CHAPTER I

INTRODUCTION

Diabetes has become a major public health concern in the world than any other disease due to the increased prevalence of diabetes-related complications (Sarah *et al.,* 2004). Diabetes does not cure permanently but it can be controlled in various techniques. One of the most important techniques is nutrition therapy (ADA, 2015). For nutrition therapy, patients need their nutritional knowledge to control blood glucose. Inadequate glycemic control may occur due to poor nutritional knowledge and misguide of dietary prescriptions (Castro-Sánchez *et al.,* 2013).

There are four types of diabetes such as type 1, type 2, gestational, and malnutrition-related diabetes (WHO, 2006). Type 1 diabetes (T1D) is caused due to the autoimmune destruction of insulin-producing pancreatic β cells (Atkinson, 2001) and unable to produce insulin. Type 1 diabetes is most prevalent in children, but it can also affect adults, particularly in their late thirties and early forties. Patients with type 1 diabetes are rarely obese and often present with diabetes ketoacidosis, a life-threatening disease (ADA, 2017). Type 2 diabetes is a chronic disease that caused by inherited and acquired insulin resistance or an increased insulin secretion disorder (Gaede *et al.,* 2008).

Gestational diabetes is a form of glucose intolerance that develops or becomes evident during pregnancy. Diabetes associated with complex hereditary syndromes, surgery, malnutrition, infection, medications, and other illnesses are examples of other forms of diabetes. Diabetes has been characterized as a demolishing and deadly disease after 2000 years (Agbabiaka, 2010).

Diabetes mellitus has arisen an important public concern as over four million people are suffering this ailment and only 20 percent of this group is aware of what they are passing through (Lang *et al.,* 2008). World Health Organization indicates that there were 171 million people in the world with diabetes in the year 2000. It will increase to 366 million by the year, 2030 (WHO, 2006). It is estimated that diabetes mellitus currently accounts for 5.2% of all deaths worldwide (Roglic *et al.,* 2000).

In the world, diabetic patients were 140 million. By 2025, this amount would have risen to 300 million. Asia is the world's biggest continent where the estimated amount

of diabetic patients will be more than 150 million by 2025. In Asia, two countries e.g India and China contain more diabetic patients. In India, it is predicted to rise 15 million in 1995 to 57 million in 2025. In China, recent estimates rise 15 to 20 million, with a predicted rise to 50 million in 2025. In 2025, more than 30% of diabetes will be in these two countries alone in the world (King ,1999).

The International Diabetes Federation (IDF) published in 2014 has reported that the diabetes mellitus patients in the middle east as 3%, Southeast Asia as 8.8% and western pacific region as 7.9%, respectively (Anjana *et al.,* 2015).

Another report has estimated that diabetes mellitus is supposed to be double from 175 million in 2000 to 353 million in 2030. The greatest rise is anticipated in developed countries, with 305 million people expected to have diabetes by 2030. (Yaeh *et al.,* 2006).

Bangladesh is a developing country where the prevalence of diabetes is gradually growing. In Bangladesh, according to the International Centre for Diarrhoeal Disease Studies, 7.1 million people had diabetes in 2015, with 3.7 million cases going undiagnosed and 129000 deaths occurred due to the disease (Chowdhury *et al.,* 2016). The prevalence of diabetes in Bangladesh, based on published studies, ranges from 2.21% to 35% (Sayeed *et al.,* 1995). However, the most recent meta-analysis, which merged studies conducted between 1995 and 2010, was published in 2012 (Saquib *et al.,* 1995-2010).

Diabetes is characterized by elevated blood sugar levels, which raise the risk of microvascular damage such as retinopathy, nephropathy, and neuropathy.

It is associated with decreased life expectancy, increases morbidity due to diabetes related microvascular complications, increased risk of macrovascular complications such as heart disease, stroke and peripheral vascular disease. The American Diabetes Association estimated the national costs of diabetes in the USA for 2002 to be 132 billion USD, which increasing to 192 billion USD in 2020 (ADA, 2000).

Obesity has become more common in recent years, bringing attention to the problem's global importance. About two-thirds of the adult population of the United States are considered overweight or obese. Obesity has been related to a number of medical, psychological, and social problems, the most severe of which is type 2 diabetes. 171

million people were believed to have type 2 diabetes at the turn of the century, and this number is projected to rise to 360 million by 2030 *(*Mc Keigue *et al.*, 1991).

Insulin resistance is related to both type 2 diabetes and obesity. While being insulin resistant, most obese people do not develop hyperglycemia. Pancreatic β-cells of the islet of Langerhans release adequate amounts of insulin that are sufficient to overcome insulin level reductions under normal circumstances, thus maintaining normal glucose tolerance (Røder *et al., 1998*).

Another essential factor that affects insulin sensitivity is body fat distribution. Insulin resistance is related to BMI regardless of the degree of weight gain. Insulin sensitivity varies considerably between lean and obese people due to variations in body fat distribution. Individuals whose fat distribution is more peripheral have more insulin sensitivity than do individuals whose fat distribution is more central (ie, in the abdomen and chest area (Karpe *et al.,* 2011).

Taking appropriate amount of nutrition is an important section of diabetes management. Self-care of education, physical exercise, aiming at the attainment and maintenance of optimal metabolic outcomes (WHO,2004).

Low calorie fruits and vegetables help to maintain optimal blood glucose level and decrease mortality rate, obesity, cancer, hypertension, cardiovascular disease (Thomas, 2005).

Keeping the present situation of diabetes in mind the present study has aimed to determine the socio-demographic characteristics, nutritional status and food habit pattern of the diabetic patient in Chattogram District.

Aim of the study:

The aim of the study is to generate information towards improving the nutritional status of diabetic patient and enhance their nutritional education to control diabetes at a normal range.

Objectives of the study:

The main objective of the study is to determine the nutritional status of Diabetic patients in Chattogram area, Bangladesh.

The specific objectives of the study are:

- To assess the nutritional status of diabetic patients.
- To study the dietary pattern and food consumption data of the diabetics.
- To relate factors associated with diabetes

CHAPTER II

REVIEW OF LITERATURE

2.1 General Overview of Nutritional Status

Nutrition may be defined as the consumption of food, considered in relation to the body's dietary needs (WHO, 2011). Food contains different nutrients that include water, carbohydrates, proteins, fats, vitamins and minerals. Good nutrition is essential for survival and the proper functioning of critical functions such as the body's production of energy, movement, work, and temperature regulation, as well as growth, development, replacement, and repair of cells and tissues, chemical processes such as digestion, metabolism and maintenance and protection against illness, fighting infections and recovery from illness. Poor nutrition can lead to reduced immunity, increased susceptibility to disease, impaired physical and mental development, and reduced productivity (Sakamaki *et al.,* 2005). A balanced diet is an essential aspect of living a healthy lifestyle. The Body Mass Index (BMI) and eating plan analysis are useful in individual's nutritional assessment (Nieradko-lwanicka *et al.,* 2004). Nutritional status is a measure of an individual's health that is influenced mainly by food consumption and nutrient use. Malnutrition defines a state when the body neither have enough of the required nutrients (under-nutrition) nor has an excess of required nutrients (over- nutrition) (Miere *et al.,* 2007). In clinical practice, accurate measurement of individual nutritional status is needed. Population measures are more important in research. They may be used to define a group's nutritional status, to classify populations or groups of populations at risk for nutrition-related health problems, and to assess interventions (Labib *et al.*,2001).

2.2 Nutrition Education

To fill nutritional requirements, one should know which food contains good nutrition. People need to know what constitutes a healthy diet and how to make good choice. Nutrition education is defined as the combination of educational tricks, along with environmental supports that designed to facilitate the voluntary adaptation of food choices and nutrition related behaviors, beneficial to health and well-being (Contento IR Nutrition Education, 2008). Nutrition education is an effective technique to control diabetes. Several trials have shown that those people having more nutritional

knowledge with practice indicates effective outcome (Coppola *et al.,* 2015). To control diabetes, need to lifestyle change along with diet therapy. Lifestyle change may vary according to education (Brunton *et al.*, 2008).

2.3 Energy Deficiency

Energy deficiency is defined as negative energy balance and includes chronic energy deficiency which is characterized by decreased body mass index i.e., BMI of less than 18.5kg/m^2. Adult malnutrition is another name for this disorder. Present undernutrition among both sexes in the country is about 25% (WHO, 2011). Maternal undernutrition (body mass index <18.5 kg/m^2) in non-pregnant rural women in Bangladesh declined from 54% in 1996/97 to 38% in 2003, 34% in 2004 and 30% in 2007 (BDHS). Intrauterine and/or early childhood undernutrition is also linked with adult obesity or abdominal obesity and related adult diseases such as hypertension and diabetes (Godfrey and Barker, 2000; Popkin, 2001). Undernutrition at critical periods in intrauterine development causes permanent changes in the structure and/or function of the developing systems of the fetus (Lucas, 1991; Barker, 1998; Yajnik, 2004). This increases the susceptibility to disease in later life. The original hypothesis overlooked the classic association among maternal diabetes, fetal macrosomia and increased risk of diabetes for the offspring but new hypothesis allows for this (Hales and Barker 2001). However, the relationships among maternal nutrition, fetal nutrition, neonatal size and later diabetes appear to be more complicated than originally proposed (Harding,2001).

2.4 Energy Requirements and Reference Body Weight

Dietary energy requirements of a healthy, well-nourished population should allow for maintaining an adequate BMI at the population's usual level of energy expenditure. At the individual level, a normal range of 18.5 to 24.9 kg/m^2 BMI is generally accepted (WHO 1995, 2000). At population level, a median BMI of 21.0 was suggested by the joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases (WHO/FAO, 2003). Age, gender, height, weight and BMI are interlinked to the energy and nutrient requirements of individuals. Anthropometric standards for population groups differ from country to country. Since the population's height and weight vary from country to country, each must develop its own reference standards. The aim of recommending nutrient requirements is to assist in the creation of norms for achieving anthropometric reference standards. The World Health Organization (WHO)

and the Food and Agriculture Organization (FAO) have introduced reference criteria for developing countries. The 95th percentile values of weights and heights for given age/gender can be taken to be representative of well- nourished normal population and considered as standard reference values for India. For children below age 17, the reference body weight is fixed at the median of the range of weight-for-height given by the BMI reference tables (WHO, 2006 and 2007). The reference body weight for adults and children aged 10 and up is calculated using the fifth percentile of the BMI distribution (WHO, 1995 and 2007).

2.5 Overview of Diabetes

Diabetes mellitus is a metabolic disorder that occurred due to hyperglycemia resulting from defect in insulin secretion or insulin action or both due to genetic and/or environmental factors acting along. It is noticed as the body's incapability to effectively regulate the sugar balance which leads to acute and chronic complexity such as, diabetic ketoacidosis, hyperosmolar non-ketotic coma, hypoglycemia, hyperglycemia, obesity, , retinopathy, cardiopathy, neuropathy, nephropathy, osteoporosis and coma leading to death. Pancreatic dysfunction of cells causes disordered glucose homeostasis. Glucose is the only fuel that the neuronal tissue can use for energy under normal circumstances (Sokoloff, 1981). There are four types of diabetes. Type 1 diabetes (T1D) is a condition that arises the autoimmune destruction of β cell that produce insulin (Bluestone *et al.*, 2010). Type 1 diabetes is most often found in children and adolescents and/ or who are below 30 years of age with classifying symptoms (i.e., polydypsia, polyphagia, polyuria). Among those questions are related to the percentage of T1D cases that are diagnosed in adults whose estimates range from a low of 25% to as much as 50% (Thunandera *et al.*, 2008). Due to insulin resistance that is termed as non-Insulin dependent Diabetes Mellitus (NIDDM) or Type2 it has been estimated that 5%–15% of adults diagnosed with T2D may, in actuality, have T1D (Palmer *et al.*, 2005), Gestational diabetes mellitus (GDM) diagnosed in the second or third trimester of pregnancy, others types of diabetes due to hormonal disease, drugs, pancreatic disease (ADA, 2015).

In 1910, English physiologist Sir Edward Albert Sharpey suggested that the pancreas led to the discovery of insulin, a drug that is naturally developed in non-diabetics. Insula refers to the pancreas' insulin-producing islets of Langerhans, which are named

after the Latin term insula, which means "island.". Frederick Banting, MD, and his student assistant Charles Best, MD, collect insulin from the pancreases of dogs in 1921.In 1922 Fredrick Banting and his assistant Charles Best discovered insulin to save the lives of diabetics. Anteing and Macleod were awarded the 1923 Nobel Prize in Physiology or Medicine. Though the contributions of all four men have been recognized as important in the discovery of insulin (Banting *et al.*,1922).

Insulin is first commercially produced by Eli Lilly and Company. Manufacturers developed a number of slower-acting insulins in the decades after, the first of which was Novo Nordisk's protamine insulin, which was introduced in 1936. In 2013 FDA approves Invokana (Canagliflozin) is the first of a new class of medicines known as SGLT-2 inhibitors, and is used to treat high blood sugar in type 2 diabetes patients. SGLT-2 inhibitors block the activity of sodium glucose transport proteins in the kidney, reducing glucose re- uptake and increasing secretion of glucose in the urine (ADA, 2015).

2.6 Prevalence and incidence of diabetes

Bangladesh is a densely populated country in the Asian continent. Total 158.9 million people in Bangladesh (BBS, 2017). Epidemiological studies suggested that the incidence of diabetes is increasing worldwide. More than 85% of total diabetic population throughout the world belongs to type-2 diabetes mellitus. Recent estimates indicated that there were 171 million people in the world with diabetes in the year 2000 and this is projected to increase to 366 million by 2030.Type 2 diabetes mellitus has now become an epidemic form because of nature the disease. All type 1 diabetes mellitus can be diagnosed earlier in comparison to only 50% of type 2 diabetes. In 2007 the prevalence rate of diabetes in the world among people of 20-79 years of age was 5.9%. Prevalence of impaired glucose tolerance (IGT) in the world was about 7.5% in people of 20-79 years of age in 2007. In 2007, the prevalence of diabetes in Bangladesh people among 20-79 years of age was 4.8% that of IGT was 8.5% (WHO, 2006).

2.7 Anthropometric Measurement

Anthropometry is the measurement of physical dimensions and composition of the body (Onis *et al.,* 1996). This method can be used to detect the degree of malnutrition in an individual or population. To assess the presence or absence of malnutrition,

three measurements such as age, height and weight. These measurements are used to calculate the major anthropometric indicators of nutritional status namely; weight-for-age, weight-for-height and height-for-age. These indicators are then compared with those obtained from an international reference population (WHO, 2006). The use of height-for-age and weight-for-height as primary indicators of nutritional status in children was recommended by a joint board consisting of FAO, UNICEF and WHO (WHO, 2006).

2.8 Dietary Methods

Low dietary intakes, either due to a primary deficiency (low levels in the diet), a secondary deficiency (interference with ingestion, absorption, transport, utilization or excretion of nutrients), or inadequate food consumption, are a first indicator of malnutrition (Lohman *et al.,* 1988), Dietary assessment can be done in two ways-

A. By quantitative measurement of recalls or records of consumption at meal time over a one-day period.

B. By the use of dietary history and the food frequency questionnaire. These two methods obtain retrospective information on the patterns of food consumption during a longer and precisely defined time period.

2.9 Dietary Pattern in Bangladesh

In Bangladesh, cereals, mostly rice, are the staples of the diet. Bangladesh's traditional diet is unbalanced, with a high consumption of cereals dominating (Jahan *et al.,* 1998; BBS, 2005 and2010).

Table 2.1: Intake of major food items (g) per capita/day in Bangladeshi population, HIES

Food items, (gm)	1995-96	2000	2005	2010	
				Poor	Non-poor
Rice	464.3	458.54	439.64	406.19	420.52
Wheat	33.7	17.24	12.08	20.36	28.73
Potato	49.5	55.45	63.30	63.44	73.78
Vegetables	152.5	140.47	157.02	141.8	177.25
Edible oil	9.8	12.82	16.45	14.20	23.41
Chicken/Duck	4.0	4.50	6.85	4.11	15.09

Beef	6.6	8.30	7.78	1.55	9.27
Mutton	1.0	0.49	0.59	0.11	0.83
Fish	43.8	38.45	42.14	31.16	57.81
Eggs	3.22	5.27	5.15	3.40	9.02
Milk & milk Products	32.6	29.71	32.40	12.18	43.63
Onion	11.6	15.41	18.37	15.69	24.74
Sugar/Gur	9.20	6.85	8.08	3.32	10.88
Fruits	27.6	28.35	32.54	20.46	56.0
Food taken outside (fast food)	-	-	24.74	17.17	35.41
Miscellaneous	50.9	55.44	48.38	50.28	81.81

Household food consumption studies over the last 15 years have shown the consumption of cereal intake decreases but it still makes up the largest share (70 percent) of the diet, non-leafy fruits, roots, and tubers are next, accounting for more than four-fifths of the overall diet of rural people (BBS, 2010). Fish, poultry, eggs, milk, milk products, fats and oils, and other protein- and micronutrient-rich foods make up less than 10% of a rural person's diet, vegetable and fruit intake is steadily improving over time. Rural consumption of leafy and non-leafy vegetables has remained relatively constant over the last two decades. The average Bangladeshi consumes 212 grams of fruit and vegetables per day, with 31 grams of leafy vegetables, 136 grams of non-leafy vegetables, and 45 grams of fruit (HIES, 2010). This is even less than the FAO/WHO recommendation of 400 grams of vegetables and fruit in 2003. The fact that the HIES 2010 indicates a rise in vitamin A and iron intake is encouraging as compared to HIES 2005 (Bermudez *et al*., 2012), but it still needs improvements to fulfill the requirements. Furthermore, cultural traditions require that males have a better diet than female, receiving the largest meal portions. Persistent poverty, a lack of nutrition education, and gender inequality all contribute to widespread malnutrition among women especially pregnant and lactating mothers.

2.10 Previous studies on nutritional status of diabetic patients

In Anjuman *et al.* (2004) determined nutritional status of 117 diabetic patients aged 20-65 years. Most (64%) of the patients were normal in nutritional status followed by underweight (4.3%) and overweight (31%). 50.4% of the male patients were affected by diabetes as compared to 49.6% of the female patients. Middle age group was

appeared to suffer more diabetes than others age group. Diabetes range was shown more on the basis of occupation in retired persons (50%), housewives (32%) as compared to others profession. As a result, health education should strive to raise awareness among rural and illiterate people about the importance of visiting a nearby diabetic center on a regular basis and strictly following dietician's advice.

In Oladapo *et al.* (2014) study of a total 60 subjects were selected to determine nutritional status of the diabetic patients. A structured questionnaire was used to collect the information from the patients. The study revealed that 40% of the male and 60% of the female were in diabetes. Middle age (36.7%) group appeared to suffer more diabetes than others age groups. Diabetes rate were high both in employee and businessman. Leg ulcer was higher than other disease among the patients. 41.7% of the male and 38.9% of the female were normal nutritional status. Rate percentage of overweight and obese was higher as compared to underweight.

In Mohlakotsana-Mokhehle (2014), study of a total 124 subjects were conducted viva-voice to collect information of the diabetic patients. Most (82.9%) believed that overweight causes diabetes, yet based on BMI, 89.2% were overweight/obese; were at risk for diabetes-related complications. Almost all were knowledgeable about prudent dietary and lifestyle guidelines and the importance thereof for the management of diabetes.

In Sultana *et al.* (2013) a total 140 diabetic patients were randomly selected to collect information for the study. Majority (50.7%) of the middle age group was suffered from diabetes than all others group. 60.7% of the patients age were bellow five years. 57.1% of the patients were female and 42.9% of the patients were male. Majority (50.7%) of the housewives had diabetes.

In Amin *et al.* (2010) study of a total 90 patients were randomly selected for the study. Dietary intakes were collected by an interviewer administered 24-hour recall. For each case, average daily total energy and nutrient intakes, as well as food habits, were reported. Rate of diabetic patients were high in the middle age group. Most of the patients were consumed more carbohydrate rich food than protein and fat containing food. Fiber consumption was also very low. Overweight and obesity were high than normal bodyweight.

In Firouz *et al.* (2015) study, a total 104 diabetic patients were included. Majority of the respondents were middle group with diabetes. Most of the patients were overweight. Blood glucose level was high than the normal range. The respondents depended on drug as compared to diet to control diabetes.

In Wahom *et al.* (2016) a cross-sectional study was conducted to collect information of the 153 diabetic patients attending on a hospital. The respondents had low dietary awareness (69.3%) and a high prevalence of obesity (50.9%), according to the report. There is a statistically significant link between nutritional awareness and respondents' nutritional status. 47.7% of the employee were suffered from diabetes among all others occupations. The findings revealed a connection between nutritional awareness and the respondents' nutritional status. Analysis of Variance showed that those with a normal nutritional status had the highest nutritional knowledge score. Significant differences were also noted between the mean score of the different nutritional status groups.

CHAPTER III

MATERIALS AND METHODS

3.1 Study Region

The study was carried out at Chattogram district. Nearest hospital and diagnostic centers were selected for diabetes patient availability.

3.2 Subject Selection

The study was conducted between December 2020 to February 2021. In this study, three hundred and seven diabetic patient subjects aged from 20 to 69 years were selected randomly.

3.3 Study Design

By using raosoft sample size calculation method a certain number of population size is used. In terms of the numbers, the sample size n and margin of error E are given by

$$X = Z(^{c}/_{100})^{2} r(100-r)$$

$$N = {}^{N\,x}/_{((N-1)E^{2}+x)}$$

$$E = \mathrm{Sqrt}[{}^{(N-n)x}/_{n(N-1)}]$$

Where, N is the population size, r is the fraction of responses, and Z(c/100) is the critical value for the confidence level c. By using 5% error, 95% confidence level, 50% response distribution and 50000 population size. After the calculation, recommended sample size is 382.

Here is the limitation of collecting data from the outpatients as there was lack of cooperation from many of the patients as they think it is a waste of time or will not help them or make a change in their life. Despite these inherent limitations, data from this study can be used as a baseline for further research in this area. Due to COVID-19 pandemic situation targeted sample size could not be reach. Unwillingness of patient and some ethical issues also related with this.

A cross-sectional retrospective study design was employed in this study. The study population consisted of 307 people aged 20-69 years from selected Chattogram region, Bangladesh. Socio-demographic characteristic, medical history, Physical activity, Anthropometric and food habit data were collected from each study subjects.

3.4 Study Population

The study involved three hundred and seven respondents with diabetes aged from 20-69 years old diabetics attending the diabetic hospital in Chattogram District. Pregnant and lactating women were excluded from the study. All those who declined to participate were also excluded from the study.

3.5 Inclusion Criteria

The eligible diabetic patients living in Chattogram district were included in the study. Adult diabetic patients were selected. Diabetes patients living in Chattogram area were given preferences.

3.6 Exclusion Criteria

Diabetes patients who were not patients of Chattogram district were not included in the study population. Also, diabetes patients from the selected groups but not below the age of 20 years or above 69 years were not included in the study.

3.7 Study Tools

Study tools for this study are described below-

3.7.1 Structured Interview Questionnaire

The main tool was a structured questionnaire which was divided into different sections as per the objectives. A semi-structured questionnaire was used to gather information on socio- demographic characteristics of the respondents. Information collected included; name, sex, age, education, occupation marital status, monthly income. Medical history included: family history of diabetes, other disease apart from diabetes, duration of illness, blood glucose level, knowledge of diabetes, types of

treatments. Anthropometric assessment included: height, weight, BMI. Food habit pattern questionnaire also included.

3.8 Anthropometric Tools

3.8.1 Weight

Weight was measured with bathroom scale that was kept on a firm horizontal surface. Subjects were required to dress comfortably and weigh themselves to the nearest 0.5 kg.

3.8.2 Height

This was measured with tape to the nearest 0.01 cm. Subjects were instructed to stand with their backs against the wall, heels together, and eyes pointed forward when standing without shoes.

3.8.3 Body Mass Index

Nutritional status among the diabetic patients was classified based on the following classes as provided by WHO.

Category	BMI (kg/m^2)
Under weight	< 18.5
Normal	18.5-24.9
Overweight	25.0-29.9
Class I obesity	30.0-34.9
Class II obesity	35.0-39.9
Class III obesity	≥40

Source: WHO (1995, 2000 and 2004)

$$\text{BMI} = \frac{\text{Weight in Kg}}{\text{Height in sq. meter}}$$

Obesity was defined as anyone having BMI equal and above 25 kg/m^2 according to the recommended guidelines by WHO.

3.8.4 Ideal Body Weight

The IBW of the topic was determined using Jelliffe's formula (1996).

$$\text{IBW for men} = \frac{\text{Height in cm} \times 400}{1000}$$

$$\text{IBW for women} = \frac{\text{Height in cm} \times 350}{1000}$$

3.8.5 Blood Test

Fasting blood glucose was taken in the morning after an overnight fast 8-14 hours. Water was allowed, but smoking, tea, and any kind of foods or drinks were prohibited. No physical activity was allowed. Again, blood was collected from vein and in tube containing EDTA after consumption of 75 gm of glucose mixed with 250-300 ml of water within 5 minutes. Blood glucose were measured from the study subjects. Blood test was done at the respective laboratory of Hospitals.

3.9 Data Collection Procedure

3.9.1 Administration of the Questionnaire

Structured questionnaires were specifically administered to select diabetic patients through face-to-face interview.

Data that was collected in the questionnaires included; Socio-demographic data, socio-economic condition, Medical history, anthropometric data, and dietary intake. The completeness of the questionnaires was checked before releasing every patient.

3.9.2 Socio-demographic characteristic

In Socio-demographic characteristic included personal information, sex, ages between 20-69 years, marital status, educational qualification and occupation.

3.9.3 Medical history

In this section included family history of diabetes, other disease apart from diabetes, duration of illness, blood test, knowledge of diabetes, types of treatment.

3.9.4 Anthropometric Measurements

Anthropometric measurements i.e., height and weight together with the age and sex of the diabetes patients were collected. Height was obtained by positioning the measuring board in a vertical position. A barefooted person was asked to stand straight against the measuring board while looking straight ahead. With the help of the field assistant, the

heels were maintained together and the body positioned so that the shoulder blades, buttocks and heels were touching the vertical surface of the height meter. The feet were maintained flat on the floor although slightly apart with the back straight and the hands freely hanging on the sides. As he/she stood still, the horizontal headboard was placed lightly but firmly against the head perpendicular to the height meter. The height of each patient was then read to the nearest 0.l cm at the point where the headboard touched the height meter. Two measurements were taken for each patient and the average height computed as the actual height of his/her.

Weight was taken using a bathroom scale, which was calibrated in kilograms and grams. The patient was weighed with minimum clothing on and without shoes. Two readings were recorded to the nearest 0.1 kg and their average was taken as his/her actual weight.

3.9.5 Dietary pattern

Data on dietary consumption of study subjects was collected by using diet recall method. Food frequency questionnaire was used to obtain data on the types of foods eaten by the diabetes patients. Questionnaire was listed all the possible types of foods consumed by the diabetes patients. Each respondent was asked to give the frequencies at which he/she consumes the listed food. Each respondent was asked to recall in detail of all the food items and diet type were consumed during the last 24-hour period preceding the survey and then findings were recorded on an individual dietary diversity scoresheet.

3.10 Data Quality Control

Data quality control measures were employed during data collection as follows-

3.11 Standardization/Calibration of Instruments

The scale was calibrated before each weight was taken. Standardization tests were performed every morning prior to the field work with known weights to ensure that the scale used was accurate and reliable.

3.12 Accuracy of Anthropometric Measurements

Accuracy of the measurements was achieved through good training and supervision of the field assistants by the principal investigator. During height and weight measurement, two measures were taken on the same patient and the average of the two measures was taken as the actual measurement.

3.13 Minimizing Biases

In order to minimize bias and obtain complete and reliable information, the study respondents were informed about the purpose of the research. To avoid observer bias and assure validity of anthropometric measurements, two readings were taken.

The completed questionnaires were cross-checked for completeness of data, consistency of answers and measurements obtained and for the correct filling of the questions. Any errors identified were corrected. After data entry, data cleaning was done to ensure that data had been entered correctly in the computer.

3.14 Data processing and analysis

Data from the completed questionnaires and anthropometric measures were put, cleaned and analyzed using IBM SPSS/PC version 21 statistical software. Anthropometric data were converted into nutritional indices. Chi-square tests were employed to test for proportionality differences in the study distribution. Associations/correlations were also done for continuous variables.

CHAPTER IV
RESULTS

This section will discuss the findings of this study. The socio-demographic characteristics of the respondents are shown in the **Table 4.1.**

Table 4.1: Distribution of Socio-demographic characteristics of the respondents

Variables		Frequency	Percentage (%)
Sex	Male	112	36.5
	Female	195	63.5
Age (Years)	20-29	19	6.2
	30-39	60	19.5
	40-49	65	21.2
	50-59	98	31.9
	Above 60	65	21.2
Marital Status	Single	9	2.9
	Married	290	94.5
	Widow	6	2.0
	Divorce	2	0.7
Educational Qualification	Primary	63	20.5
	Secondary	85	27.7
	Higher Secondary	43	14.0
	Graduation	27	8.8
	Illiterate	89	29.0
Occupation	Employee	38	12.4
	Businessman	48	15.6
	Retired	30	9.8
	House Wife	151	49.2
	Farmer	13	4.2
	Others	27	8.8
Income	10000-14999	195	63.5
	15000-19999	51	16.6
	Above 20000	61	19.9

Among the study subjects 36.5% were male while 63.5 % were female. The majority of the married (94.5%) people were affected by diabetes. A total of 307 diabetic patients randomly divided into five age groups where 19 persons were in 20-29 years of age, 60 persons were in 30-39 years of age, 65 persons were in 40-49 years of age,

98 persons were in 50-59 years of age, 65 persons were in 60-69 years of age. This study also found that the 50-59 age group belonged to a higher number of diabetes patients. The rate of illiteracy was 29.0% higher than the rate of education level (14.0%). Most of the respondents (49.2%) were housewives while farmers were 4.2%.

The frequency of the physical activity level and nutritional status of the respondents were described in **Table 4.2**. Most of the respondents did not perform regular physical exercise.

Table 4.2: Physical activity and nutritional status of the respondent

Variables		Frequency	Percentage (%)
Physical Activity	High	17	5.5
	Moderate	172	56.0
	Light	110	35.8
	Sedentary	8	2.6
BMI	Underweight(<18.5)	8	2.6
	Normal (18.5-24.99)	129	42.0
	Overweight (25-29.9)	136	44.3
	Obesity (>30)	34	11.1

Continuous variables: High, Moderate, Light, Sedentary. BMI-Body mass index, unit: Kg/m^2

Lifestyle of the patient reveals that 38.4% (Both light and sedentary) have no regular physical activity. BMI also affects this factor where 44.3% of people were overweight and 11.1% were obese. Physical activity and nutritional status affect the diabetic disease.

Table 4.3 shows that the frequency of medical history of the respondents. The medical history of the respondents was representing that 25.4 % of the family members had diabetes while 74.6% of the family had no diabetes. The majority of patients (33.3%) found the onset of diabetes disease between 6 to 10 years. Hypertension (53.1%) problem was higher compared with another other disease apart from diabetes. Only 4.6% were taking diet therapy, 58.6% of the patients were dependent on the diet and drug therapy and 36.8% of patients were found insulin-dependent.

Table 4.3: Medical history of the respondents

Variables		Frequency	Percentage (%)
Family History of	Yes	78	25.4

Diabetes	No		229	74.6
Other Disease apart from diabetes	Hypertension	YES	163	53.1
		NO	144	46.9
	Kidney problem	YES	92	30.0
		NO	215	70.0
	Visual problem	YES	41	13.4
		NO	266	86.6
	Heart problem	YES	140	45.6
		NO	167	54.4
	Diabetic foot	YES	47	15.3
		NO	260	84.7
Duration of illness	< 1 Year		57	18.6
	1-5 Years		87	28.3
	6-10 Years		102	33.2
	Above 10 Years		61	19.9
Types of treatment	Only diet therapy		14	4.6
	Diet and drug therapy		180	58.6
	Insulin/Medicine only		113	36.8

The amount of blood glucose level e.g., fasting and after two hours of breakfast was described in **Table 4.4.** According to this blood glucose level, which was higher than normal range in both fasting and after two hours breakfast. The average blood glucose level during fasting was 188.57±82.971 mg/dl in males while 151.29±55.686 mg/dl in the female. Total 165.89 mg/dl in both males and females during fasting condition. Normal fasting blood glucose level is 80-120mg/dl. Higher blood glucose level represents the condition of diabetes is not controlled in both male and female patients.

Table 4.4: Blood Glucose level

Blood Glucose Level	Male Mean±SD	Female Mean±SD	Total Mean±SD	Normal
Fasting Glucose level (FBG)(mg/dl)	188.57±82.971	151.29±55.686	165.89±69.913	100-125
2hours postprandial blood glucose(2hppBG) (mg/dl)	284.26±94.573	221.85±78.219	245.67±89.9	140-200

Continuous variables: SD=Standard Deviation, glucose level-mg/dl, Normal fasting range 100-125mg/dl

The frequency of food habit patterns of diabetic patients described in **Table 4.5**. In this present study, only 38% were vegetarian and 35.5% were non-vegetarian and 52.1% were in the mixed category. Most of the respondents (45.6%) skipping their meals which were 45.6%, 24.8% were not taking snacks and 66.8% were taking fast food. Furthermore, 57.0% of people were using the nutrient supplement to fulfill their nutritional needs.

Table: 4.5 Food habit pattern and eating behavior of the diabetic patient

Variables		Frequency	Percentage (%)
Type of diet	Vegetarian	38	12.4
	Non-Vegetarian	109	35.5
	Mixed	160	52.1
Skipping Meals	Yes	140	45.6
	No	56	18.2
	Sometimes	111	36.2
Having snacks	Yes	135	44.0
	No	76	24.8
	Sometimes	96	31.2
Consuming fast food	Yes	205	66.8
	No	102	33.2
Using of nutrients supplement	Yes	175	57.0
	No	132	43.0

Associations of socio-demographic conditions with the nutritional status of the diabetic patient are shown in **table 4.6**. Male and female respondents included in the study were 36.5% and 63.5% respectively. The number of diabetic patients was increasing after the age of 40 years. There is a significant association (P=0.016) found in chi-square test with nutritional status and education. Lower education level increases the number of the overweight and obese patient. There is a significant association found between occupation and nutritional status of the diabetic patient. There is no significant relationship between the income of the respondents and their nutritional status.

Table 4.6: Association between nutritional status and Socio-demographic

Variable	Group by variable	BMI				Total	P-value
		<18.5 Underweight	18.5-24.99 Normal	25-29.9 Overweight	>30 Obese		
Gender	Male	2 (1.8%)	50 (44.6%)	52 (46.4%)	8 (7.1%)	112 (36.5%)	0.336
	Female	6 (3.1%)	79 (40.5%)	84 (43.1%)	26 (13.3%)	195 (63.5%)	
Age	20-29 years	1 (12.5%)	7 (5.4%)	7 (5.1%)	4 (11.8%)	19 (6.2%)	0.054
	30-39 Years	0 (0.0%)	25 (19.4%)	21 (15.4%)	14 (41.2%)	60 (19.5%)	
	40-49 years	2 (25.0%)	24 (18.6%)	35 (25.7%)	4 (11.8%)	65 (21.2%)	
	50-59 years	3 (37.5%)	47 (36.4%)	40 (29.4%)	8 (23.5%)	98 (31.9%)	
	Above 60 years	2 (25.0%)	26 (20.2%)	33 (24.3%)	4 (11.8%)	65 (21.2%)	
Education	Primary	3 (4.8%)	25 (39.7%)	30 (47.6%)	5 (7.9%)	63 (20.5%)	0.016
	Secondary	0 (0.0%)	38 (41.2%)	39 (43.8%)	8 (9.0%)	85 (27.7%)	
	Higher Secondary	3 (7.0%)	26 (60.5%)	9 (20.9%)	5 (11.6)	43 (14.0%)	
	Graduation	0 (0.0) %	6 (22.2%)	17 (63.0%)	4 (14.8%)	27 (8.8%)	
	Illiterate	4 (4.8%)	32 (36.3%)	41 (48.2%)	12 (14.1%)	89 (29.0%)	
Occupation	Employee	0 (0.0%)	12 (31.6%)	22 (57.9%)	4 (10.5%)	38 (12.4%)	0.011
	Businessmen	0 (0.0%)	29 (60.4%)	15 (31.3%)	4 (8.3%)	48 (15.6%)	
	Retired	1 (3.3%)	19 (63.3%)	10 (33.3%)	0 (0.0%)	30 (9.8%)	
	Housewife	6 (4.0%)	55 (36.4%)	66 (43.7%)	24 (15.9%)	151 (49.2%)	
	Farmers	0 (0.0%)	7 (53.8%)	6 (46.2%)	0 (0.0%)	13 (4.2%)	
	Others	1 (3.7%)	7 (25.9%)	17 (63.0%)	2 (7.4%)	27 (8.8%)	
Income	Low	7 (3.6%)	82 (42.1%)	86 (44.1%)	20 (10.7%)	195 (63.4%)	0.119
	Medium	1 (1.3%)	28 (21.4%)	18 (22.6%)	4 (5.6%)	51 (16.6%)	
	High	0 (0.0%)	19 (31.1%)	32 (52.5%)	10 (16.4%)	61 (19.9%)	

Significant association with variables was set p<0.005. BMI-Body mass index.

Table 4.7 shows the relationship between nutritional status and medical history. Significant relation was obtained between family history of a diabetes patient and nutritional status. Duration of diabetes disease and types of treatment were showing a significant relationship with nutritional status. Drug and diet therapy has a 61.8% obesity rate of the respondents. Hypertension (53.1%) problem was high compared with another disease apart from diabetes. 12.3% (20 respondents) of obesity found in the hypertension group.

Table 4.7: Association between nutritional status and medical history of the respondents

Variable	Group by variable	BMI					P-value
		<18.5 Underweight	18.5-24.99 Normal	25-29.9 Overweight	>30 Obese	Total	
Family history of diabetes	Yes	0 (0.0%)	24 (18.6%)	47 (34.6%)	7 (20.6%)	78 (25.4%)	0.006
	No	8 (100%)	105 (81.4%)	89 (65.4%)	27 (79.4%)	229 (74.6%)	
Duration of diabetes disease	<1 year	0 (0.0%)	16 (12.4%)	26 (19.1%)	15 (44.1%)	57 (18.6%)	<0.001
	1-5 years	0 (0.0%)	37 (28.7%)	49 (36.0%)	1 (2.9%)	87 (28.3%)	
	6-10 year	7 (87.5%)	54 (41.9%)	27 (19.9%)	14 (41.2%)	102 (33.2%)	
	Above 10 years	1 (12.5%)	22 (17.1%)	34 (25.0%)	4 (11.8%)	61 (19.9%)	
Types of treatment	Insulin/ Medicine	1 (12.5%)	61 (47.3%)	44 (32.4%)	7 (20.6%)	113 (36.8%)	<0.001
	Drug and Diet	7 (87.5%)	64 (49.6%)	88 (64.7%)	21 (61.8%)	180 (58.6%)	
	Only Diet	0 (0.0%)	4 (3.1%)	4 (2.9%)	6 (17.6%)	14 (4.6%)	
Hypertension	YES group	5 (3.1%)	70 (42.9%)	68 (41.7%)	20 (12.3%)	163 (53.1%)	0.723
Kidney problem	YES group	0 (21.4%)	39 (42.4%)	40 (43.5%)	13 (14.1%)	92 (30%)	0.207
Heart failure	YES group	0 (0.0 %)	57 (40.7%)	65 (46.4%)	18 (12.9%)	140 (45.6%)	0.050
Visual problem	YES group	1 (12.5%)	18 (14.0%)	20 (14.7%)	2 (5.9%)	41 (13.4%)	0.593
Diabetic foot	YES group	1 (12.5%)	23 (17.8%)	16 (11.8%)	7 (20.6%)	47 (15.3%)	0.435

Significant association with variables was set $p<0.05$. BMI-Body mass index

Association between nutritional status and physical activity described in following **table 4.8**. A significant relationship was obtained between physical activity and nutritional status. Light and sedentary category people were not involved in regular physical exercise.

Table 4.8 Association between nutritional status and Physical Activity

Variable	Group by variable	BMI					P-value
		<18.5 Underweight	18.5-24.99 Normal	25-29.9 Overweight	>30 Obese	Total	
Physical Activity	High	1 (5.9%)	12 (70.6%)	4 (23.5%)	0 (0%)	17 (5.5%)	0.014
	Moderate	4 (2.3%)	59 (34.3%)	89 (51.7%)	20 (11.6%)	172 (56.0%)	
	Light	3 (2.7%)	56 (50.9%)	37 (33.6%)	14 (12.7%)	110 (35.8%)	
	Sedentary	0 (0.0%)	2 (25.0%)	6 (75.0%)	0 (0.0%)	8 (2.6%)	

Significant association with variables was set p<0.05(Chi square test). BMI-Body mass index. Light and sedentary= irregular physical activity

The association between food habit pattern and nutritional status of diabetic patients is analyzed in **table 4.9**. There is no significant relationship with these variables. In this present study, only 38% were vegetarian and 35.5% were non-vegetarian and 52.1% were in the category. Most of the respondents (45.6 %.) skipping their meals, 24.8% were not taken snacks and 66.8% were taking fast food. The rate of intake of the nutrient supplement was 57.0% to fulfill their nutritional needs. Diabetic patients may take a small meal after a short interval in a day to control blood glucose levels. If the fasting time is so long, the patient may cause hypoglycemia.

Table 4.9: Association between nutritional status and Food habit pattern of diabetic patient

Variable	Group by variable	BMI					P-value
		<18.5Underweight	18.5-24.99 Normal	25-29.9 Overweight	>30 Obese	Total	
Type of Diet	Vegetarian	1 (12.5%)	14 (10.9%)	21 (15.4%)	2 (5.9%)	38 (12.4%)	

	Non-Vegetarian	6 (75%)	46 (35.7%)	49 (36.0%)	8 (23.5%)	109 (35.5%)	0.055
	Mixed	1 (12.5%)	69 (53.5%)	66 (48.5%)	24 (70.6)	160 (52.1%)	
Skipping meals	Yes	6 (75.0%)	63 (48.8%)	57 (41.9%)	14 (41.2%)	140 (45.5%)	0.053
	No	0 (0.0%)	21 (16.3%)	23 (16.9%)	12 (35.3%)	56 (18.2%)	
	Sometimes	2 (25.0%)	45 (34.9%)	56 (41.2%)	8 (23.5%)	111 (36.2%)	
Having snacks	Yes	3 (37.5%)	56 (43.4%)	58 (42.6%)	18 (20.6%)	135 (44.0%)	0.745
	No	1 (12.5%)	32 (24.8%)	34 (25.0%)	9 (26.5%)	76 (24.8%)	
	Sometimes	4 (50.0%)	41 (31.8%)	44 (32.4%)	7 (20.6%)	96 (31.3%)	
Consumption of fast food	Yes	5 (62.5%)	92 (71.3%)	92 (67.6%)	16 (47.1%)	205 (66.8%)	0.064
	No	3 (37.5%)	37 (28.7%)	44 (32.4%)	18 (52.9%)	92 (30%)	
Using of nutrient supplement	Yes	6 (75.0%)	68 (52.7%)	78 (57.4%)	23 (67.6%)	175 (57%)	0.307
	No	2 (25%)	61 (47.3%)	58 (42.6%)	11 (32.4%)	132 (43%)	

CHAPTER V

DISCUSSION

In this study, the number of diabetic patients were found to increase with age. In this study, most of the patients were 50-59 years of their age. WHO reported that the majority of people with diabetes were 41 years and above, which means that type 2 diabetes mostly occurred in the mid-year of life. According to WHO (2003), the majority of diabetes type 2 cases were above 45 years of age. This may be attributed to glucose intolerance associated with an increase in age. As age increases cell sensitivity to insulin also reduces. This insensitivity could be due to physical inactivity associated with advancing age. Similar results were obtained by other authors (Arora *et al.,* 2010). Diabetic Mellitus is an important health problem in Bangladesh due to the higher density of the population (Ibrahim *et al.,* 1962). It may occur either undernutrition or overnutrition. Diabetes may control or prevent by changing diet patterns (Anita *et al.,* 1992).

A majority of the respondents (94.5%) were married, this finding higher than that reported in their counterparts in Saudi Arabia (73.5%) (Anseri *et al.,*2019) and Lebanon (81.9%) (Naja *et al*., 2012), Sudan (60%) (Mohamed *et al.,* 2017).

The rate of illiteracy among the diabetic patients were 29.0%, the primary level was 20.5%, the secondary level was 27.7%, the higher secondary level was 14.0% and the graduation level were 8.8%. Establishing patient education can lead to better over this disease. This study shows a significant difference in nutritional knowledge associated with obesity which is the major risk factor for diabetes. Nutrition education is a pre-requisite aspect to control diabetes associated with other diseases (Habib *et al.,* 2016). There was a strong association between nutritional status and education level of the respondent where a significant p-value was found 0.016($p<0.05$). This could be attributed to the fact that when one is educated, they are exposed to diversified sources of dietary information which would impact positively on their nutritional knowledge and can choose healthy food and maintain optimal weight (Wahome and kiboi, 2016). A significant number of overweight and obese patients were found prior to education level which is the risk factor for diabetes. American Diabetes Association (ADA) has

also stressed the importance of patient's educations in the management and prevention of chronic complications of such a community health problem (ADA, 2013).

Occupation may lead to disease consequences for diabetic patients. The study shows that half of the respondents were housewives (49.2%). Employees 12.4%, businessmen 15.6% and farmers 4.2%. The increased rate of diabetes in females because most of the women lead a sedentary life and hence are more obese, engage in less strenuous activities as compared to the men. Found a significant relationship with nutritional status with their occupation. Similar findings have also been reported in other studies (Anseri et al., 2019); Mwann et al., 2018; Wahome and Kibi, 2016).

Diabetes is not a single disease but it can develop the risk of other diseases such as heart disease, kidney disease, stroke, visual problems; if diabetes was not controlled. In terms of complications of diabetes, there have many diseases observed in this study which is associated with diabetes such as hypertension (53.1%), kidney problem (30.0%), visual problem (15.0%), and diabetic foot (7.5%). It is observed that hypertension and kidney problem is higher than another disease. This study also confirms that onset of the duration of diabetes was found at 6-10 years and above category, which shows significant association with nutritional status.

A significant number of patients in this study took drug and diet therapy to control diabetes. Results of this study showed that 58.6% of patients took drug and diet therapy whereas 4.6% of patients took only diet therapy. Diet and drug therapy was the important treatment to maintain normal blood glucose level (Krause and Mahon, 1984). Diet and drug therapy are vital to ensure the successful outcome of diabetes management. The use of diet in the treatment of adult-onset diabetes and the combination of drugs and diet in the treatment of juvenile-onset diabetes has been recommended (Krause and Mahon, 1984). However, my findings are different from the finding of Oladapo *et al.,* 2013, they found out that about 60% of diabetics were in both drug and diet which was similar to our study. Other findings from this study were 25.4% of patients had a family history of diabetes.

According to the present study, the nutritional status of the respondent describes half of the respondents (44.3%) were overweight and 11.1% were obese. This could explain

the occurrence of diabetes since overweight and obesity have been linked to diabetes. Overweight and obesity is one of the predisposing factors to diabetes type-2. It results from poor feeding habits and lack of physical activity. Notably, one in three of the worlds´s adults are overweight and one in ten is obese (Wahome and Kibi, 2016).

In this study, females were more obese compared to males. The risk of diabetes increased with a higher BMI range and this study showed that female respondents were at risk condition. This could be managed by maintaining a proper nutritional balance that means intake of food according to requirements of the body (Anjuman *et al.,* 2004).

Lifestyle study of the patients shown that the respondents (Light 35.8% and sedentary 2.6%) had no regular activity pattern. This percentage is lower than that reported by Oladapo *et al.,* (2013) who found that 70% of the respondents did not exercise regularly, and also Firouzi *et al.*, (2015) found 59% of the subjects rarely or never exercise. Several studies have found a link between increased physical activity and better glycemic control (Zanetti et al.,2017, Aylin et al., 2009) In this study, Physical activity patterns were significantly associated with nutritional status (P-value 0.014). Obesity is one of the major factors of diabetes type 2. It results from a high intake of food and lack of physical activity. Notably, one in three of the world's adults are overweight and one in ten is obese (WHO, 2008). Overweight and obesity are associated with increased resistance of the cells to insulin activity (WHO, 2002).

According to the blood glucose level of the respondents, the majority were above normal blood glucose level both fasting and after two hours of breakfast. This could explain the lower glycemic control and occurrence of diabetes since the intake of food more than their requirements and lack of physical activity have been linked to diabetes. Blood glucose level was measured two times, before breakfast and after two hours of breakfast. The average fasting blood glucose level of males and females were 188.57±82.971 mg/dl and 151.29±55.686 mg/dl respectively which was above the normal range. Average blood glucose level after two hours of breakfast 284.26±94.573 mg/dl and 221.85±78.219 mg/dl respectively which was also above the normal range. This result indicates the respondent took much amount of food than the requirement of their body and also, they did not do regular physical exercise. Blood glucose may control by taking an accurate amount of food and regular physical exercise.

The nutritional needs of the respondents are met when they follow a traditional vegetarian or non-vegetarian dietary pattern. The study shows only 12.4% vegetarian, 35.5% non-vegetarian and 52.1% were of mixed diet types.

Food habits might change during maturation; we found higher meal skipping and breakfast skipping among respondents. Among meal skippers, 45.6% of respondents were skipping breakfast more than once a week.

A Swedish study found a negative age trend in breakfast eating, which is a similar trend (Berg-Kelly, 1995). Breakfast consumption has been linked to lower blood cholesterol and body weight (Ruxtonand Kirk, 1997).

non-staple foods such as beef, eggs, dhal (lentils), fruits, and leafy vegetables were not widely consumed. Subjects were deprived of significant sources of animal protein, calcium, and vitamin A, as can be observed. Other Bangladeshi studies have shown a similar trend (Ahmed et al., 1998; Alam et al., 2010).

This present study described that 44.0% of respondents having snacks were significantly higher. A higher prevalence of snacking among respondents might be linked to increased energy intake. Snacking, which is generally described as eating at times other than main meals (breakfast, lunch, dinner/supper), has long been thought to contribute to obesity (Berteus, 2005; Piernas,2010).

Obese people have been shown to have a significantly higher energy intake (Berteus H, 2005). In the present study, 66.8% of subjects consumed fast foods daily or frequently and a higher proportion of students in high socio-economic status had fast foods, more frequent. There were 57.0% of respondents were taking a nutrient supplement to fulfill their nutritional needs. They may intake it from natural food sources.

CHAPTER VI

CONCLUSION

The outcome of this study describes those respondents were mostly overweight and obese with having abdominal obesity. Besides, hypertension and kidney problem were also prevalent among subjects of this study. Poor glycemic control was observed among diabetic patients and contributed to a lack of appropriate levels of physical activity, and a higher number of medications. One potential explanation is that people's energy expenditure has decreased dramatically as the Bangladeshi labor force has moved away from agriculture toward manufacturing services and industry. Obesity and insulin resistance are elevated as a result of the combination of increased energy consumption and decreased energy production induced by sedentary lifestyles, which raises the risk of pre-diabetes. Those patients who had a higher level of education resulting in better nutritional status and glycemic control. The food habit pattern of the respondents was not satisfying, mostly were meal skippers, consuming fast food and snacks. Diabetes patients may take an appropriate amount of carbohydrate, protein, fat and perform a regular exercise at a definite time. Since diabetes is becoming more common in Bangladesh, the government should develop diabetes control programs throughout the country. To reduce the rate of diabetes in Bangladesh, policy action is urgently needed. Bangladeshis should also maintain their conventional and more active lifestyles, which should include more physical activity and nutritious food. Further evaluation is needed to determine the contribution of factors affecting glycemic control among larger population.

CHAPTER VII

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APPENDIX I
Questionnaire of The Study

Research Title: Nutritional Status and Food Habit Pattern of Diabetic patient in Chattogram District, Bangladesh

Date:……. Questionnaire No:…….

A. SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THERESPONDENT

i. Name:…… Contact No.....

ii. Sex ☐Male ☐Female

iii. Age (Years)

☐20-29 ☐30-39 ☐40-49

☐50-59 ☐60 and above

iv. Marital status

☐Single ☐Married ☐Widow ☐Divorce

v. Educational qualification

☐Primary ☐Secondary ☐

Higher secondary ☐Graduation ☐Others

vi. Occupation

☐ Employee ☐ Businessman ☐ Retired

☐ House wife ☐ Farmer ☐ Others

vii. Income

☐10000-14999 ☐15000-19999

☐Above 20000

B. MEDICAL HISTORY

i. Family history of diabetes

☐Yes:……..… ☐No

ii. Other diseases apart from diabetes

☐ Hypertension ☐ Heart failure ☐ Kidney problem

☐ Leg ulcer ☐ Diabetic foot ☐ Visual problem

iii. Duration of illness

☐ < 1Years ☐ 1-5Years

☐ 6-10 Years ☐ Above 10Years

iv. Regular blood glucose check-up

☐ Yes ..... ☐ No

☐ Where? ☐ Home ☐ Shop ☐ Healthcare

v. Blood glucose level

☐ Fasting……. ☐
ABF…….

vi. First knowledge of diabetes

☐ Before coming to clinic ☐ During routine medical check-up ☐ Study ☐ During treatment of a disease

vii. Types of treatment

☐ Drug and diet Therapy ☐ Drug only: Insulin/Medicine ☐ Only diet therapy

C. REGULAR PHYSICAL ACTIVITY

i. Physical activity level

☐ High ☐ Moderate

☐ Light ☐ Sedentary

ii. Do you exercise regularly?

☐ Yes……min/Day ☐ No

D. ANTHROPOMETRICASSESSMENT

☐Height……cm ☐Weight….Kg

☐BMI……

E. NUTRITIONAL KNOWLEDGEAND FOOD HABIT PATTERN TEST

1. What is Diabetes?
2. Why Diabetes is occurred?
3. Which foods are helpful in controlling Diabetes? Type of diet(Veg/non-veg/mixed)
4. Which foods are harmful for Diabetic patients? Do you take fast food?(Yes/NO)
5. How many meals should be consumed in a day? Do you skip meal?(Yes/No/Sometimes)
6. What should be interval time between two meals? Having snacks? (Yes/No/Sometimes)
7. Which diseases are connected to Diabetes?
8. How much exercise should be done in a day? Do you take nutrient supplement? (Yes/No)
9. Which is the amount of normal blood glucose level?
10. Is diabetes a contagious disease?

…….

Signature of the respondent

APPENDIX II

Data Collection

Anthropometric assessment

DM Patient Insulin Sample

Data collection from diabetic patient

Collecting data from different Hispitals

APPENDIX III

Data Analysis

Rahim.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help

	Name	Type	Width	Decimals	Label	Values	Missing	Columns	Align	Measure	Role
1	Name_ID	String	8	0		None	None	8	Left	Nominal	Input
2	Gender	Numeric	2	0		{1, Male}...	None	8	Right	Scale	Input
3	Age	Numeric	8	0		{1, 20-29}...	None	8	Right	Scale	Input
4	Education	Numeric	7	0		{1, Primary}...	None	8	Right	Scale	Input
5	marrital	Numeric	8	0		{1, Single}...	None	8	Right	Scale	Input
6	Occupation	Numeric	8	0		{1, Employe...	None	8	Right	Scale	Input
7	Income	Numeric	8	0		{1, Low}...	None	8	Right	Scale	Input
8	familyhistory	Numeric	8	0		{1, yes}...	None	8	Right	Scale	Input
9	Duration	Numeric	8	0		{1, <1 year}...	None	8	Right	Scale	Input
10	treatment	Numeric	8	0		{1, Insulin/M...	None	8	Right	Scale	Input
11	Activity	Numeric	8	0		{1, High}...	None	8	Right	Scale	Input
12	Status	Numeric	8	0		{1, Underwe...	None	8	Right	Scale	Input
13	HTN	Numeric	8	0		{1, YES}...	None	8	Right	Scale	Input
14	Heart	Numeric	8	0		{1, NO}...	None	8	Right	Scale	Input
15	Kidney	Numeric	8	0		{2, NO}...	None	8	Right	Scale	Input
16	Fasting	Numeric	8	0		None	None	8	Right	Scale	Input
17	ABF	Numeric	8	0		None	None	8	Right	Scale	Input
18	Random	Numeric	8	0		None	None	8	Right	Scale	Input
19	Calorie	Numeric	8	0		None	None	8	Right	Scale	Input
20	Height	Numeric	8	0		None	None	8	Right	Scale	Input
21	Weight	Numeric	8	0		None	None	8	Right	Scale	Input
22	BMI	Numeric	8	0		None	None	8	Right	Scale	Input
23	Visual	Numeric	8	0		{1, No}...	None	8	Right	Scale	Input
24	Foot	Numeric	8	0		{1, No}...	None	8	Right	Scale	Input

Data View | Variable View

IBM SPSS Statistics Processor i

				Age					Medical History												Physical A
2	Name	ID	Gender	Age Group	Marital status	E. Qualification	Occupation	Income	Family history of diabetes	HTN	Heart	kidney	Visual problem	Diabetic foot	Duration of illness	Random	Blood glucose level-Fasting	Blood glucose level-after 2h	Types of treatment	High, moderate, sedentary, light
3	Lutfur Nahar(S)	1	2	4	2	1	4	1	1	2	1	2	1	1	1	149			1	4
4	Shahida Akter (S)	2	2	2	2	3	4	1	1	1	1	2	1	1	2		108	122	2	2
5	Md. Selim	3	1	3	2	3	2	3	2	1	1	2	1	1	3		108	129.6	2	3
6	Siraz Khatun	4	2	4	2	1	4	1	2	2	1	3	1	1	1		122.4	235.8	2	3
7	Sayed Ahmad	5	1	5	2	2	6	1	2	2	1	2	1	1	3		126	272	1	3
8	Anisa Begum	6	2	4	2	3	4	1	1	2	1	2	1	1	4	156			2	2
9	Emran Hossain	7	1	3	2	2	6	2	2	1	1	3	4	6	3		177	204	2	2
10	NUR JAHAN	8	2	5	2	1	4	1	2	1	1	2	1	1	4			119	2	2
11	Abdur Razzak	9	1	3	2	2	2	3	2	2	1	2	1	1	4		331	460	1	4
12	Nargis Akhter	10	2	2	2	2	4	1	1	1	2	2	1	1	3		145	202	2	2
13	Emranul Haque	11	1	2	2	4	1	3	2	2	1	2	1	1	3			332	3	2
14	Arju Ara Begum	12	2	2	2	5	4	1	1	2	1	2	1	1	3		140	205	3	2
15	Achia Begum	13	2	4	2	5	4	1	2	1	1	2	1	6	4	182			1	2
16	Hosne Ara Begum	14	2	4	2	5	4	1	2	2	1	2	1	1	2			97	2	2
17	Masud PRVEZ	15	1	2	2	3	2	3	2	2	1	2	1	1	2		130	205	2	1
18	Saiful Alam	16	1	2	2	5	6	3	2	2	2	2	1	1	1		111	129	2	3
19	Tayeba Begum	17	2	3	2	2	4	1	1	2	2	2	1	6	3		210	261	2	3

Sheet1 Sheet3 Sheet2

Brief Biography

Mohammad Abdur Rahim passed with GPA 5.00 in Secondary School Certificate Examination 2010 and Higher Secondary School Certificate Examination with GPA 4.70 in science group. He received the B. Sc (Hon's) in Food Science and Technology degree from the faculty of Food Science and Technology of Chattogram Veterinary and Animal Sciences University in 2016. Now he is a candidate of MS in Applied Human Nutrition and Dietetics under the department of Applied Food Science and Nutrition, Faculty of Food science and Technology, CVASU. He has boundless interest in exploration on the nutritional epidemiology and public health research in his area to improve nutritional status of malnourished people in rural area of Bangladesh.