
45-49	24.49±0.96	170.94±10.73	209.10±13.94	28.52±0.62
50-54	25.41±0.68	174.11±9.34	230.29±12.95	26.41±0.82
55-59	24.12±0.91	177.89±13.65	217.44±18.72	25.77±1.16
60+	25.74±1.16	183±17.68	224.69±19.01	26.68±0.76
Total	24.86±0.18	175.60±2.61	223.05±3.23	27.51±0.15

Table 22. Mean BMI Blood glucose levels (fasting and Random) and Skin thickness in first cousin IDDM females.

Age Group	BMI	Blood Glucose Fasting level	Blood Glucose Random level	Skin thickness
<35	27.90±1.24	178.71±21..39	233.62±15.52	2719±1.01
35-39	30.78±2.01	209.67±19.19	267.72±16.97	28.55±0.69
40-44	25.97±1.21	167.8±19.18	215.8±19.06	26.2±-0.37
45-49	26.80±1.05	219±19.11	249±26.49	27±1.00
50-54	22.89±1.45	218.75±32.16	311.25±15.86	25.75±1.60
55-59	30.64±2.01	326.5±31.14	256.25±28.09	28.5±0.79
60+	-	-	-	-
Total	27.96±0.76	194.38±8.0	248±9.10	27.31±0.50-

Table 23. Mean BMI, Blood glucose levels (fasting and Random) and Skin thickness in first cousin IDDM males.

Age Group	BMI	Blood Glucose Fasting level	Blood Glucose Random level	Skin thickness
<35	23.83±0.72	191.96±10.32	237±12.70	26.54±0.85
35-39	25.26±0.66	166.27±8.08	223.13±12..97	27.66+0.77
40-44	23.25±1.40	210.44±9.53	275.6±22.89	27.00+0.71
45-49	24.52±1.29	146±9.14	197.5±12.14	26.5+1.19
50-54	21.22±1.00	235±33.29	256±25.71	25.00+2.00
55-59	23.04±1.39	180.6±36.26	184.6±23.81	26.6+2.29
60+	25.44±1.33	149±29	208.5±28.5	32.5+0.05
Total	24.05±0.41	183.5±6.40	229.5±7.44	27.00+0.48

Table 24. Mean BMI, Blood glucose levels (fasting and Random) and Skin thickness unrelated IDDM females.

Age Group	BMI	Blood Glucose Fasting level	Blood Glucose Random level	Skin thickness
<35	25.66±1.87	136.4±27.56	214±19.96	27.8±1.24
35-39	30.50±2.60	178.5±19.03	214.38±21.35	26.37±0.87
40-44	27.85±1.29	182.5±7.5	252.5±62.5	28±1
45-49	26.97±2.21	181.25±27.26	198.25±37.36	26.25±1.25
50-54	42.64	190	230	28
55-59	30.69±1.10	202.5±5.30	272±26.16	28.5±0.35
60+	26.60	114	158	29
Total	28.98±126	169.96±10.64	218.04±12.13	27.13±0.47

Table 25. Mean BMI, Blood glucose levels (fasting and Random) and Skin thickness in unrelated IDDM males.

Age Group	BMI	Blood Glucose Fasting level	Blood Glucose Random level	Skin Thickness
<35	22.59±1.02	158.11±16..30	210.78±24.37	26.11±1.00
35-39	21.20±1.24	187 ±23	217±37	22±1
40-44	27.33±3.77	165.8±92.90	208±26.90	27.6±1.50
45-49	22.54±0.68	225±60.10	295±74.24	29±2.12
50-54	-	-	-	-
55-59	-	-	-	-
60+	-	-	-	-
Total	23.75±1.22	170.88±14.06	220.05±17.57	26.38±0.81

Table 26: Distribution of paternal education of IDDM patients into various education levels in different genetic relationships.

	IC	11/2 C	2C	DR	B	U	TOTAL
None	25.71%	-	-	-	24.44%	24.39%	23.7%
(n)	27	-	-	-	11	10	48
School	36.19%	66.66%	-	75%	33.33%	39.02%	38.1%
(n)	38	2	-	6	15	16	77
College	33.33%	-	-	25%	35.55%	29.26%	32.1%
(n)	35	-	-	2	16	12	665
University	4.76%	33.33%	-		6.66%	7.31%	5.94%
(n)	5	1	-	-	3	3	12
Total	105	3	-	8	45	41	202

($X^2_{(12)}$=38.11,P<0.001)

Table 27. Distribution of maternal education of IDDM patients in to various education levels in different genetic relationships.

Education	IC	11/2 C	2C	DR	B	U	TOTAL
None	44.76%	100%	-	-	37.77%	43.90%	42
	47	3	-	-	17	18	85
School	41.90%	-	-	100%	22.22%	46.34%	4
	44	-	-	8	105	19	81
College	12.38%	-	-	-	40.5%	7.31%	16.33
	13	-	-	-	18	3	34
University	0.95%	-	-	-	-	2.43%	0.9%
	1	-	-	-	-	1	2
	51.98%	1.48%		3.96%	22.27%	20.29%	
Total	105	3	-	8	45.	41	202

($X^2_{(12)} = 50.27$ P<<0.01

Table 28. Distribution of paternal education levels of NIDDM patients in different

genetic relationships

Education	IC	11/2 C	2C	DR	B	U	TOTAL
None	25.5%	-	22.22%	23.18%	24.29%	12.37%	21.36%
	86	-	2	16	43	25	172
School	43.32%	45.45%	33.33%	53.62%	37.85%	47.52%	43.97%
	146	5	3	37	67	96	354
College	26.70%	36.36%	33.3%	20.28%	33.89%	34.65%	29.93%
	90	4	3	14	60	70	241
University	4.45%	18.18%	11.11%	2.89%	3.95%	5.44%	4.72%
	15	2	1	2	7	11	38
Total	337	11	9	69	177	202	805

($x^2_{=(15)} 36.93$ p<<0.001)

Table 29. Distribution of maternal education of NIDDM-patients in to various education levels in different genetic relationships

	IC	$1^{1/2}$ C	2C	DR	B	U	TOTAL
None	41.83%	36.36%	44.44%	47.82%	41.801.12%	38.11%	41.36%
n	141	4	4	33	74	77	333
School	36.49%	27.27%	33.33%	18.84%	40.111.12%	41.08%	30.19%
n	123	3	3	13	71	83	296
College	19.88	36.36%	22.22%	15.94%	16.941.12%	19.30%	19.00%
n	67	4	2	11	30	39	153
University	1.78%			17.39%	1.12%	1.48%	2.85%
n	6	-	-	12	2	3	23
Total	337	11	9	69	177	202	805

($X^2_{(15)}$ = 92.98 P<<0.001)

Table 30. Distribution of NIDDM type of diabetics in to various occupational categories according to Husband /Father's economic status

	IC	$1^{1/2}$ C	2C	DR	B	U	TOTAL
C-I	2.96%	-	11.11%	13.04%	6.21%	2.47%	4.47%
	10	-	1	9	11	5	36
C-II	33.82%	45.54	-	36.23%	37.85%	43.56%	37.14%
	114	5	-	25	67	88	299
C.III	5.34%	-	-	1.44%	2.25%	0.99%	3.10%
	18	-	-	1	4	2	25
C-IV	16.61%	-	11.11%	8.69%	9.60%	12.87%	13.10%
	56	-	1	6	17	26	106
C-V	25.81%	27.27	55.555	17.39%	25.42%	24.75%	25.59%
	87	3	5	12	45	50	206
C_VI	15.43%	27.27	22.22%	17.39%	18.64%	15.34%	16.52%
	52	3	2	12	33	31	133
Total	**337**	**11**	**9**	**69**	**177**	**202**	**805**

($X^2_{(25)}$ = 55.4; P<< 0.001)

Table 31. Distribution of IDDM type diabetics into various occupational categories according to husband / Father's economic status

	IC	$1^{1/2}$ C	2C	DR	B	U	TOTAL
C-I	4.76%	33.33%	-	-	4.4%-	12.19%	6.43%
	5	1	-	-	2	5	13
C-II	40%	66.66%	-	50%	35.5%	26.82%	37.12%
	42	2	-	-4	16	11	75
C.III	-	-	-	-	-	4.87%	0.99%
	-	-	-	-	-	2	2
C-IV	4.76%	-	-	-	-11.1%	9.5%	6.93%
	5	-	-	-	5	4	14
C_V	36.19%			2%	24.4%	2%	32.17%
	38			2	11	14	65
C_VI	14.28%			2%	24.4%	12.1%	16.33%
	15	-	-	2	11	5	33
Total	105	3	-	8	45	41	202

($X^2_{(20)} = 26.13$ P>0.20)

Table 32. Distribution of smoking habit in IDDM patients in various genetic relationships.

Life style	IC	$1^{1/2}$	DR	B	U	Total
%	43.33	100	50	68.89	78.04	66.83
Non Smokers	65	3	4	31	32	135
%	26.67		50	31.11	21.95	33.17
Smokers	40	-	4	14	9	67
Total	150	3	8	45	41	202

Table33. Distribution of smoking habit in NIDDM patients in various genetic relationships

Life style	IC	$I^{1/2}$	2C	DR	B	U	Total
%	75.07	63.63	44.44	66.67	66.67	75.74	72.17
Non Smokers	253	7	4	46	118	153	581
%	24.92	36.37	55.56	33.33	33.33	24.26	27.83
Smokers	84	4	5	23	59	49	224
Total	337	11	9	69	177	202	805

Table 34. Distribution of other diseases in NIDDM patients in various genetic relationships.

Disease	IC %	$I^{1/2}$C%	2C %	DR %	B %	U %	TOTAL
Hypertension	82 54.66	4 50	1 33.33	38 53.5	8 42.1	3753.6	170
Heart Problem	18 12	2 25	1 33.33	9 12.7	2 10.5	8 11.6	39
Kidney Problem	8 5.33	1 12.5	-	7 9.85	1 5.26	6 8.69	24
Asthma	14 9.33	-	-	3 4.22	2 10.5	3 4.34	22
Cataract	3 2	-	-	2 2.81	-	3 4.34	8
Ulcer	5 3.33	-	-	2 2.81	1 5.3	2 2.89	10
Rheumatism	3 2	1 12.5	-	4 5.63	1 5.3	3 4.34	12
Weak eye sight	8 5.33	--	-	4 5.63	-	3 4.34	15
Stomach Pb	5 3.33	-	1 33.33	1 1.40	2 10.5	3 4.34	12
Thyroid Pb	1 0.66	-	-	1 1.40	-	1 1.44	2
Paralysis	-	-	-	-	2 10.5	1	3
Miscellaneous	3 2	-	-	-	-	-	3
Total	150	8	3	71	19	69	320

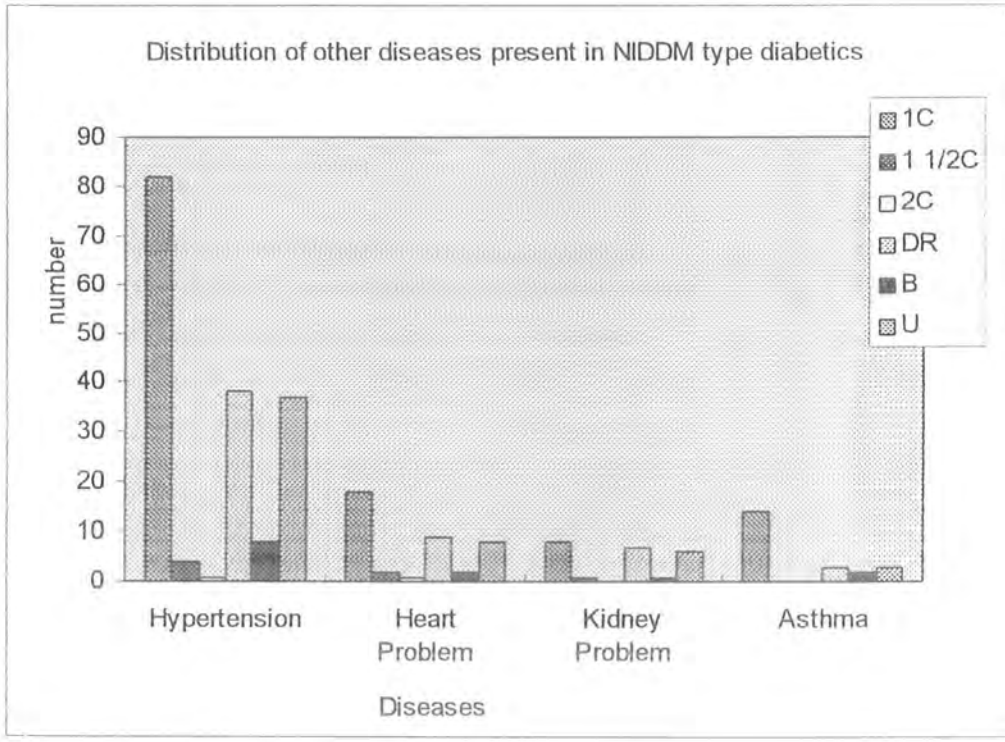

Distribution of other diseases present in NIDDM type diabetics
number
90
80
70
60
50
40
30
20
10
0
1C
1 1/2C
2C
DR
B
U
Hypertension
Heart Problem
Kidney Problem
Asthma
Diseases

Table 35. Distribution of other diseases in IDDM patients in various genetic relationships.

Disease	IC	$1^{1/2}$C%	2C	DR	B %	U %	TOTAL
Hypertension	14 9.16	5 50	-	9 40.9	3 33.3	12 54.54	43
Heart Problem	3 6.25	3 30	-	52 2.72	1 11.1	1 4.54	13
Kidney Problem	3 6.25	-	-	1 4.54	1 11.1	2 9.09	7
Asthma	2 4.16	-	-	2 9.09	3 33.3	2 9.09	9
Cataract	6 12.5	-	-	-	-	1 4.54	7
Ulcer	4 8.33	-	-	2 9.09	-	2 9.09	8
Rheumatism	3 6.25	-	-	-	-	1 4.54	4
Weak sight	3 6.25	1 10	-	3 13.63	-	-	7
Stomach Pb	4 8.33	-	-	-	1 11.1	1 4.54	6
Thyroid Pb	1 2.08	-	-	-	--	-	1
Paralysis	3 6.25	1 10	-	-	-	-	4
Miscellaneous	2 4.16	-	-	-	-	-	2
Total	48	10	-	22	9	22	111

Distribution of other diseases present in IDDM type diabetics

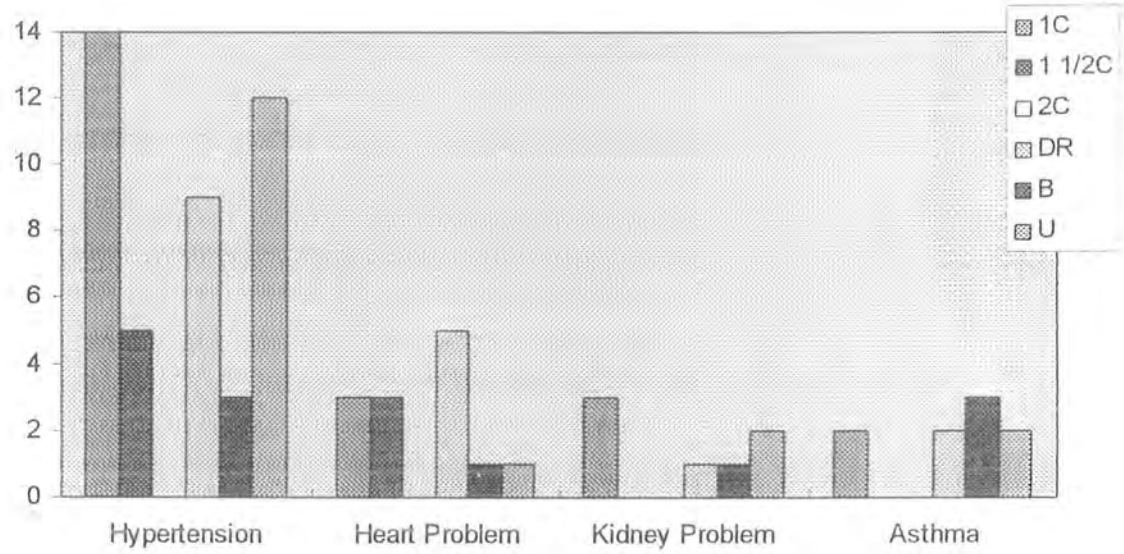


Table 36. Distribution of affected relatives of NIDDM type diabetics.

Relation	IC %	$1^{1/2}$C %	2C %	DR %	B %	U %	TOTAL
F	57 36.8	4 33.33	-	13 36.11	13 28.88	31 42.46	118
M	46 29.7	4 33.33	3 75	9 25	21 46.66	19 26.02	102
F+M	24 15.5	2 16.66	-	5 13.8	4 8.88	9 12.32	44
G.F	4 2.5	1 0.64	-	2 5.55	2 4.44	3 4.10	12
G.M	8 5.1	-	-	1 2.77	2 4.44	1 1.36	12
F+S	3 1.9	-	-	3 8.33	2 4.44	4 5.47	12
F+B	1 0.6	1 0.64	-	-	1 2.22	2 2.73	5
M+S	2 1.2	-		-	-	-	2
M+B	1 0.6	-	-	1 2.77	-	2 2.73	4
U	9 5.8	-	1 25	25.55	-	2 2.73	14
Total	155	12	4	36	45	73	325

F+M = Father and mother
G.F = Grand father
G.M = Grand mother
F+S = Father and Sister
F+B = Father and brother
M+S = Mother and sister
M+B = Mother and brother

Table 37: Distribution of affected relatives of IDDM type diabetics.

Relation	IC %	$1^{1/2}$C %	2C %	DR %	B %	U %	TOTAL
F	15 33.93	-	-	5 35.71	1 14.28	5 27.77	26
M	6 13.33	1 33.33	-	4 28.57	3 4.28	4 22.22	18
F+M	7 15.55	-	-	1 7.14	1 14.28	2 11.11	11
G.F	2 4.44	-	-	1 7.14	-	2 11.11	5
G.M	2 4.44	-	-	-	-	1 5.55	3
F+S	1 2.22	-	-	-	1 14.28	-	4
F+B	1 2.22	-	-	2 14.28	1 14.28	-	2
M+S	-	1 33.33	-	-	-	2 11.11	3
M+B	2 4.44	-	-	-	-	-	2
U	9 20	1 33.33	-	1 7.14	-	2 11.11	13
Total	45	3	-	14	7	18	87

F+M = Father and mother
G.F = Grand father
G.M = Grand mother
F+S = Father and Sister
F+B = Father and brother
M+S = Mother and sister

SUR NAME DISTRIBUTION

Table 38 shows the distribution of IDDM and NIDDM type diabetics among different sur-names recorded in present study. Percentage of diabetic patients was calculated, where each sur-name has a representation of atleast 20 patients. All those Surnames, represented by less than 20 patients were grouped as 'others'. The highest percentage of diabetes is seen in Maliks (11.32%) and the lowest percentage in Khokhar and Kashmiris is 2.18%. The highest percentage of IDDM patients was observed in Malik (11.88%) khan (8.91%) and Awan (8.41%).The highest percentage of NIDDM patients was observed in Malik(11.18%), Awan (8.69%) and Sheikh (6.48%).

Table 39 and table 40 show the distribution of IDDM and NIDDM type diabetics among different Sur-names in relation to their parental consanguinity. Higher number of these sur-names is associated with first cousins as compared to unrelated relations.

The highest mean coefficient of inbreeding (F) was seen in Mughal (0.0391) and lowest in Abbasi(0.01931).(Table 41).

Table 42 shows the mean age at diagnosis (years), BMI (kg/m^2) fasting and random blood glucose levels (mg/dl), in different Sur-names. Malik show an earlier onset of this disease (42.27 ± 0.01 years) while Kashmiris show a delayed (49.09 ± 2.27 years) onset of this disease. Kokhar show highest BMI (28.18 ± 0.98 kg/m^2) but Raja show lowest BMI (25.69 ± 0.66 kg/m^2) among different Sur-names.

Bhattis showed highest blood glucose levels, fasting (191.15 ± 8.14 kg/m^2) and random (242.70 ± 10.22 mg/ dl) Whereas Kashmiris show

the lowest blood glucose levels, fasting (127.16 ± 0.82 mg/ dl),and random (177.18 ± 11.13 mg/ dl).

Table38. Distribution of different sur names in IDDM and NIDDM type diabetics

SURNAMES	IDDM %		NIDDM %		TOTAL	
Malik	24	11.88%	90	11.18%	144	11.32%
Awan	17	8.41%	70	8.69%	87	8.63%
Sheikh	16	7.92%	52	6.48%	68	6.75%
Khan	18	8.91%	46	5.71%	64	6.35%
Rajput	15	7.42%	43	5.34%	58	5.75%
Arain	7	3.46%	50	6.21%	57	5.66%
Bhatti	11	5.44%	40	4.96%	51	5.06%
Syed	9	4.45%	39	4.84%	48	4.76%
Chaudry	10	4.95%	37	4.59%	47	4.66%
Mughal	5	2.47%	35	4.34%	40	3.97%
Qureshi	7	3.46%	33	4.09%	40	3.97%
Raja	10	4.95%	30	3.7%	40	3.97%
Kayani	4	1.98%	27	3.35%	33	3.27%
Abbasi	8	3.96%	17	2.11%	25	2.48%
Kashmiri	2	0.99%	20	2.48%	22	2.18%
Khokhar	3	1.48%	19	2.36%	22	2.18%
Others	36	17.82%	157	19.50%	191	18.96%
	202		805		1007	

Table 39. Mean age at diagnosis, BMI and blood glucose levels(fasting and random) of different sur names.

Surname	Age at Diagnosis	BMI	Blood Glucose Fasting	Random
Abbasi	46.75±2.37	27.48±1.19	175.62±10.24	215.96±12.38
Arain	47.02±1.37	26.99±0.73	174.5±6.61	235.59±9.14
Awan	47.45±1.18	26.36±0.52	183.77±6.27	228.08±7.54
Bhatti	45.29±1.34	25.84±0.54	191.15±8.14	242.70±10.22
Chaudry	45.18±1.51	26.94±0.62	182.96±9.05	229.29±10.95
Kashmiri	49.09±2.27	27.15±0.82	127.16±0.82	177.18±11.13
Kayani	44.42±1.79	28.05±0.83	173.63±8.33	215.36±9.27
Khan	44.54±1.40	26.43±0.49	174.29±6.25	222.16±8.02
Khokhar	46.09±2.01	28.18±0.98	163.60±9.60	221.73±13.85
Malik	42.27±.01	26.25±0.44	182.14±4.91	234.38±6.25
Mughal	48.45±2.07	25.96±0.59	178.25±8.64	230.5±9.37
Qureshi	48.07±1.48	26.29±0.64	178.82±7.43	222.15±9.22
Raja	47.07±1.76	25.69±0.66	181.05±8.95	227.82±9.79
Rajput	45.27±1.67	26.66±0.52	186.81±7.79	229.67±8.57
Sheikh	48.24±1.41	26.72±0.63	179±5.16	226.72±6.40
Syed	47.66±1.71	26.15±0.62	170.08±8.72	221±8.37

Table 40. Distribution of coefficient of inbreeding (F) in different sur names

Surnames	F-Value
Abbasi	0.01934
Arain	0.02108
Awan	0.03411
Bhatti	0.02633
Chaudry	0.02393
Kashmiri	0.03477
Kayani	0.02822
Khan	0.03001
Khokhar	0.02272
Malik	0.02438
Mughal	0.03906
Qureshi	0.02812
Raja	0.02225
Rajput	0.03070
Syed	0.02895
Sheikh	0.24573

Table 41. Distribution of different sur names of IDDM patients in various genetic relationships

Sur-Name	1C	%	$1^{1/2}$C	%	2C	%	DR	%	B	%	U	%	Total
Abbasi	3	2.85	-		-		1	12.5	3	6.66	1	2.43	8
Arain	4	3.80	1	33.33	-		1	12.5	2	4.44	2	4.87	7
Awan	14	13.33	-		-		-		2	4.44	1	2.43	47
Bhatti	5.	4.76	-		-		-		3	6.66	3	7.31	11
Chaudry	3	2.85	-		-		-		4	8.88	3	7.31	10
Kashmiri	1	0.95	-		-		4		1	2.22	-		2
Kayani	1	0.95	-		-		1	12.5	1	2.22	1	2.43	4
Khan	8	7.61	-		-		2	25	4	8.88	4	9.75	18
Khokhar	1	0.95	-		-		-		2	4.44	-		3
Malik	12	11.42	-		-		2	25	4	8.88	5	12.19	24
Mughal	4	3.80	-		-		-				1	2.43	5
Qureshi	5	4.76	-		-		-		1	2.22	-		7
Raja	4	3.86	-		-		-		3	6.66	1	2.43	10
Rajput	6	5.71	1	33..33	-		-		5	11.11	3	7.31	15
Syed	7	6.66	-		-		-		2	4.44	-		9
Shaikh	9	8.57	-		-		-		2	4.44	5	12.17	16
Others	18	17.14	1	33.33	-		1	12.51	6	13.33	11	26.82	36
Total	105		3		-		8		45		41		202

Table 42. Distribution of different sur names of NIDDM patients in various genetic relationships

Sur-name	1C %	$1^{1/2}$C %	2C %	DR %	B %	U %	Total
Abbasi	4 1.2	1 9.09	1 11.11	6 8.69	2 1.13	3 1.48	17
Arain	14 4.2	1 9.09	1 11.11	7 10.1	16 9.04	11 54.4	50
Awan	32 9.49	3 27.27	-	3 4.34	18 10.1	14 6.93	70
Bhatti	15 4.45	3 27.27	-	6 8.69	6 3.39	10 4.95	40
Chaudry	15 4.45	-	-	2 2.89	8 4.52	12 5.94	37
Kashmiri	11 3.26	-	1 11.11	-	2 1.13	6 2.97	20
Kayani	13 3.85	-	-	4 5.79	7 3.95	3 1.48	27
Khan	22 6.52	1 9.09	1 11.11	1 1.45	1 16.2	10 4.95	46
Khokhar	7 2.07	-	-	2 2.89	4 2.25	6 2.97	19
Malik	32 9.49	-	2 22.22	7 10.1	2 1.13	24 11.8	90
Mughal	21 6.23	-	-	1 1.45	3 1.69	10 4.95	35
Qureshi	13 3.85	-	-	5 7.25	5 2.82	10 4.95	33
Raja	10 2.96	-	1 11.11	2 2.89	10 5.65	7 3.46	30
Rajput	22 6.52	-	-	2 2.89	9 5.08	10 4.95	43
Syed	15 4.45	-	1 11.11	3 4.34	8 4.52	12 5.94	39
Shaikh	17 5.04	1 9.09	1 11.11	3 4.34	12 6.78	18 8.91	52
Others	74 21.95	1 9.09	-	15 21.7	31 17.5	36 17.8	157
Total	337	11	9	69	177	202	805

COMPARISONS WITH CONTROLS

Table 43:- Shows the distribution of male and female controls in various genetic relation ship. Females are 59.88% and males are 40.12%.

Table 44:- Gives mean height (m) , weight (KG) BMI (Kg/m2), fasting and Random blood glucose levels (mg/dl) , skin thickness (cm) , and sugar consumption / day (spoons) of males in various genetic relationships . Comparisons were made for BMI and fasting and random blood glucose levels , to figure out the differences between diabetics and controls.

Comparisons were made for controls with IDDM and NIDDM patients separately.

First cousin IDDM male patients differ non- significantly for BMI compared to controls ($t_{(194)}$=2.32; p>0.20), but NIDDM first cousin male patients are significantly obese compared to controls ($t_{(201)}$= 2.08 ; p < 0.05).

Fasting blood glucose levels in IDDM males ($t_{(94)}$=10.29; p<<0.001)and in NIDDM males ($t_{(201)}$=19.45; p<0.001)from first cousin unions is significantly different compared to control first cousins.

In comparisons for BMI between unrelated control males and unrelated IDDM males the difference was not significant ($t_{(31)}$=0.50; p>0.60) The comparison with unrelated NIDDM males and controls show the significant result ($t_{(104)}$=2.05; p<0.05) .

For fasting blood glucose level (mg/dl), the difference between unrelated control males with unrelated IDDM males ($t_{(31)}$=4.74; p<0.001) was significant and unrelated NIDDM males($t_{(104)}$=13.21;P<<0.001).

When comparisons were made for random blood glucose level mg /dl of unrelated control males with unrelated NIDDM males the difference in both cases was highly significant ($t_{(104)}$=13.21; p<<0.001).

Table 45 Gives mean height (m) weight (kg) BMI (kg /m^2), fasting and random blood glucose levels mg /dl, skin thickness (cm) and sugar consumed per day(spoons)of control females, comparisons were made between control females and diabetic IDDM and NIDDM type females.

Comparison for BMI of first cousin control females with first cousin IDDM females ($t_{(86)}$=11.55;P) and NIDDM first cousins females show non-significant differences ($t_{(210)}$=1.91; P >0.05).

For fasting blood glucose level mg/dl, comparison between first cousin IDDM females ($t_{(86)}$=11.55; p<<0.001) and NIDDM females ($t_{(210)}$=13.84 ; p<<0.001) show that difference was highly significant .

Again for random blood glucose level mg/dl, the difference between first cousin control females and first cousin IDDM ($t_{(86)}$=14.93; p<0.001) and NIDDM females ($t_{(201)}$=22.62 ; p<0.001) was significant.

Comparison for BMI between unrelated controls females and unrelated IDDM females is significant ($t_{(49)}$=1.56; p<0.02)and in NIDDM females is negligible.

For fasting blood glucose level mg /dI , when unrelated control females were compared with unrelated females of IDDM ($t_{(49)}$= 602 ; P<< 0.001) and NIDDM females ($t_{(135)}$= 13.8 ; P<< 0.001) , the difference was highly significant.

A highly significant difference was also observed when unrelated control females were compared with unrelated IDDM females ($t_{(49)}$= 8.43 , P<<o.oo1) and with unrelated NIDDM females ($t_{(135)}$ = 13.00, P<< 0.001) for random blood glucose level.

Mean skin thickness and mean spoons of sugar /day used by control males and females show negligible differences compared with IDDM and NIDDM males and females.

Table 46 shows the distribution of controls in various paternal education levels in different genetic relationships Highest percentage of paternal education in controls in up to college level (55.08%) and upto school level (31.73%). In IDDM diabetics paternal education was highest upto school level (38.11%) and upto college level (32.17%).And in NIDDM diabetics highest percentage of patients have paternal education at school level (43.92%) and at college level (29.43%).

Table 47 shows the distribution of maternal education of controls. Highest percentage of controls have their maternal education upto college level (41.91%) and at school level (35.32%). In IDDM diabetics maternal education was highest in those who had none levels of education (42.07%) and education up to school level (40.06%). Similarly, in NIDDM diabetics, highest percentage had none education (41.49%) and education up to school level 36.77%).

Table 48 shows the distribution of controls in various occupational categories in various genetic relationships. Highest percentage of controls are engaged in business (46.70%) and in government Jobs (clerks) (39.52%). Where as in IDDM patients highest percentage was seen of patients in government jobs (37.12%) and in business (32.17%). Similarly, in NIDDM patients mostly were in government jobs (37.14%), and in business (25.59%).

Table 49 shows distribution of controls into smokers and non-smokers in various genetic relations ships. Over all, there are (23.95%) smokers in controls and in IDDM patients smokers were (33.16%) and in NIDDM patients (28.19%).

Table 43. Distribution of control males and females in different genetic relationships

Sex	IC	%	DR	%	B	%	U	%	Total	%
Females	41	52.56	8	61.53	25	71.42	26	63.41	100	59.88
Males	37	47.43	5	38.46	10	28.57	15	36.58	67	40.12
	78		13		35		41		167	

Table 44. Mean height, weight, BMI and blood glucose levels(fasting and random) of control males

Item	1C	DR	B	U	Total
Height	1.72±0.005	1.76±0.01	1.74±0.013	1.73±0.01	1.73±0.004
Weight	68.22±2025	70.2±3.07	70.6±2.48	69.06±1.52	68.91±1.35
BMI	22.90±0.76	22.69±1.15	23.26±0.81	22.99±0.63	22.96±0.46
Blood Glucose fasting level	103.86±3.39	100±9.53	100.3±4.99	101.47±3.50	102.5±2.23
Blood Glucose random level	120.05±1.9	120.4±6.53	112.9±3.15	119.67±2.19	118.92±1.34
Skin thickness	27.14±0.44	27.4±0.6	28.4±0.69	27.6±0.67	27.44±0.31
Spoons of sugar	2.63±0.22	2.8±0.49	4.66±0.74	3±0.35	3.03±0.19

Table45. Mean height, weight, BMI and blood glucose levels(fasting and random) of control females

Item	1C	DR	B	U	Total
Height	1.56±0.006	1.59±0.01	1.56±0.009	1.55±0.01	1.56±0.04
Weight	64.95±0.85	65.5±0.92	66.76±1.14	64.69±1.33	65.33±0.54
BMI	26.95±0.46	25.90±0.43	27.28±0.55	26.83±0.69	26.77±0.29
Blood Glucose fasting level	94.68±3.31	93.75±6.78	95.72±3.26	104±2..31	97.29±1.87
Blood Glucose random level	109.4±2.55	107.62±4.42	109.84±2.64	114.77±2..31	110.27±1.42
Skin thickness	27.29±0.21	26.87±0.52	27.72±0.27	27.42±0.27	27.4±1.37
Spoons of sugar	3.64±0.27	3.71±0.78	3.16±0.31	3.58±0.40	3.33±1.91

Table 46. Distribution of paternal education of controls in different genetic relationships

Education	1C	DR	B	U	Total
None %	8.97	7.69	5.71	7.31	7.78
(n)	7	1	2	3	13
School %	28.20	38.46	28.57	39.02	31.37
(n)	22	5	10	16	53
College %	58.97	46.15	57.14	48.78	55.08
(n)	46	6	20	20	92
University %	3.84	7.69	8.57	4.87	5.38
(n)	3	1	3	2	9
Total	78	13	35	41	167

Table 47. Distribution of maternal education of controls in different genetic relationships

Education	1C	DR	B	U	Total
None %	19.23	23.07	17.14	29.26	21.55
	15	3	6	12	36
School %	37.13	30.76	31.42	36.58	35.32
	29	4	11	15	59
College %	42.30	46.15	48.57	34.14	41.91
	33	6	17	14	70
University %	1.28	-	2.85	-	1.19
	1	-	1	-	2
Total	78	13	35	41	167

Table 48. Distribution of controls in different occupational categories in various genetic relationships

Occupation	1C	DR	B	U	Total
%	2.56	-	7.69	7.31	3.59
C-I	2	-	1	3	6
%	44.87	37.14	38.46	31.70	39.52
C-II	35	13	5	13	66
%	-	-	-	-	-
C-III	-	-	-	-	-
%	8.97	5.71	84.61	4.87	7.18
C-IV	7	2	11	2	12
%	39.74	54.28	38.46	56.09	46.70
C-V	31	19	5	23	78
%	3.84	3.84	7.69	-	2.99
C-VI	3	1	1	-	5
Total	78	35	13	41	167

Table 49. Distribution of control smokers and non-smokers in different genetic relationships

Life Style	1C	DR	B	U	Total
Non Smokers %	70.51	61.53	88.57	80.48	76.05
	55	8	31	33	127
Smokers %	29.48	38.46	11.42	19.51	23.95
	23	5	4	8	40
	78	13	35	41	167

DISCUSSION

The analyses of present study sample of 1007 diabetes was carried out in two ways

1. Based on population study.
2. In relation to consanguinity

POPULATION STUDY

The study sample was diagnosed for main diabetes types i.e. IDDM (20.50%) and NIDDM (79.94%) . According to Glatthaar et al (1988), NIDDM constitutes about 855 of all cases of diabetes in developed counties, and the majority of cases in some developing countries, especially those with a high prevalence of diabetes(Dowse et al, 1989).

Zimmet (1983) reported that in developing countries NIDDM diabetes appears to be the most common form, but tropical malnutrition diabetes also occurs in many regions of globe.

Results from this study agree with the reported information

In IDDM, 49.50% were males and 50.49 were males, while in NIDDM 47.70% were males and 52.92% females .The difference in the distribution of males and females in IDDM and NIDDM types in non significant.

According to WHO(1985) study, the age at diagnosis of IDDM type diabetes is usually below 30 years. IDDM usually becomes evident when the patient is less than 40 years old ,often in adolescence or childhood, men and women are affected equally. (Ritchie, 1990).

In this study sample, the age at diagnosis in IDDM type patients is 30.93 +_ 0.69 years. Most patient with NIDDM are over 40 years of age when the disease first becomes evident. As the age increases , the likelihood of developing NIDDM increases. (Ritchie, 1990).

It was found that the age at onset of diabetes mellitus was significantly earlier in females than males. (Mason, 1987) . Present results show non significant difference in the age at onset of the disease in females (40.28 +0.41) years and males (40.67 +_ 0.48) years.

Through a diabetic survey of the adult population aged 15 years and above, carried out in 1975, it was found that the prevalence of diabetes is 1.99% . It occurs mainly in the age group 40 years and above (5.08%) and is uncommon in the age group 15-39 years(0.40%) . In males the highest prevalence of diabetes (70%) is in the age - group 45-49 years, while in females the highest prevalence (7.2%) is in the age group 55-59 years. (Cheah, 1985).

This study shows that the highest percentage of diabetic patients (18.96%) is in the age group 45-49 years. Male patients show the highest percentage (8.63%) in the age group 45-49 years and female patients show the highest percentage (10.32%) in 50-54 years.

According to Jarrett (1989) age and obesity are the two important factors in the incidence of diabetes mellitus .

In this study sample, females (28.1. $\pm$ 0.21) are obese than males (24.67 $\pm$ 0.16) ($P<<0.001$). Since obesity is one of the most important factors for developing diabetes mellitus (WHO, 1985; Mykkanen et al.,

1990). This study also supports the view that, obesity is a factor for the infliction of diabetes.

In this study, sugar consumption/ day in the diabetics show no association with diabetes.

Analyses was carried out to see the influence of education, socio economic status and life style (smoking habit) on the diabetes mellitus.

There is no influence of paternal education in the prevalence of diabetes. Although, higher percentage of diabetes is seen in patients whose fathers have attained up to school and college level of education . In case of maternal education, the highest percentage of patients is seen whose mothers have none level of education or they have attained education up to school level.

Patients holding clerical jobs in IDDM (37.12%) and in NIDDM (37.14%) and those who are engaged in business(32.17%) in IDDM and (25.59%) in NIDDM show the highest percentage of the disease.

Prevalence increases with physical idleness and with obesity but is less evident among those who regularly exert themselves. The prevalence is, therefore, changing in most parts, of the world and may even be expected to fall in societies which adopt an attitude to the need for exercise and weight control (Malins, 1972).

As less physical activity increases the chances of obesity and then increases the chances of diabetes . Regular physical activity has been shown to reduce a number of atherogenic risk factors, this way it increases HDL levels, assists in reducing obesity and blood pressure and improves insulin sensitivity (Zimmet, et al, 1991).

Recently, prospective, studies have also shown that physical activity is associated with the reduced risk of NIDDM (Schranz, 1989); Helmrich et al., 1991).

In this study, smoking habit does not show any direct influence on the diabetes. There are 28.89% smokers and 71.10% non- smokers. When compared to normal smokers and non-smokers, the results are not-significant. ($\chi^2_{(1)} = 3.69$; $p > 0.05$).

Among diabetics, the diseases recorded are hypertension, cardiac diseases and kidney diseases. Hypertension is the most frequent disease present in the diabetic patients, out of which 21.11% are NIDDM type and 21.28% are of IDDM type diabetics . Heart patients are 12.06%,of which 6.43% are of IDDM type and 4.84% of NIDDM type . There are 7.19% of diabetic patients inflicted with kidney disease, 3.46% from IDDM type and 2.98% from NIDDM type.

Patients with diabetes are at high risk for complication which are associated with extreme morbidity and mortality (Jacobs et al., 1991) .

The genetic mechanism of diabetic heredity is disputed (Rimoin, 1971) but the disease does run in families. .Family history of the diabetic patients for diabetes show that their fathers (34.94%) were diabetic in highest percentage, and 29.13% of their mothers were diabetic.

In USA among whites , the overall risk of developing diabetes mellitus is about 5% , while offsprings of diabetic parents have 2-3% risk if the mother has the disease and 5-6% risk if the father has the disease. (Skyler, 1991) .

This study also corroborates the results reported by Skyler (1993) and Rimoin (1971).

CONSANGUINITY

In Pakistan first cousin marriages are preferred compared to unrelated relations and the rates of in breeding range from 37.8% to 48.9%. Calculated coefficient of inbreeding for general population ranges from 0.0236 to 0.0286 (Shami et al., 1990) Data for diabetic patients were arranged in relation to parental genetic relationship to see if inbreeding is associated with the occurrence of diabetes mellitus.

Diabetic patients in our study are higher in first cousins marriages (43.89%) compared to unrelated relations (24.13%). Inbreeding coefficient calculated for diabetic patients is (F = 0.028), where as coefficient of inbreeding calculated for males is (F = 0.0293) and in females is (F = 0.026). Higher co-efficient of inbreeding is seen in males as compared to females.

Age at diagnosis in IDDM type female patients is earlier (30.68 $\pm$ 1.33 years) than unrelated (33.04 $\pm$ 2.33) years. However, there is not significant difference between the two ($t_{(68)}$ = 1.25; P > 0.20).First cousin females in IDDM are slightly thinner (27.96 $\pm$ 0.76) than unrelated females (28.98 $\pm$ 1.25).Fasting (194.38 $\pm$ 8.00) and Random (248 $\pm$ 9.10) blood glucose levels mg/dl in first cousin females are higher than in unrelated females (169.96 $\pm$ 10.64 and 218.04 $\pm$ 12.13) mg/dl respectively.

The difference for fasting blood glucose level between first cousin and unrelated females is significant ($t_{(68)}$ = 1.83; P > 0.05) but for the random blood glucose level the difference is not significant ($t_{(68)}$ = 1.98; 70.05).

Skin thickness (cm) and Sugar (Spoons/day) do not show any significant differences in first cousins and unrelated females in IDDM.

Age at diagnosis in unrelated IDDM males is earlier (25.5 ± 2.07) to first cousin males (30.75 ± 1,30).

First cousin IDDM males are heavier (70.29 ± 1.45) in weight to unrelated IDDM males (64.22 ± 2.94) but the difference is not significant.

In males, fasting (183.5 ± 6.40) and random (229.5 ± 7.4) mg/dl blood glucose levels are higher than in unrelated male patients (170.88 ± 14.06 and 220.05 ± 17.59 respectively, but the difference between two is not significant.

In NIDDM, males and females of first cousin unions do not show any difference in the age at diagnosis compared to unrelated male and female patients.

Fasting and random blood glucose levels (mg/dl) in first cousins of NIDDM males and females are higher to the unrelated males and females. But the difference is not significant.

A higher percentage of diabetics have paternal education up to school level. This is observed both in IDDM first cousin patients and unrelated patients. Highest percentage of first cousin and unrelated patients have maternal education at none education level.

In NIDDM patients as well higher percentage have paternal education up to school level (both in first cousin and unrelated patients). Similarly, in these two genetic relations, higher percentage of patients

have maternal education at none level. Education seems to have highly significant influence on the infliction of diabetes.

Among IDDM patients and NIDDM patients from first cousin and unrelated relation have higher percentage who hold clerical jobs or are engaged in business.

In IDDM first cousin patients holding government jobs (clerical jobs) are higher in percentage (33.82%) than those holding the other jobs. In unrelated diabetic patients, higher percentage (43.56%) is seen of those holding the government (clerical) jobs.

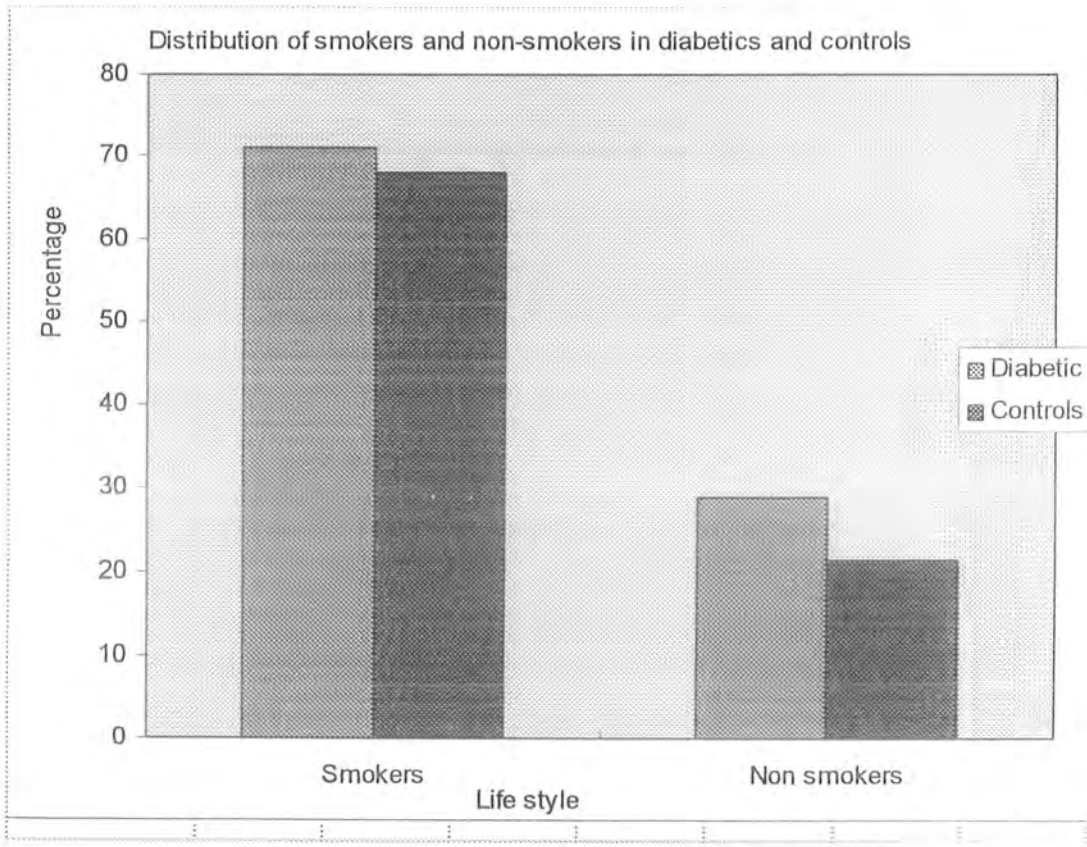
In NIDDM first cousin patients, high percentage (40%) is of those who hold the government jobs (clerical jobs) compared to unrelated where highest percentage (34.14%) is of those who are engaged in business.

T he study indicates significant association of diabetics with economic status as the patients are not fairly distributed among different categories of occupation.

Smoking habit doesn't seem to be a contributing factor towards affliction of diabetes as there is no significant difference in number of smokers among diabetics compared to control sample ($x2(1)=3.69;P>0.05$).

Associated to diabetes, are other diabetes as well. Of these diseases, the highest percentage is that of hypertension (54.66%) in first cousin and (53.62%) in unrelated patients of NIDDM.

While in IDDM the highest percentage of hypertension is again in first cousin (29.16%) and is 54.54% in unrelated.



a

Pakistani population is highly inbred and it would be expected that in some subjects familial diabetes history can be traced back. Diabetes was also traced back in the family. Results show that in IDDM first cousins, highest percentage in close relatives is of diabetic fathers (33.33%), mothers (13.33%) and father and mother (15.5%). Whereas in unrelated patients, the highest percentage of diabetic fathers (27.27), mother (22.22%) and father & mothers (11.11%).

In NIDDM first cousins the highest percentage have diabetic father (36.77%), mothers (29.67%0 and fathers & mother(15.48%). In unrelated patients diabetic fathers are 42.46%, mother are26.02 % and both father & mother are affected with NIDDM in percentage of 12.32%.

Kandemir (1994) observed that the consanguinity between parents was 23.9% and 10.3% of the patients had IDDM in first degree relatives. The diabetes is more prevalent in subjects with a positive family history (Verrillo_et. al., 1983).

BIBLIOGRAPHY

Akerblom, Hk. and Reunanen, A. 1985. The epidemiology of Insulin dependent diabetes mellitus (IDDM) in Finland and in northern Europe. Diabetes - Care. 8 Suppl. 1 : 10 - 16.

Andersen, AF; Christionsen, JS; Andersen, JK;, Keigr, S. and Deckert, T: 1983. Diabetic nephrophathy in type I (Insulin - dependent) diabetes: an epidemiological study. Diabetologia. 25: 496-501.

Barrett, E.and Khaw, KT. 1989. Cigarette Smoking and increased central adiposity, Ann Infern Med. 111; 783-787.

Bennett, PH. 1979. Recommendations on the standardization of methods and reporting of tests for diabetes and its micro-vascular complications in 10 epidemiologcal studies. Diabetes care. 2:93-104.

Bennett, PH. 1984. Diabetes in the elderly: diagnosis and epidemiology. Geriatrics.: 39(5): 37-41.

Bennett, PH. 1985. Changing concepts of the epidemiology of Insulin - dependent diabetes. Diabetes - Care. 8 Suppl 1 : 29 - 33.

Bloom, A; Hayes, TM. and Gamble, DR. 1975. Register of newly diagnosed diabetic children. Br. Med J.3: 580-583.

Cheah, JS; Yeo, PP; Thai, AC; Lui, KF; Wang, KW; Tan, YT ; Ng, YK. and Tan, BY. 1985. Epidemiology of diabetes mellitus in Singapore. Comparison with other Asian Countries. Ann. Acad- Med - Singapore. 14(2): 232 -239.

Chen, MK. and Lowenstein, FW. 1986.Epidemiology of factors related to self - reported diabetes among adults. Am-J- Prev-Med. 2(1) : 14-19.

Christau, B; Kromann, H. and Ortved, A.1977. Incidence, seasonal and geographical patterns of juvenile - on set insulin - dependent diabetes mellitus in Denmark. 13: 281 -284.

Christy, M; Green, A; Christan, B; Kromann, H; Nevup, J.1979. Epidemologic studies of Insulin - dependent diabetes mellitus. Diabetes care. 2(2): 127-30.

Cromme,P; Van der Veen, EA; Eejemer, PD. and Kulik, DJ.1987. Serum fructosamine assessment as a screening test for diabetes mellitus. Neth. J. Med. 30 : 202 - 203.

Croxson,s;Burden,AC;Bodington,M;Botha,JL.1991.The prevalence of diabetes in elderly. Diabetic Med.8:26-31.

Deckert , T; Poulsen, JE; Larsen, M. 1978. Prognosis of Diabetics with diabetes onset before the age of thirty -one. [Survival, Causes of death and complications. Diabetologia. 14:363-370.

Dowse, Gk . 1991. Abdominal obesity and physical inactivity as risk factors for NIDDM and impaired glucose tolerance in Indian, Creole and Chinese Mauritians. Diabetes care.14: 271-282.

Dowse, GK; Zimmet, PZ. 1989. The prevalence and incidence of non-Insulin dependent diabetes mellitus. In: Albeti KGMM, Mazze R, eds. Frontiers in diabetes research; current trends in non-insulin dependent diabetes mellites. Amsterdam, Elsevier: 37-59..

Drash, Al; Cho, N; Tajima, N; Rewers,.M and Laports, R. 1989. The epidemiology of diabetes in childhood with special reference to the orrient implications for mechanism of beta cell damage. Indian - J- Pediatr. 56 Suppl: 515 - 532.

Durrutty, P; Ruiz, F; Garcia, DL. and Rios, M. 1979. Age at diagnosis and seasonal variation in the onset of insulin - depended diabetes in Chile. (Southern Hemisphere). Diabetologia. 17 : 357 -3 60.

Dyck, D; Kratz, KM; Karnes, JL; Litchy, W; Klein, R. and Pach, JM. 1993. The prevalence by staged severity of various types of diabetic neuropathy, retinopathy, and nephropathy in a population based Cohort; The Rochester Diabetic Neuropathy study. Neurology. 43:817 - 824.

Engelau, MM; Herman, WH; Smith, PJ; German, RR; Aubert, RE. 1995. The epidemiology of diabetes and pregnancy in the U.S. Diabetes Care;18(7): 1029-33.

Fitzgerald, M.G; Malins, J. M; O' Sullivan, D.J. 1961. Lancet. 1; 1250.

French, LR; Boen, RJ. Martinez, AM; Bashhouse, As; sprafka, JM. and Goetz, CF.1990. Population - based study of impaired glucose tolerance and type II diabetes in wadena. Minnesota Diabetes.39: 1131-1137.

Gamble, DR. 1980. An epidemiological study of childhood diabetes affecting two or more siblings. Diabetogia. 19(4) : 341-34 4.

Gamble, DR. and Taylor,Kw.1976. Epidemiological background to diabetes. Acta - Endorcrinal - supply - Copenh. 205 : 161 -16 6.

Glatthaar, C; Whittall, De; Welborn , TA; Gibson, MJ; Brooks, BH; Byan, MM. and Byrne, GC.1988. Diabetes in western Australian children: descriptive epidemiology. Med - J- Aust. 148 (3): 117-123.

Green , A; Gale, AM. and Patterson, CC. (1992). Incidence of childhood onset insulin -dependent diabetes mellitus: The EURODIABACE study. Lancet 339:905-909.

Grzywa, M. and Sobel, A. 1995. Some aspects of epidemiology in insulin - dependent diabetes mellitus (IDDM) I. Pol Arch.Med.Wewn.93(4):329-34.

Haffner, SM. 1986. Role of obesity and fat distribution in non-Insulin - dependent diabetes mellitus in Mexican Americans and non - Hisponic whites. Diabetes Care. 9: 153-161.

Harris. M. 1985. Prevalence of non-Insulin - dependent diabetes and: impaired glucose tolerance. In : National Diabetes Date Group Diabetes in America. NIH Publication No. 85 - 1468. Washington US Government Printing Office, 1985: VI - 1- VI - 31.

Hayward, RE. and Lucena, B.c.1970. F. Inst. Actuar. 91-186.

Helmrich, SP. 1991 Physical activity and reduced occurrence of NIDDM. New England Journal of Medicine. 325: 147-152.

Horton, E; Jeanrenaud, B.1990. Obesity and diabetes mellitus. In. Rifkinh, PorteD. eds. Ellenberg and Rifkin's diabetes mellitus; Theory and practice ,4th edition . Amsterdam: elsevier. 199 : 457-463.

Jacobs, J; Sena, M. and Fox, N. 1991. The cost of hospitalization for the late complications of diabetes in the United States. Diabetic Med. 8: S23 - S29.

Jarrett, RJ. 1989. Epidemiology and Public health aspects of non-insulin dependent diabetes mellitus.Eepidemiol- Rev. 11: 151-71.

Kandemir, N; Acikgoz, E. and Yordam, N. 1994. The epidemilogy of Juvenile - onset Insulin - dependent diabetes mellitus in Turkish children. A retrospective analysis of 477cases. Turk - J - Pediatr. 36 (3) : 191 -195.

Karvonen, L; Tuomilento, J: Libman, L. and Laporte, R. 1993. For the world Health Organization Diamond Project group; A review of the recent epidemiological data on the world wide incidence of type 1 (Insulin - dependent diabetes mellitus). Diabetologia. 36: 883-892.

Katsilambros, N; Aliferis, K; Darviri, Ch; Tsapoga, P; Alexion, Z. and Tritos, N.1993. Evidence for an increase in the prevalence of known Diabetes in a sample of an urban population in Greece. Diabetic Med. 10:37-90.

Khanina, Ev.1977. Epidemilogy of diabetes mellitus in Raga Prob I - Endokrinol - Mosk. 23 (3): 17-20.

King, H. and Rewers, M. 1993 . Global estimates for prevalence of diabetes and impaired glucose tolerance in adults. Diabetes Care. 16 : 157 - 177.

King, H. and Zimmet, P. 1988. Trends in the prevalence and incidence of diabetes: non-insulin dependent diabetes mellitus. World Health Statistics Quarterly. 41 : 191 -196.

Kitagawa, T; Mano, T and Fujita, H. 1983. The epidemiology of childhood diabetes mellitus in Tokyo metropolitan area. Tohoku- J -Exp-Med. 141 suppl: 171-9.

Kitagawa,T; Owada, M; Urakami, T.and Tajlma, N. 1994. Epidemiology of type I (Insulin - dependent) and type II (Non- Insulin - dependent diabetes mellitus)in Japanese children. Diabetes - Res-Clin - Pract. 24 Suppl : S7 - 3.

Knowler. WC; Bennet, PH; Hamman, RF. and Miller, M.1978. Diabetes incidence and prevalence in Pima Indians: a 19 fold greater incidence than in Rochester Minnesota. Am Epidemiol . 108: 497 - 505.

Lioyd, CE, Wing, RR. and Orchard, TJ. 1996. Waist to hip ratio and Psychological factors in adults with Insulin - dependent diabetes mellitus: The Pittsburgh Epidemiology of Diabetes Complications study: Metabolism. 45(2): 268-72.

MacDonald, MJ; Johnson, SD; GottSchall, JL; Lank ,JL; Mason, EP; Maby, SL. and Duck,Sc.1989.Epidemiology of insulin dependent diabetes before age 20 in Wisconsin, with particular reference to seasonality. Diabetes Res. 12(4) : 151-60.

Malins, JM. 1972. Clins. Endocr. Metab. 1:645.

Masaki, N; Takashima, S; keij, K and kajufumi, I.1992. Estimation of prevalence rate of NIDDM based on a mass health examination in Hiroshisma prefecture. J. Japan Soc. 35: 547 - 552.

Maser, RF; PFeifer, MA; Dorman, JS; Kuller, LH; Becker, DJ. And Orchard, TJ. 1990. Diabetic automonimic neuropathy and cordiovascular risk. Arch intern Med.150 : 1218 - 1222.

Mason, DR; Scott, RS. and Darlow, BA. 1987.Epidemiology of Insulin dependent diabetes mellitus in Canterbury, New Zealand. Diabetes - Res - Clin- Prac3(1)21-29.

Melton, LJ, Ochij ,W; Palumbo, P. and Chuc, P.1984. Referral bias in diabetes research. Diabetes care. 7: 12 - 18.

Michalkova, DM; Cernay J; Dankova, A; Rusnak, M and Fanda,K.1995. Incidence and prevalence of childhood diabetes in Slovakia (1985-1992). Slovak childhood Diabetes Epidemiology study (group).- Diabetes - care. 18(3): 315-320.

Miselli, V; Paglian, U; Bisi, S; Foracchia, A; Dorigatti, C; Pinotti, M. and Zappavigna, A. 1994. Epidemiology of gestational diabetes in Scandiano Health District.. Minerva- Endocrinol. 19 (2): 63 -6 6.

Mykkanen; L; Laakso, M; Uusitupa, M; Pyorala, K. 1990. Prevalence of diabetes and impaired glucose tolerance in elderly subjects and their association with obesity and family history of diabetes. Diabetes Care. 13. 1099-1105.

National centre for Health statistics: 1985. The National Health Interview Survey Design (1973 - 84). and procedures 1975 - 83. (NCHS Vital and Health Statistics Series 1 , No. 18). Washington, D.C : US Department of Health and Human services .

Oakley, WG; Pyke, DA. And Taylor, KW. 1968. Clinical Diabetes and its Biochemical basis. Oxford. Black well.591.

Ohlson, L.1988. Risk factors for Type II (non-Insulin-dependent) diabetes mellitus. Thirteen and one-half years of follow-up of the participants in a study of Swedish men born in 1913. Diabetologia. 31 :798-805.

Owada, M; Hanaoka, Y; Tanimoto, Y. and Kitagawa, T. 1990. Descriptive epidemiology of non-insulin - dependent diabetes mellitus detected by urine glucose screening in school children in Japan. Acta. Pediatr. Jpn. 32: 716 - 724.

Palmberg, P; Smith, M; Wattman, S; Krupin, T; Singer, P. and Burgess, D. 1981. The natural history of retinopathy in insulin-dependent, Juvenile- Onset diabetes. Ophthalmology. 88: 613-618.

Papazoglou, NC; Manes, C; Chatzimitrofanous, P; Papadeli, E; Tzounas, K; Scarage, G; Kontogiannis, I. And Alexiades, D. 1995. Epidemiology of diabetes mellitus in elderly in Greece, a population study. Diabet - Med. 12(5) : 397 - 400.

Pedersen, J. 1967 The pregnant Diabetic and her new born. Copenhagen, Pyke, DA. 1956. Lancet. 1, 818.

Pell, S. and Alonzo, CA.1970. F. Am . Med. Ass. 214, 1833.

Philips, SF; Whisnant JP; Fallon, WM. and Frye, RL 1990. Prevalence of cardiovascular disease and diabetes mellitus in residents of Rochester, Minnesota- Mayo Clin. Proc. 65 : 344 - 359.

Pyke, D. 1956.Lancet. i, 818.

Rewers, M. 1988 Trends in the prevalence and incidence of diabetes: insuline dependent diabetes mellitus in childhood . World health Statistics Quarterly. 41 :179 - 189.

Rimoin, D.L. 1971. Med. Clins N. Am. 55, 807.

Ritchie, AC. 1990. Boyd's Text book of Pathology. Lea and Febiger Philadelphia, London.

Schranz, AG. 1989. Abnormal glucose tolerance in the Maltese. A population based longituadinal study of the natural history of NIDDM and I.G.T in Malta. Diabetes research and clinical practice. 7:7-16.

Shami, SA; Schmitt, LH. and Bittles, AH. 1990 Consanguinity, Spousal age at marriage and fertility in seven Pakistani punjab cities. Ann.hum. Biol. 17: 97-105.

Skyler, J. 1993. Immune intervention in type 1 diabetes mellitus . Diabetes/ metabolism reviews.1 : 15 - 42.

Soltesz , G, Jeges, S. and Dahlquist, G. 1994. Non genetic risk determinants for type I (insulin - dependent) diabetes mellitus in childhood. Hungarian childhood Diabetes Epidemiology study Group. Acta - Paediatr. 83(7) : 730-735.

Sterky, G; Holmgern, G. and Gustavson, KH. 1978. The incidence of diabetes mellitus in Swedish children 1970 - 1975. Acta Paediatr Scand. 67: 139-143.

Stoving , RK; Hangaard, J; Pedersen, KK. and Hegen, C. 1994. Menstruation disorders in insulin - dependent diabetes mellitus - Epidemiology and cause . Ugeskr - laeger.156 (42) : 6180 -6184.

Tajima, N; Laporte, Re; Hibi, I; Kitagawa, I; Fujita, H. and Drash,A.1985 A Comparison of the epidemiology of youth-onset Insulin dependent diabetes mellitus between Japan and the United States. Allegheny County, Pennsylvania. Diabetes- Care. 8 Suppl 1: 17-23.

Tan, MH. and Maclean, DR. 1995. Epidemiology of diabetes mellitus in Canada. Clin- invest-med. 8(4): 240 -6.

Tuomilento, J; Nissinen, A; Icivela, Pekanen, J; Koarsalo, E. and Wolf, E.1986. Prevalence of diabetes mellitus in elderly men aged 65 to 84 years in eastern and western Finland. Diabetologia . 29 : 611-615.

Verrillo , A; DeTeresa, A; Munziata, G. and Rucco, E. 1983. Epidemiology of diabetes mellitus in an Italian rural community. Diabete - Metab. 9(1): 9 -13.

Wagen Knecht, LE; Roseman, JM. and Alexander, WJ. 1989. Epidemiology of IDDM in black and white children in Jefferson County, Albama, 1979 85 [Published erratum appears in Diabetes 1989 Jul ; 38 (7) : preceeding 815]. Diabetes. 38 (5): 629 -633.

West, R; Belmonte, MM; Colle, E; Repeau, Mp; Wilkins,J. and Poirier, R. 1979. Epidemiological survey of juvenile - onset diabetes in Montreal . Diabetes. 28(7); 690-693.

WHO study group.1985. Diabetes mellitus. Technical report series no. 727: Geneva: 1925: 37

Wilborn, TA. 1984. Diabetes and macrovascular disease epidemiology, nutritional and environmental factors. Hum-Nutr-clin-Nutr. 38(3): 165-175.

Wilson, Pw; Anderson, CM. and Kannel, WB. 1986. Epidemiology of diabetes mellitus in the elderly. The Framingham study. Am-J-Med. 80 (5A): 3-9.

Working party of the college of General practitioners. Br. Med. J. 1963, ii, 655.

World Health Organization.1992. Diamond Project Group on Epidemics. American Journal of epidemiology. 135: 803-316.

Wrights. 1992. Co-efficient of inbreeding and relationships. AM. Nat. 56: 313 -338.

Zimmet, D. 1979. Epidemiology of diabetes and its macro-vascular manifestations in pacific populations. The medical effects of social progress. Diabetes - Care. 2 (2): 144 -153.

Zimmet, P.1983. The global epidemology of diabetes mellitus. Tohodu - J - Exp - Med. 141 Suppl :41-51.

Zimmet, P; King, H; Taylor ,R; Raper, LR; Balkau, B and Borger.1984. The high Prevalence of diabetes mellitus, impaired glucose tolerance and diabetic retinopathy in Nauru - the 1982 survey. Diabetes Res. 1: 13-15.

Zimmet, P; King, H; Dowse, G. and Collins, v. 1992. Antecedents of diabetes mellitus : Is hyperinsulinemia Youth predictive? Intl. Child Health. 3: 53 - 63.

Zimmet, P; Kirti, Rh; Serjeantson, Sw; King,TT. 1985. Genetic and environmental influence in the epidemiology of non-Insulin-dependent diabetes mellitus: a global perspective. Ann- A Cad - Med - Singapore. 4(2): 347 - 353.

Zimmet, PZ. 1991. The relation of physical activity to cardiovascular disease risk factor in Mauritians. American Journal of Epidemiology. 16(Suppl.): 535-539.