

A Review of Prevalence, Complications, Risk
factors, Knowledge assessment, Self-
management, Consciousness and Treatment of
Diabetes Mellitus in Bangladesh

A project submitted

By

Wasifuzzaman Chowdhury

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This work is dedicated to my parents and siblings for their continuous love and support

Certification Statement

This is to certify that, this project titled ‘Prevalence, complications, risk factors, knowledge assessment, self-management, consciousness and treatment of diabetes mellitus: A brief review of rural, urban and ethnic community of Bangladesh’ is submitted for the partial fulfillment of the requirements for the degree of Bachelor of Pharmacy from the Department of Pharmacy, BRAC UNIVERSITY constitutes my own work under the supervision of Md. Samiul Alam Rajib, Senior Lecturer, Department of Pharmacy, BRAC UNIVERSITY and that appropriate credit has been provided where I have used the language, ideas or writings of another.

Signed,

Countersigned by the Supervisor

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Abstract

Diabetes is a non-communicable disease which is considered as a universal major health concern which is related with enhanced rate of mortality and morbidity as well as its care and treatment impose economic burden on the populations. Therefore, assessing and analyzing the extent of diabetes related knowledge among the populations, the extent to which they are being treated as well as controlling their disease condition may reveal new dimensions to decrease the mortality and morbidity rate associated with diabetes, decline diabetes related complications and household economic burden. The aim of the review article is to accumulate the existing information and evidences regarding the prevalence, risk factors, knowledge assessment, awareness, treatment and self-management scenario of diabetes mellitus in Bangladesh as well as analyze these conditions in order to guide prevention strategies in the future. Methodology of this review article was research articles and literature review from various authentic sources of journals. International Diabetes Federation specifies that the number of diabetic patients in Bangladesh is 7.1 million which is second largest in South Asian region. A rapid increasing rate of diabetic patients has been observed in Bangladesh for the previous 2 decades where the presence of non-insulin dependent diabetes mellitus patients in 1995, 2000 and 2010 were 3.8%, 5.3% and 9.0% respectively. The occurrence of diabetes among the ethnic people is higher in contrast to the non-ethnic people living in Bangladesh. In general, 16% of the diabetic patients has good knowledge, sixty six percent has average knowledge and 18% of the patients has poor basic knowledge regarding diabetes mellitus in Bangladesh. The KAP (knowledge, attitude and practice) score of diabetes were superior amongst the participants who have diabetes in comparison to the nondiabetic participants. The awareness among patients, treatment receivers and those who controlled their condition were 41.2%, 36.7% and 14.2% respectively. Furthermore, people with lack of education, poverty-stricken persons and individuals from impecunious localities were observed to have lack of diagnosis, knowledge, self-management and treatment of diabetes in contrast to the educated, high socio-economic status persons. Contradictorily, number of diabetes sufferer were higher in the urban areas than the rural areas. Several risk factors of diabetes mellitus includes smoking-59.9%, abdominal obesity-43.3%, hypertension-14.3%, depression-43% whereas the incidence of routine bodily exercise (only 1.3%) and the habit of consuming seasonal fruits as well as veggie (8.6%) remain significantly low among the people of Bangladesh. Earlier age onset of diabetes have been observed among

the participants in 2005 compared to participants of 1995 along with notable increase in body mass index indicating that people are getting affected by diabetes mellitus at an early age due to obesity which is a strong influential factor for the onset of diabetes mellitus. There was decreased occurrence in the development of diabetes among patients with IGT (impaired glucose tolerance) who controlled their diet and took regular physical exercise compared to the ones who didn't bring any type of lifestyle modifications. Several blood glucose lowering agents used as remedy for diabetic sufferers in Bangladesh include metformin-46.9%, insulin-40.8%, sulfonylurea-38.7% and anti-hypertensive drugs-38.7% etc. Several anti-diabetic medicinal plants for example *Coccinia indica*, *Mamordica Charantia*, *Trigonella foenum graceum*, *Azardica indica*, *Ficus racemose* and *Terminalia chebula* etc. are also used for the treatment of diabetes. Use of information technology by the government of Bangladesh by sending awareness messages related to diabetes through the cellphones also resulted in positive influence in the treatment of hyperglycemia. Moreover, launching of new oral hypoglycemic drugs Dapazin (Dipagliflozin) and launching of new generation insulin 'Tresiba' in Bangladesh has opened new dimensions as these medicines can play significant role to control and cure diabetes. The review article also picturized a comparative context of prevalence, knowledge assessment, treatment, self-management and control of diabetes mellitus among Bangladesh and other South Asian or South-East Asian countries. Although is now regarded as a major worrying matter for the well-being of individuals the treatment as well as control of diabetes mellitus remain significantly low in Bangladesh. More researches should be conducted by focusing at the root causes, environmental risk factors (arsenic contaminated water, air pollution) etc. on the occurrence of diabetes mellitus, pharmacovigilance data and survey of anti-diabetic drugs as well as the prognosis of diabetes.

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List of Abbreviations

BMI-	Body Mass Index
IGT	Impaired Glucose Tolerance
IFG	Impaired Fasting Glycaemia
NIDDM	Noninsulin Dependent Diabetes Mellitus
IDF	International Diabetes Federation
WHO	World Health Organization
GDM	Gestational Diabetes Mellitus

Chapter One: Introduction

1.1 Background

Diabetes mellitus is an extreme rapid growing chronic metabolic ailment defined by increased blood glucose level as a result of complete or partial inadequacy of insulin (Shrivastava, Shrivastava, & Ramasamy, 2013). World Health Organization (1994), recognized diabetes mellitus as a prime global health concern. Diabetes mellitus is related with enhanced rate of mortality and morbidity as well as its care and treatment impose economic burden on the people throughout the world especially on the citizens of developing and underdeveloped countries (King, Aubert, & Herman, 1998).

The number of diabetic patients in the world is 382 million and this chronic disease caused death of 5.3 million people in 2013 (International Diabetes Federation, 2013). Majority of the adult patients (80%) who have diabetes live in the underdeveloped and developing countries (IDF, 2013). Diabetes was found among the people of high economic status previously but at present it has been considered as an widespread disease in the middle and low income countries (Guariguata et al., 2014).

In Southeast Asia there are 72.1 million or 8.2% adult diabetic sufferers which may rise as high as 123 million in 2035 as a result of increased urbanization as well as lifestyle modification. More than 50% people having diabetes mellitus is unaware about their condition and the prevalence of pre-diabetes is 24.3 million which may rise to 38.8 million in the Southeast Asian regions (International Diabetes Federation, 2013).

The overall population of Bangladesh is 160 million (IDF, 2011). IDF (2011) concluded that Bangladesh is the residence of 7.1 million diabetic individuals which is second largest in South Asian region. It is projected to double by the year of 2025 (International Diabetes Federation, 2011). The total health care expenses by the government was 3.4% of total GDP and average annual health care expenses per person was only US\$ 15 in 2008 (Dhillon et al., 2012). In Bangladesh the prevalence and rapid increasing rate of diabetic patients is anticipated to have disastrous socio-economic effects on the healthcare systems of Bangladesh (Shariful Islam et al., 2017). The occurrence of diabetes mellitus results in several complications which may be life threatening for example nephropathy, heart attack, damage of the peripheral nerves etc. Various studies revealed that visual impairment, heart diseases, nephropathy are depression are the major diabetes related complications in Bangladesh (S. M. ohamme. S. Islam, Rawal, & Niessen, 2015; S. M. S. Islam, Alam, et al., 2015; S. M. S. Islam, Ferrari, Seissler, Niessen, & Lechner, 2015).

Besides the increasing prevalence, the earlier onset of diabetes is also observed in Bangladesh where the mean age of diagnosis of diabetes mellitus was notably lower in 2005 in comparison to 1995 (Khanam, Mahtab, Ahmed, Sayeed & Khan, 2008). Not only the medicinal drugs, but also the diabetic knowledge and education are equally important in order to control and manage diabetes mellitus properly (Dussa, Parimalakrishnan, & Sahay, 2015). Proper cognizance and instructions of diabetes can assist the individuals to determine the threat factors of developing diabetes mellitus, instigates the individuals to receive treatment properly as well as encourages to adopt preventive measures against their diseases in their whole life (Moodley & Rambiritch, 2007). Contradictorily, deficiency of proper understanding and education results in the occurrence of several diabetes related complications which enhances the health care expenses (S. M. S. Islam, Niessen, Seissler, et al., 2015). It is a matter of concern that the level of knowledge and education regarding the etiology, management, complications and risk factors of diabetes mellitus are significantly low among the people of Bangladesh, especially among the rural people and ethnic minorities (S. M. S. Islam, Niessen, Seissler, et al., 2015; Sayeed et al., 2004). Although people living in the rural area have less prevalence of diabetes mellitus compared to the urban people with high social and economic status, the care as well as control of diabetes mellitus remain tragically low among the people with lack of education and lower economic status residing in the disadvantaged regions of Bangladesh (M. S. Rahman et al., 2015). Self-management of diabetes comprises an extensive variety of events for example self-measurement of plasma glucose level, dietary modification, regular physical activities etc. (Glasgow & Eakin, 1998; Orme & Binik, 1989; Rubin & Peyrot, 1992). These precautionary practices have been observed to be related with better regulation of blood glucose level, decrease of complications as well as betterment of life quality. Individual patient have been found to provide a significant influence on the progress of disease by engaging themselves in self-care practices (Shrivastava et al., 2013). A significant part of the daily diabetic care is directed by the patients (Etzwiler, 1994). It is very important to measure and determine the status self-care practices among the diabetic patients (Goodall & Halford, 1991; Johnson, 1994; McNabb, 1997). Such assessment are very much important for the health care professionals and educators in order to treat individual patients as well as for the researchers in order to evaluate new strategies of treatment (Toobert, Hampson, & Glasgow, 2000). Very few diabetic patients in Bangladesh have satisfactory health care practices which means very few proportion of the diabetic patients perform regular physical

exercise, measure their blood glucose level and maintain recommended dietary habit (Fatema et al., 2017). Besides having proper knowledge and awareness, continuous medical care is required to control this chronic disease (American Diabetes Association, 2014). In order to control diabetes at a regular basis, patients must take the anti-diabetic medicines (insulin or pills) as prescribed or recommended (Dowshen, 2016). Tragically diabetes care and treatment remain significantly low in Bangladesh in spite of increasing its prevalence. Although a significant portion of diabetic patients with high education and high socio-economic status receive treatment, majority of the patients with less education and poor socio-economic status remain untreated due to lack of knowledge and consciousness as well as inability to bear the expenses on health care purposes (M. S. Rahman et al., 2015).

1.2 Rationale of the study

If the motto of a study is to govern the upcoming hindrance approaches of the disease, then the primary footstep is to address the current facts. Therefore, it is essential to gather information linked with diabetic impediments as well as analyzing the most significant risk factors, gathering and compiling evidences regarding the status and range of diabetes knowledge, awareness, personal carefulness practices and treatment facilities amongst patients of various socio-economic classes and education level along with the regional varieties consisting of urban, rural and ethnic minorities people in Bangladesh in order to grab the attention of health care professionals as well as government health service officers to take necessary steps and implement those strategies with a view to reduce the concerned increasing rate of diabetes mellitus, its complications, mortality, morbidity and ensure a healthy life for the mass people of Bangladesh.

1.3 Aim of the study

The purpose of the evaluation paper is to accumulate the existing data and evidences on the prevalence, risk factors, complications, knowledge level, self-management and treatment of diabetes mellitus among the rural people, city dwellers and ethnic minorities of Bangladesh to guide the future prevention policies and recommend the direction of future research strategies and efforts.

1.4 Objectives of the study

There are several objectives of this review paper. These are given below:

- a. To accumulate the current data regarding the prevalence and most significantly existing risk factors of diabetes in Bangladesh.
- b. To compare and contrast the context of knowledge assessment, self-management and treatment of diabetes mellitus among the rural people, city dwellers and ethnic minorities of Bangladesh.
- c. To identify and address the information and evidence regarding the most dominant factors and reasons behind poor knowledge of diabetes, miserable self-management issues, improper and insufficient treatment facilities for grabbing the attention of the health care professionals and government health care leaders.
- d. To find out the strengths and limitations of the research articles and reviewed studies.
- e. To guide the strategy of future research
- f. To gather the information of the most recently launched new generation anti-diabetic drugs in Bangladesh.
- g. To notify the possible alternatives of insulin.

Chapter Two: Prevalence of diabetes mellitus

2.1 Current diabetes status in Bangladesh

According to WHO (2015), among all the non-communicable diseases, diabetes mellitus is an extremely fast expanding diseases which acts as a global threat to the well-being of individuals and the onset of diabetes mellitus is escalating at a shocking rate in the emerging states because a significant number of people are moving from the rural areas to the urban areas and being accustomed to sedentary lifestyle (WHO, 2015).

In 2007, UN(United Nations) affirmed that this disease is a prime health concern of the people around the world (Wild, Roglic, Green, Sicree, & King, 2004).Earlier it was not judged as a serious health issue in the developing states.But the condition has now changed completely where as in the year of 2012, IDF argued that 3800000 people or 4.8% of the total population of Bangladesh are suffering from diabetes mellitus. It is predicted that by the year of 2025 the number may rise to 6.1% or 7.8 million. By the year of 2025, this situation will turn Bangladesh from 10th to 7thposition amongst the states which are ranked as top ten in term of total number of population who have diabetes and 80% of all the patients having diabetes will prevail in low class or middle class families who have miserable diabetic knowledge (Gauriguata et al., 2014). Bangladesh is ranked second in South Asia in terms of total number of adults having diabetes mellitus which is near about 5.1 million adults or 6.1%. (International Diabetes Federation [IDF], 2013).

2.2 Pre-dominance of diabetic patients in South Asia

About one fourth of the total population of the world live in South Asia region having diverse ethnicity, belief and language. Bangladesh, Sri Lanka, India, Pakistan, Maldives, Bhutan and Nepal are the south Asian countries where there is higher pervasiveness of non-insulin dependent diabetes (Mather & Keen, 1985). A huge number of immigrants from the South Asian vicinity are residing in prosperous international locations. Thus, sickness which include severity of non-insulin dependent diabetes distressing the indigenous South Asian individuals could have devastating consequences on worldwide health status (Jayawardena et al., 2012).Diabetes has grown to be a vital health problem within the South Asian people with an anticipated boom of more than 151% among year 2000 and 2030 (Wild et al., 2004).South Asians living in the

western countries are at an extended chance of evolving diabetes in contrast to further indigenous individuals (Mather and keen, 1985). Inside the United Kingdom, the chance of diabetes is 5 instances greater for settlers from Bangladesh and Pakistan and 3 instances higher for immigrants from Indian, with an extended danger of morbidity and mortality in contrast to the local white population (Eren, Primatesta and Prior, 2001). Besides, South Asian suffering from this disease are of less aged and overweight in contrast to the local white Caucasians (Eren, Primatesta and Prior, 2001). The decline in glycemic management over time became tons more speedy amongst South Asians whilst in comparison to Europeans (Mukhopadhyay, Forouhi, Fisher, Kesson, & Sattar, 2006). Subsequently, it's far specious that this disease amongst South Asians provide a vast healthiness distress with distinct threat issues (Jayawardena et al., 2012).

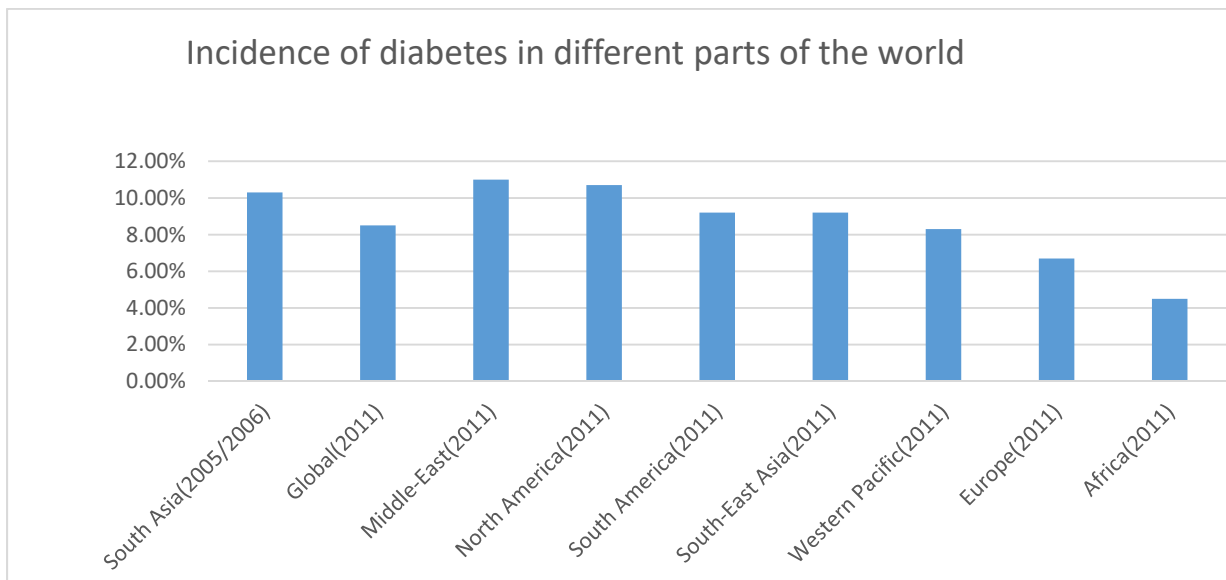


Figure 2.1: Diabetes mellitus in various regions of the earth (International Diabetes Federation, 2011).

South Asian people have suffered from lack of vitamins for a long time and they are born shorter as well as the prevalence of obesity plays an influential threat features for the onset of diabetes in their later life (Yajnik, 2004). A current review has stated numerous nutritional issues related with resistance of insulin among South Asians, consisting of much intake of carbohydrate,

saturated fatty acids, trans-fatty acids and n-6 PUFA, and lower intakes of n-3 PUFA and fiber, so Asian dietary habit can be regarded as significant risk factor resulting in excessive sickness incidence (Misra, Khurana, Isharwal, & Bhardwaj, 2009). Unhealthy lifestyle modification related with urbanization for example physical inactivity, modification in food habit etc. which rise the danger of diabetes have been demonstrated by the affiliation proven in many South Asian studies (Jayawardena et al., 2012).

2.3 Growth rate of diabetes in Bangladesh

In 2008, Khanam, Mahtab, Ahmed, Sayeed and Khan conducted a comparative study regarding the biophysical feature of BIRDEM registered diabetic patients in 1995 and patients who registered in 2005. In comparison subjects who registered in 1995, a vast escalation of archive of lady patients had been determined (39.5% female patients in 1995 vs 46.7% female patients in 2005) and patient's registry from rural area has also increased significantly (31.9% registry in 1995 vs 47.4% registry in 2005). The registry of young people (less than 40 years old) also increased significantly in 2005 which indicates earlier onset of diabetes in Bangladesh (34.4% in 1995 vs 37.1 % in 2005). Compared to the diabetic subjects of 1995, the ones of 2005 showed a drastically high level of BMI (body mass index). A considerably decreased blood pressure, decreased height and lower age have been noticed in the patients of 2005.

The pervasiveness of non-insulin dependent diabetes in Bangladesh in 2000, 2005 and 2010 were 3.8%, 5.3% and 9.0% respectively (Khanam et al., 2008).

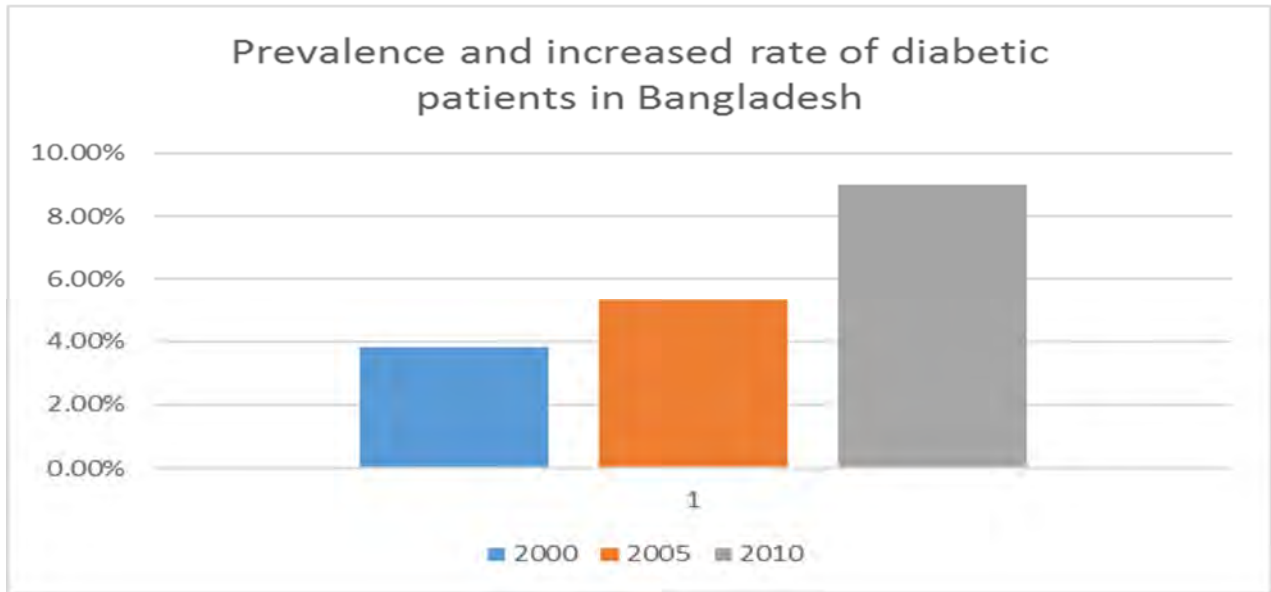


Figure 2.2: Growth rate of diabetes mellitus in Bangladesh (Khanam et al., 2008).

The occurrence of this disease in Bangladesh is growing at an upsetting rate along with the increase of significant threat issues for its progress.

2.4 Scenario of TCP: Bangladesh perspective

The disease which is known as tropical calcific pancreatitis (TCP) is a type of long-lasting calcific pancreatitis (CCP) noticed mainly in youngsters and young grownups in lots of countries of Asia, Africa and a tremendous proportion of those younger patients sufferer from chronic pancreatitis present along with a sort of diabetes termed fibrocalculus pancreatic diabetes or FCPD (Khan & Ali, 1997). World Health Organization (WHO) categorized fibrocalculus pancreatic diabetes as a variety of diabetes which arise from malnutrition (World Health Organization [WHO], 1985). TCD isn't a commonplace ailment ; however it's not rare in Bangladesh (Khan & Ali, 1997). A study in Bangladesh conducted by Khan and Ali (1997) found that both plasma glucose during starvation period as well as after 2 hour of meal were nearly 4 intense higher in FCPD sufferers than the ones of TCP sufferers. Measurement of microvascular alterations imply early nephropathyin FCPD sufferers and theyhave 2 instances

excessive c-peptide level during starvation period in comparison to FCPD sufferers (Khan & Ali, 1997).

2.5 Nationwide peripheral neuropathy among NIDDM patients

Peripheral neuropathy can be defined as nerve damage which occurs due to the increased level of blood sugar and diabetes including the symptoms of lack of sensation in the feet and patients also suffer from pain in the leg, feet or hands. Without any proper treatment ulceration, callus in the foot and infection may occur and further grow to be painful injury. Diabetic patients who have foot ulcer suffer from it due to nerve damage and it is prominently curable (Boulton, Vileikyte, Ragnarson-Tennvall, & Apelqvist, 2005). A study conducted in the outpatient section of BIRDEM hospital located in the capital of Bangladesh by Mørkrid, Ali and Hussain (2010) found that 19.7% of the total registered type 2 diabetic patients are suffering from diabetes peripheral neuropathy which is lower in comparison to the other researches which have been directed in various states of Europe. The prevalence of diabetes peripheral neuropathy among the type 2 diabetic sufferers from the hospital outpatient department is 32.1% in United Kingdom-17, 60% in Turkey-12 and 35.4% in Spain (Cabezas-Cerrato, 1998).

Table 2.1: Diabetic neuropathy in Bangladesh (Mørkrid, Ali, & Hussain, 2010).

Features	Percentage of diabetes neuropathy sufferers among type 2 diabetic patients
Age-23 to 40 years old	11.1%
Age-60 to 80 years old	32.3%
Patients suffering from diabetes for 5 years	14.1%
Patients suffering from diabetes for 9-11 years	29.2%

The significant danger issues for the progress of diabetes peripheral neuropathy are high age, longer period or span of diabetes, low income, insulin therapy, lack of proper glycemic

management etc. and higher prevalence of diabetes peripheral neuropathy has been observed among patients who have increased blood pressure, high level of cholesterol and habit of smoking. Proper curative measures must be taken in order to reduce the foot complications among the patients who have type 2 diabetes (Mørkrid et al., 2010).

2.6 Diabetes among the indigenous people

Ethnic population appears an extended boom of diabetes around the world (Rasmussen, Glümer, Sandbaek, Lauritzen, & Borch-Johnsen, 2007). The existence of diabetes is high among the ethnic people of Canada, Alaska, America and the indigenous Australians (Greenlund, Valdez, Casper & Rith-Najaran, 1999; Hoehner, Greenlund, Rith-Najaran & Casper, 2002; Pioro, Dyck & Gills, 1996). These ethnic communities exhibited an excessive occurrence of metabolic syndrome also (Rowley et al., 2000). Comparable outcomes had been mentioned among the ethnic people from United Arab Emirates, Taiwan and Sudan which indicates a high prevalence of diabetes among these communities (Chen, Shaw, Tseng, Chen, & Lee, 1997). Very few records are available concerning the occurrence of diabetes mellitus among the ethnic people residing in South-East Asian locations such as Bangladesh (Islam & Hossain, 2015). Various groups of ethnic people live in Bangladesh. Chakma, Garo, Marma and Santals etc. are the major ethnic communities of Bangladesh and the total number of ethnic people in Bangladesh is more than 140000 which is below than one percent of the overall population consisting of more than 30 indigenous communities (Islam and Hossain, 2015).

2.6.1 Factors stimulating the health status of ethnic people

In 2010 Islam and his working partners conducted a study on the “Cultural and socio-economic factors in health, health services and prevention for indigenous people” and observed that besides common factors, ethnic peoples’ health status is simulated by some specific elements for example indignity, absence of acceptance and lack of cognizance of the government towards them and many others., which general individuals have to experience at a less extent. Further, indigenous peoples around the globe suffer from various health issues because of the differences

in the socio-economic as well as cultural circumstances. Studies monitor that ethnic people suffer in more health related issues as well as disparities in contrast to the mainstream populations.(Islam, M.R. et al. 2010)

2.6.2 Diabetes severity in Khagrachari

Sayed et al. (2004) conducted a research on “Diabetes and impaired fasting glycemia in the tribes of Khagrachari hill tracts of Bangladesh” and found that the occurrence of diabetes among the ethnic people is higher (6.4%) in contrast to the non-ethnic people living in Bangladesh. The total cholesterol level was found higher among the ethnic people in comparison to the non-ethnic diabetic patients. Higher age, high body fat distribution, increased income as well as insulin resistance are the influential reasons for the progress of diabetes among the ethnic participants. The occurrence of IFG was 8.4% as well as the frequency of type 2 diabetes was 6.4%. It is suggested that doctors and health care experts should ensure proper treatment facilities and counseling regarding diabetes care among the ethnic people of Bangladesh (Sayed et al., 2004).

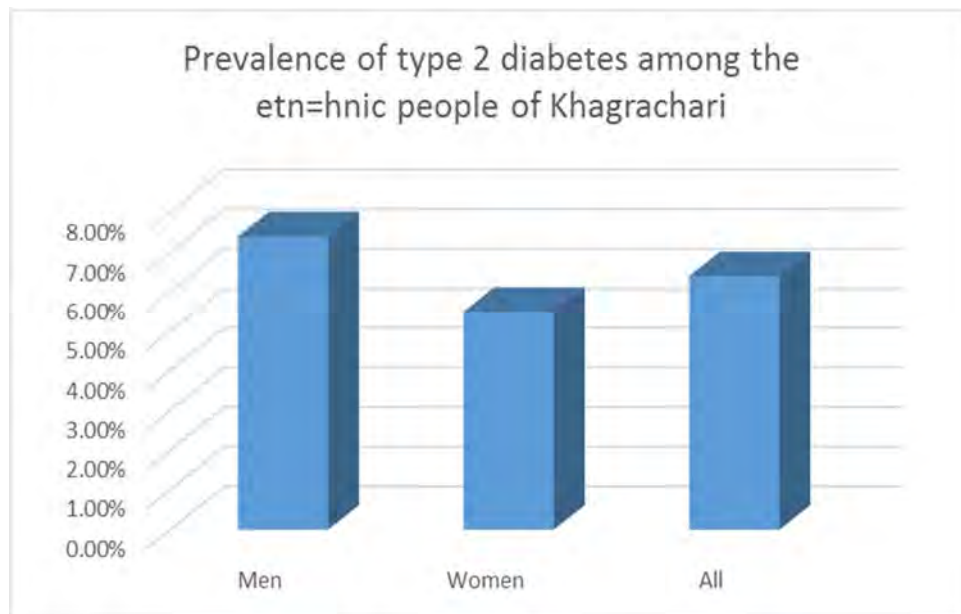


Figure 2.3: Prevalence of NIDDM in Khagrachari (Sayed et al., 2004).

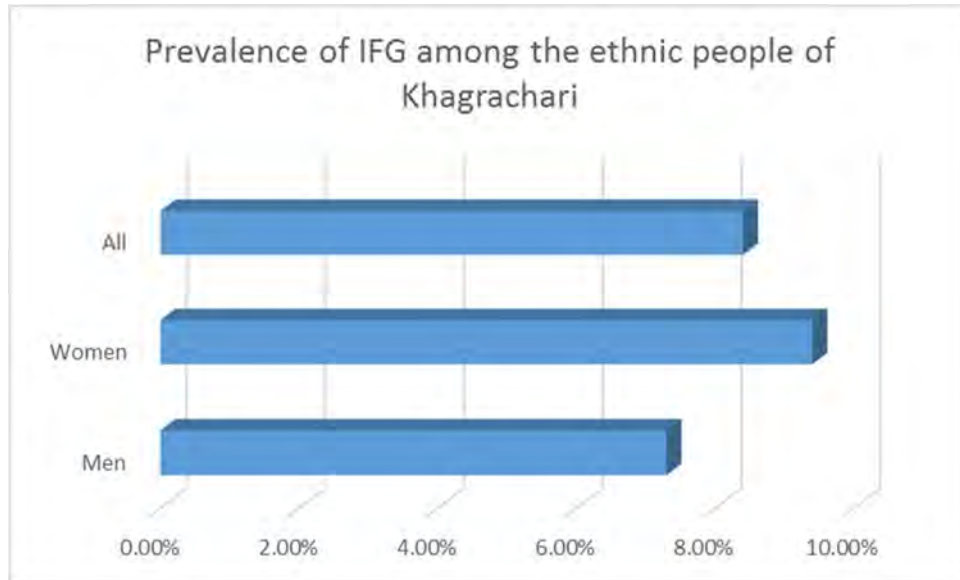


Figure 2.4: IFG among the ethnic people of Khagrachari (Sayeed et al., 2004).

2.6.3 Severity of diabetes and risk factors amongst the Santals

A study conducted by Islam and Hossain (2015) regarding the incidence of diabetes amongst the Santal (ethnic) community of Dinajpur district in Bangladesh found that the frequency of diabetes mellitus among the Santal population who participated was 2.5%, the occurrence of IFG and IGT were 0.9% and 4.4% respectively. The prevalence of smokers and alcohol consumers were significantly higher among the Santal (ethnic) communities. As cigarette consumption as well as drinking alcohol act as risk factors for type 2 diabetes proper measures must be taken in order to REDUCE smoking and alcohol consumption (MN Islam and Hossain, 2015).

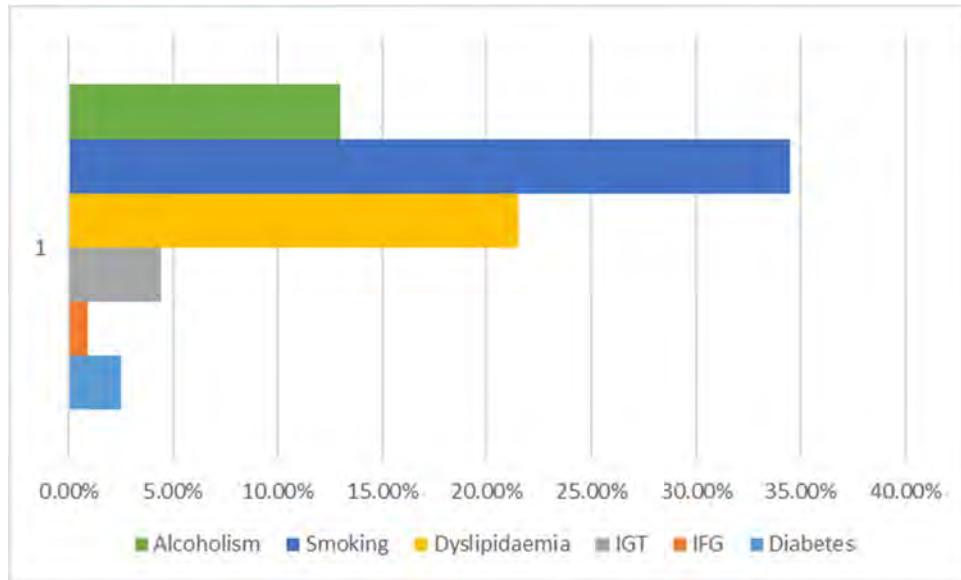


Figure 2.5: Diabetes, IGT, IFT and risk factors amongst the Santals

(M.N. Islam and Hossain, 2015).

2.7 Diabetes and depression: Bangladesh perspective

In 2007, Asghar, Hussain, Ali, Khan and Magnusson conducted a study regarding the association of diabetes and depression among countryside society and observed that the occurrence of depressing issues among male and female patients with diabetes were 29% and 30.5% respectively whereas the existence of depressive syndromes amongst male and female participants without having diabetes were only six percent and 14.6 % respectively. This indicates an important association between diabetes and depression. It is recommended that besides proper counseling and lifestyle modification psychiatric treatment is equally necessary to reduce prevalence of type 2 diabetes (Asghar, Hussain, Ali, Khan, & Magnusson, 2007).

Chapter Three: Knowledge, Self-management and Awareness of diabetes

3.1 Significance of proper diabetic knowledge

Diabetes mellitus is a metabolic ailment, besides medicinal drugs patient's diabetes awareness and education for embracing vital life style changes are also necessary in order to ensure proper control and treatment of diabetes mellitus. It is not unexpected that patients having better knowledge regarding diabetes mellitus can control blood glucose level in a more effective and efficient manner (Dussa et al., 2015).

Controlling this disease is mainly dependent on patient's capability to ensure self-management in each day of living .So, patient's knowledge and education is recognized as a vital element to ensure proper management of diabetes (Tan et al., 1997). Proper education regarding diabetes mellitus in addition with enhancements in understanding, attitudes and abilities, leads to improved management of the disorder, and is broadly recognized as a vital part of complete diabetes mellitus treatment and control (Assal et al., 1985; Norris et al., 2002;Asha et al., 2004). On the contrary, less knowledge as well as consciousness may cause expanded vulnerability to the occurrence of diabetic problems along with increased rate of healthcare charges among sufferers with diabetes mellitus (S. M. S. Islam, Niessen, Seissler, et al., 2015).

3.2 Tragic scenario of diabetes in Bangladesh

Patients having diabetes in Bangladesh have lack of awareness and educations on the reasons, control and danger elements for diabetes, in spite of getting healthiness support in the hospitals (S. M. S. Islam, Niessen, Seissler, et al., 2015). A study conducted by Saleh and his co-workers found that 16% had good knowledge, sixty six percent had average knowledge and 18% of the participants had poor basic knowledge regarding diabetes mellitus (Saleh, Mumu, Ara, Begum, & Ali, 2012). In 2015 Islam and his co-workers conducted a research on the knowledge assessment and glycemic management amongst NIDDM sufferers in Bangladesh and observed that 45.6%, 37.7% and 16.7% respondents had good, moderate and poor diabetic knowledge respectively. The study also found that awareness regarding diabetes was highly related with proper education, sex, month-to-month earnings, span of diabetes, obesity, diabetes occurrence amongst circle of relatives as well as conjugal factor on the other hand found poor connection between awareness, span of diabetes mellitus and glucose management (Islam et al., 2015). Fatema et al. (2017) conducted a survey in Bangladesh and found that 15% respondents had

good diabetic knowledge, 68% had average and seventeen percent had poor knowledge about diabetes mellitus. The study also found that the KAP (Knowledge, attitude and practice) in terms of diabetes were superior amongst diabetic sufferers in comparison to the nondiabetic participants. Diabetic knowledge and practice were found better among males whereas the attitude score was found better among the females. The KAP as an entire were noticed better among the middle aged respondents whose age were between 31 years to 50 years. Respondents from city dwellers, better educational status high socio-economic status showed higher KAP score (Fatema et al., 2017). Rahman et al. (2015) conducted a survey regarding the awareness, care as well as control of diabetes among the diabetic patients living in different regions of the country and found that the awareness among patients, treatment receivers and those who controlled their condition were 41.2%, 36.9% and 14.2% respectively. The awareness, treatment as well as control of diabetes varied greatly with the socio-economic status of the subjects. Among the respondents whose economic condition were miserable, awareness prevailed only 18.2% whereas awareness was found to be 63.2% among the wealthy participants. Similarly 15.8% of the poor patients received proper treatment where as 56.6% of the rich patients received proper diabetes treatment. Furthermore the control of diabetes was 8.2% among the poor patients which has significantly higher (18.4%) among the rich respondents (M. S. Rahman et al., 2015).

The study found that the frequency of diabetes in Bangladesh was 9.2% whereas the occurrence of diabetes in India is 8.6%, Nauru 13.7%, China 9.6%, Sri Lanka 8.0%. The existence of diabetic awareness was found 36.0% in India and 45.8% in China (Rahman et al., 2015).

Rahman et al. (2015) claimed that there was less awareness among the diabetic patients residing in the poorer locality such as northwestern region in Bangladesh the treatment level was also very low among patients with lack of education, miserable economic situation and those who are residing in the village areas. The management of diabetes as well as hypertension obtain lack of attention in Bangladesh. So, to eradicate this situation proper strategies and care should be ensured (Rahman et al., 2015).

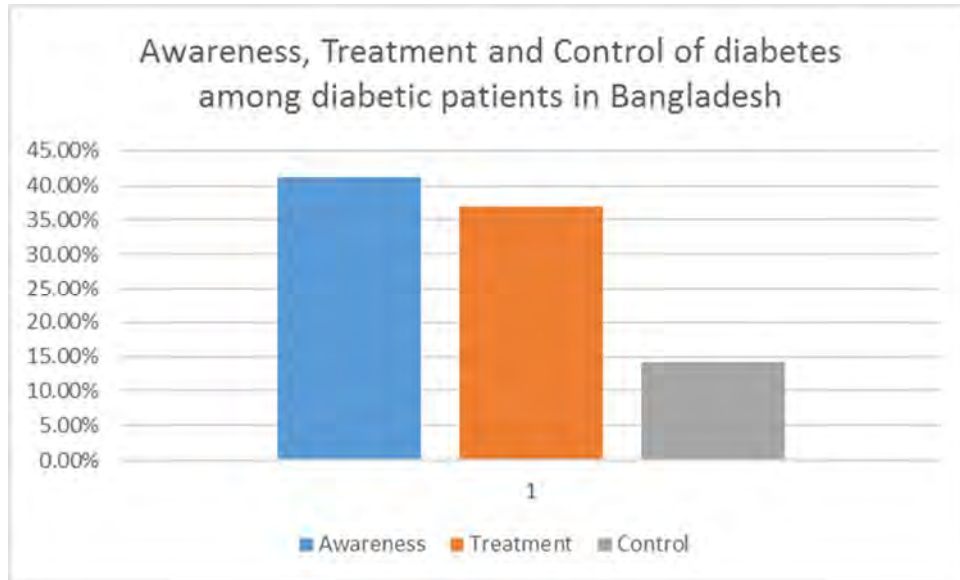


Figure 3.1 : Consciousness, therapeutics and diabetes control (M. S. Rahman et al., 2015).

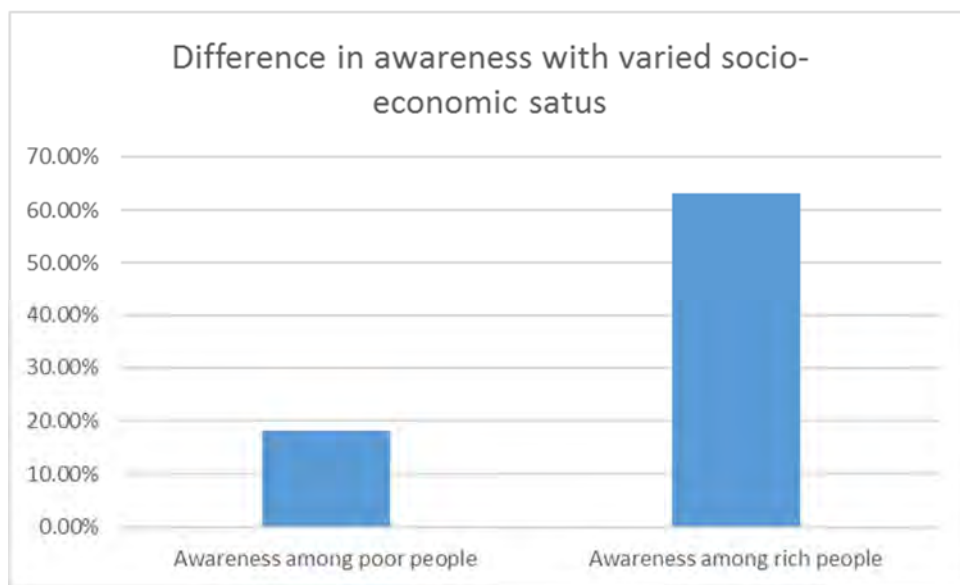


Figure 3.2: Diabetes awareness in different socio-economic groups (M. S. Rahman et al., 2015).

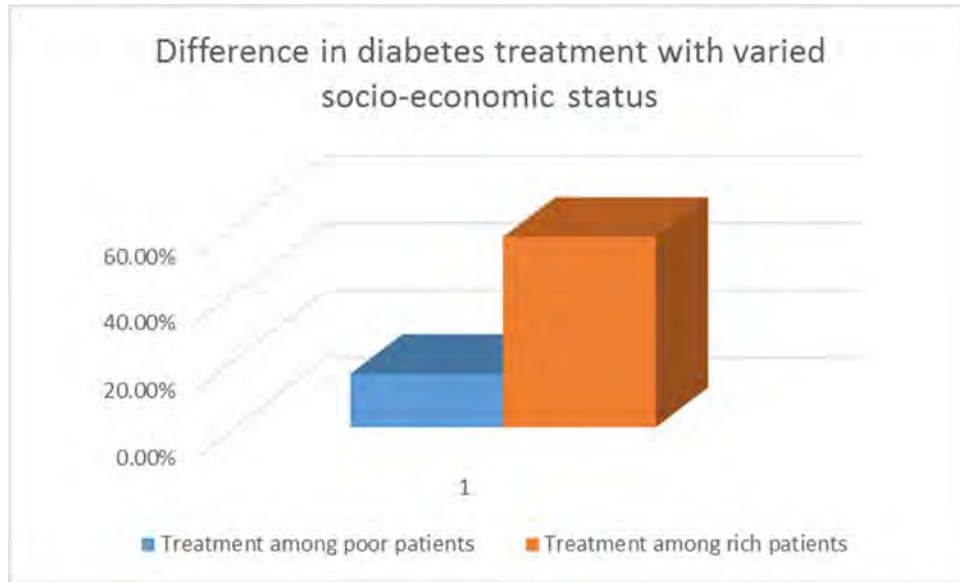


Figure 3.3: Diabetes treatment in different socio-economic classes (M. S. Rahman et al., 2015).

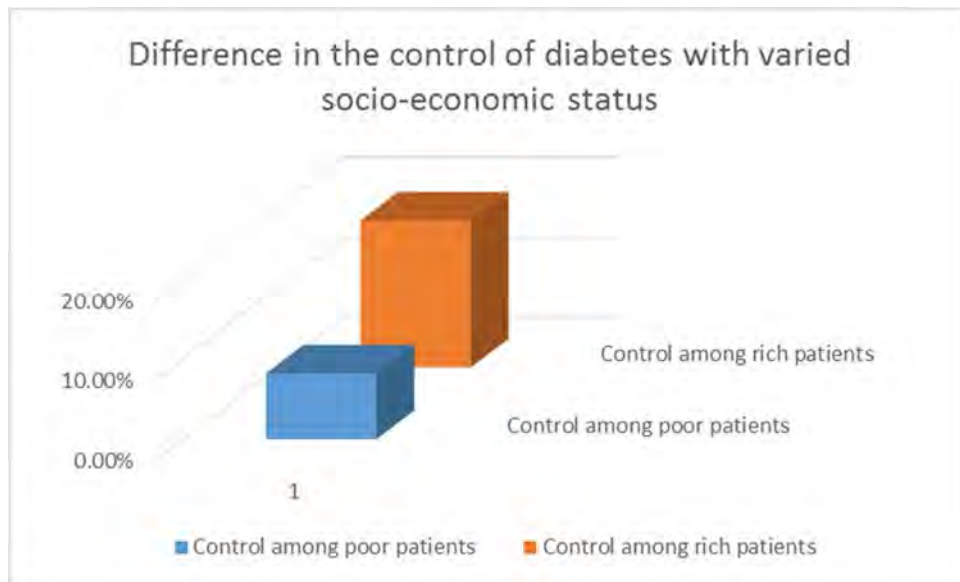


Figure 3.4: Difference control in various socio-economic groups (M. S. Rahman et al., 2015).

Table 3.1 (A)-3.1 (F): Treatment, awareness and control of diabetes (M. S. Rahman et al., 2015).

Table 3.1 (A)

Academic education	Treatment	Awareness	Control
No education	22.0%	25.8%	10.9%
Primary education	37%	40.6	13.9%
Secondary education	48.85	55.0%	16.7%
Higher education	63.2%	67.8%	24.0%

Table 3.1 (B)

Diabetic patients who have hypertension	Treatment	Awareness	control
No	30.3%	34.2%	11.2%
Yes	50.2%	55.3%	20.8%

Table 3.1 (C)

Obesity	Treatment	Awareness	Control
Normal	34.7%	38.9%	13.4%
Overweight	54.7%	61.2%	22.2%
Obese	58.4%	58.4%	25.7%

Table 3.1 (D)

Socio-economic status	Treatment	Awareness	Control
Poorest	15.8%	18.2%	8.2%

Poorer	10.1%	12.1%	10.1%
Middle	25.8%	31.0%	11.2%
Richer	40.2%	42.6%	17.6%
Richest	56.6%	63.2%	18.4%

Table 3.1 (E)

Location	Treatment	Awareness	Control
Rural area	31.8%	35.2%	12.2%
Urban area	50.0%	56.3%	20.1%

Table 3.1 (F)

Area of residence	Treatment	Awareness	control
Southern	21.2%	24.2%	10.1%
Southeastern	37.6%	42.8%	8.0%
Central	48.9%	55.3%	22.4%
Western	33.5%	37.1%	7.7%
Mid-western	35.7%	40.4%	16.8%
Northwestern	19.1%	18.2%	8.6%
Eastern	44.8%	45.6%	21.4%

Table 3.1 (A)-3.1 (F): Scenario of treatment, awareness and control of diabetes among diabetic patients of Bangladesh with different education level, hypertensive occurrence, obesity, societal dignity and regional variations.

In Bangladesh the number of diabetic patients is increasing at an alarming rate (Saquib, Saquib, Ahmed, Khanam, & Cullen, 2012). Rahman et al. (2015) argued that in the developing countries such as Bangladesh various causes are responsible for the difference in treatment as well as awareness among the diabetic patients. Diabetic care is intently related to family income, which

could have an effect on cognizance and remedy (Rahman et al., 2015). A recent research directed in Bangladesh argued that the destitute patients had less ability to expend for treatment purposes (International Diabetes Federation, 2013). Furthermore consciousness and diabetes remedy extremely depend upon the ability of health organizations to provide diagnosis as well as additional facilities with low cost for mass population (Rahman et al., 2015). According to a previous study conducted in Bangladesh greater than twelve percent of families loaned cash or vended their property for treatment expenses associated to persistent illnesses(M. M. Rahman, Gilmour, Saito, Sultana, & Shibuya, 2013b).Although government provide the funding of public health care, (Killingsworth et al., 1999), they Are not able not ensure low cost treatment facilities for the patients with low socio-economic status(M. M. Rahman, Gilmour, Saito, Sultana, & Shibuya, 2013a)(M. M. Rahman et al., 2013b). This indicates that financially supported programs are not providing desired outcomes among the poor population. So, the poor patients of Bangladesh do no show interest in taking medicinal drugs as well as refrain themselves from health care facilities in order to avoid the expenses associated with health care support (Rahman et al., 2015).

Fatema et al. (2017) directed a study on the knowledge assessment and self-management of diabetes in Bangladesh and found poor self-management issues of diabetic sufferers in Bangladesh. The study observed that only 16% of the total diabetic patients had satisfactory scores in that area which indicates that very few number of people do recommended physical activity, screen glycemia as well as maintain the suggested diet each day. There are numerous circumstances of incorrect information concerning dietary recommendation for diabetic patients in Bangladesh, ‘for example eating less sugar as well as less carbohydrate is the handiest manner to reduce blood glucose level.’ According to this study a satisfactory portion of the participants (70%) were conscious regarding the behavioral approach like proper physical activity, eating recommended foods, consumption of greater amount of vegetables, avoiding food containing high amount of fat and cholesterol as well as refraining from the habit of smoking (Fatema et al., 2017).

Participants with little or no education, poor economic condition and those living in the rural regions had decreased level of awareness as well as treatment. On the whole, management of diabetes mellitus among the Bangladeshi people remain extremely low which rise an alarming

concern for increased rate of mortality, morbidity, incapacity and family financial burden in future (Rahman et al., 2015)

3.3 Evaluation of diabetic complications, and risk factors

Diabetes mellitus is a major chronic illness the complications which are associated with diabetes such as disease of the peripheral nervous or neuropathy, damage of the kidneys, inflammatory disease of the retina and foot ulcer etc. are significant health issues among the diabetic patients now a days. The consequences of these complications are devastating including increased mortality and morbidity rate, financial burden and economical shock etc. In Bangladesh there is less subsidy provided by the government for health care support of the mass public. So the poor families and individuals with low socio-economic status find it difficult to expend more for the health care purposes and as well as diabetes related complications are very extreme and dangerous (Shariful Islam et al., 2013)

Table 3.2: Prevalence of diabetes risk factors in Bangladesh (Joshi et al., 2007).

Characteristics/Risk factors	Percentage of the total participants
Cigarette consumption	59.9%
Abdominal obesity	43.3%
Hypertension	14.3%
Depression	43%
Regular physical activities	1.3%
Consumption of fruit as well as vegetables	8.6%

From this table it is observed that the threat issues for the progress of diabetes for example smoking, abdominal obesity, depression etc. are significantly higher among the people of Bangladesh as well as percentage of regular physical activity remains extremely low.(Joshi et al., 2007).

In 2011, Latif, Jain and Rahman conducted a research regarding the diabetic complications and self-management issues in Bangladesh and observed that only 23.1% patient controlled their blood level as per the recommendation of American Diabetes Association. The prevalence of

hypertension, intake of anti-hypertensive drugs, intake of lipid lowering agent, LDL level greater than 2.6mmom/L, triglyceride greater than 2.2mmol/L were 47%, 94.9%, 48%, 70.8% and 43.3% respectively. The study also observed a significant prevalence of diabetes related complications such as cataract, neuropath, microalbuminuria, history of angina pectoris, leg amputation etc. The occurrence of proper diet management, physical activity as well as self-monitoring of blood glucose level etc. were found to be disappointing (Latif, Jain, & Rahman, 2011).

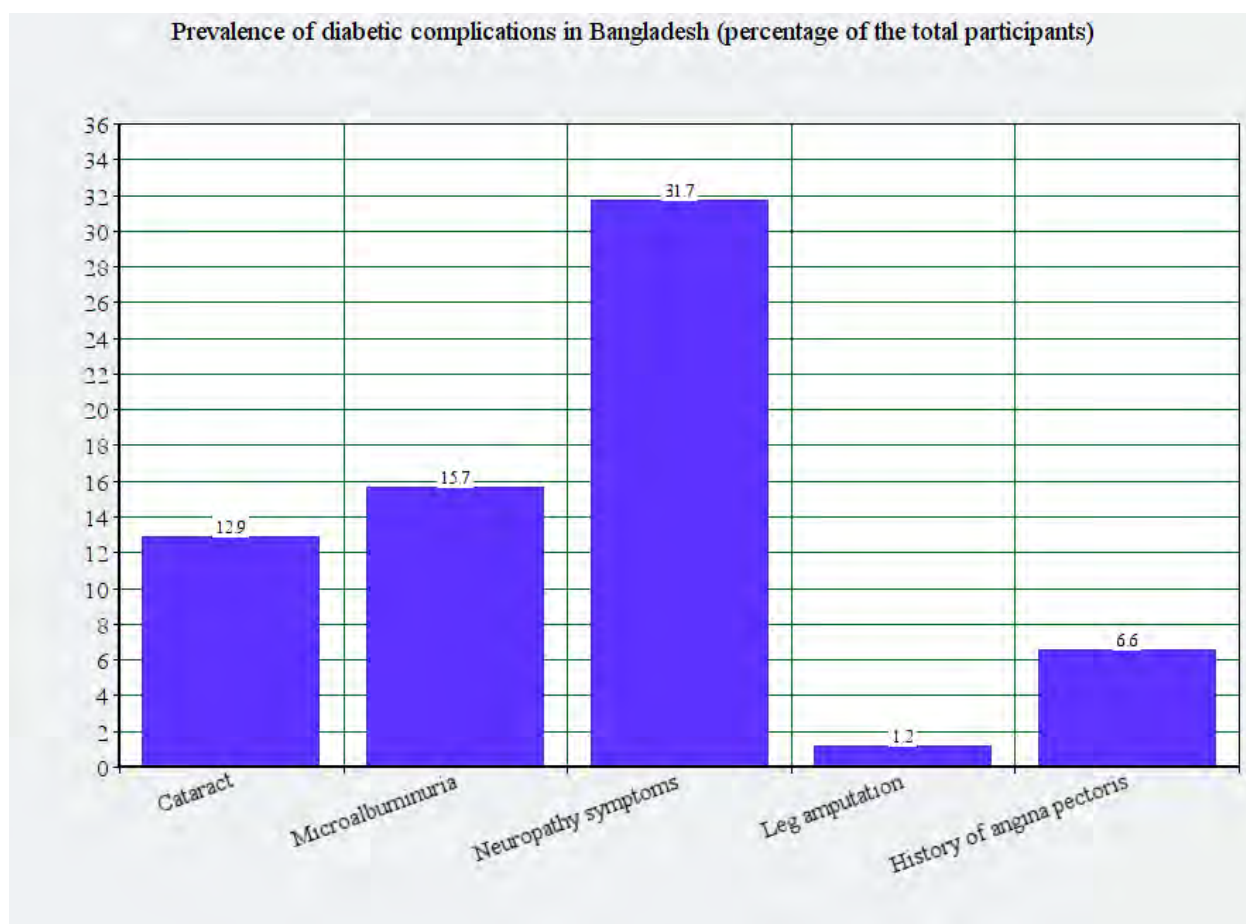


Figure 3.5: Prevalence of diabetic complications in Bangladesh (Latif et al., 2011)

3.4 Relation between knowledge and glycemic control

Diabetic knowledge was found to be strongly related with education, sex, monthly earnings, diabetes duration, obesity, occurrence of diabetes of the family members in the past etc. but any connection between knowledge score on diabetes and blood glucose control was not detected. A

poor negative link was detected between HbA1c and knowledge level. Furthermore, the alliance between duration of diabetes and knowledge score on diabetes mellitus was also found to be weak (Islam et al., 2015).

3.5 Educational program and counseling

Fatema et al. (2017) argued that in spite of being recognized as a vital part of diabetes control, the practice of educating and counseling the diabetic patients remains extremely low in Bangladesh. Skilled diabetes care professionals and doctors should counsel their patients in an effective manner while the patients visit them. As a consequence patient counseling can play a vital role in order to increase the level of proper understanding as well as cognizance about threat features, symptoms, complications as well as lifestyle modification for better control of blood glucose level (Fatema et al., 2017).

3.6 Impact of diabetes counseling program

In 2011 Malathy, Narmadha, Jose, Ramesh and Babu conducted a study regarding the influence of patient counseling on knowledge assessment among the diabetic patients in India and observed a significant improvement of knowledge assessment and practice among the participants who received proper counseling by the pharmacist whereas the knowledge level was found to be comparatively poor among the participants who did not receive counseling provided by the pharmacist. A KAP (knowledge, attitude and practice) questionnaire was provided to the trial group (participants who received counseling) and control group (participants who did not receive counseling) and better KAP score was observed among the test group. Furthermore, the test group showed better control of after meal plasma glucose level as well as triglyceride, overall amount of cholesterol and LDL (low density lipoprotein cholesterol) level were also low amongst the trial group in comparison to the controlled group. So the study disclosed that counseling provided by the pharmacist imply a substantial part for the better knowledge as well as improved personal regulation of diabetes among the diabetic patients (Malathy, Narmadha, Jose, Ramesh & Babu 2011).

Chapter Four: Relation between diabetes and obesity

4.1 Obesity, insulin resistance and heart disease among South-Asians

In 1991 McKeigue, Shah and Marmot conducted a research regarding the relation between diabetes and obesity and risk of heart disease among the South-Asians and observed that people of South –Asia had an increased tendency of central obesity as well as the occurrence of insulin resistance was not uncommon among them. The prevalence of diabetes mellitus, hypertension, increased fasting and post-prandial plasma insulin concentrations were observed among the South-Asians compared to the European participants. Furthermore, South-Asian respondents had higher average waist-hip ratio in comparison to the Europeans and the increased waist hip ratio was observed to be allied with resistance of insulin, intolerance of glucose etc. which establishes that occurrence of central obesity amongst the South-Asians are associated with the occurrence of insulin resistance among them (McKeigue, Shah, & Marmot, 1991).

4.2 Earlier onset of diabetes and obesity in Bangladesh

Khanam et al. (2008) directed a project regarding the comparison of biophysical features between the patients who enrolled in 1995 to the ones who enrolled in 2005 and observed that the age onset of diabetes mellitus was notably earlier among the patients who enrolled in 2005 compared to the ones who enrolled in 1995. Furthermore, increased obesity was obesity among the patients of 2005 compared to the ones of 1995 which establishes that increased BMI or body weight gain may act as an influential factor for the onset of diabetes mellitus at an early age.

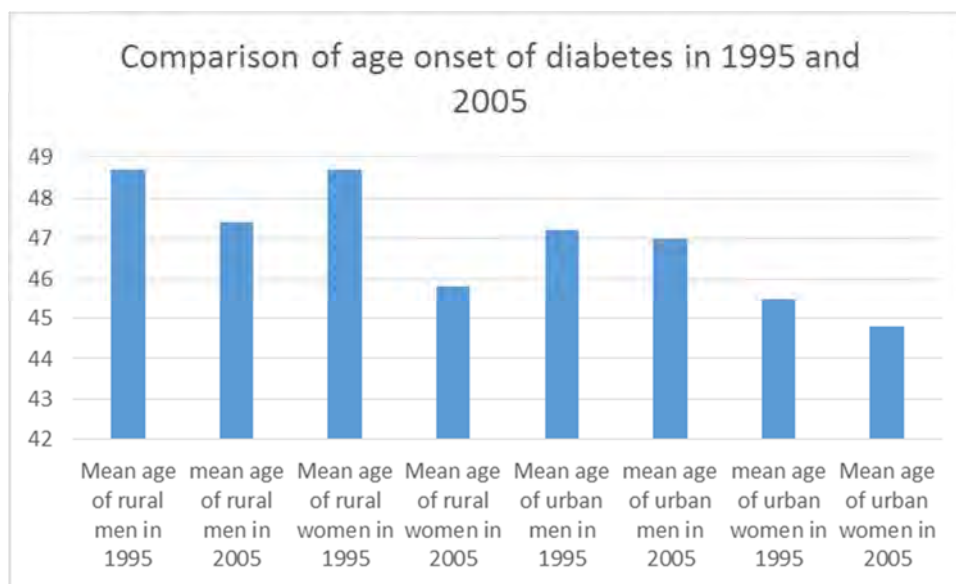


Figure 4.1: Comparison of age onset of diabetes in Bangladesh (Khanam et al., 2008).

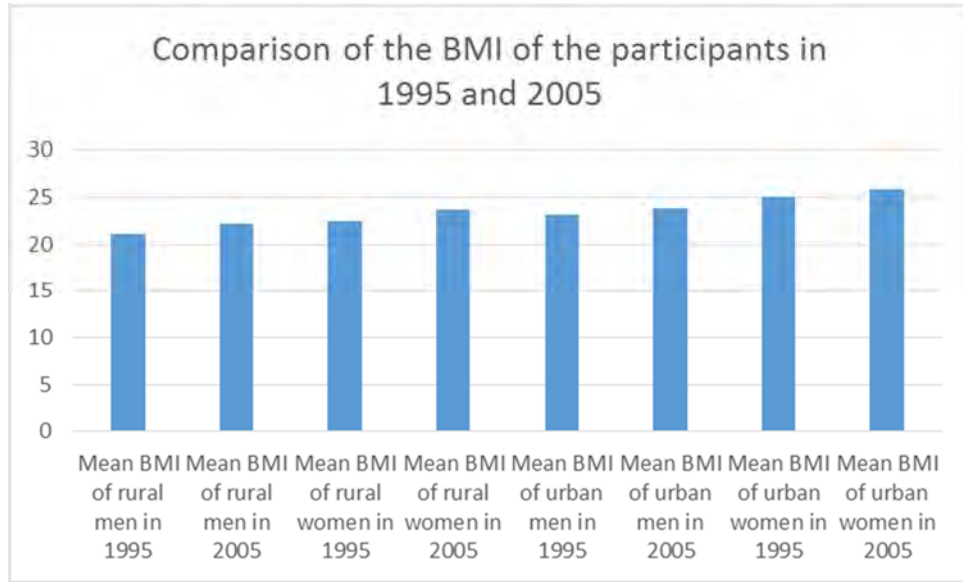


Figure 4.2: Comparison of BMI among diabetic patients (Khanam et al., 2008).

From these above two tables we see onset of diabetes at an early age in 2005 compared to those patients who registered in 1995. On the other hand, the body mass index increased notably in 2005 compared to 1995.

The study found that increased body weight gain in adulthood may results in onset of diabetes at an early age. Bangladesh is also facing the similar situation where increased body weight gain or chubbiness in adulthood leads to intolerance of glucose at an early age (Khanam et al., 2008).

Chapter Five: Dietary guidelines for diabetes

In 2013, Nahar, Choudhury, Faruque, Sultana, and Siddiquee concluded that in spite of achieving progress in crop production; Bangladesh is still facing the challenges of malnutrition of the toddler and mother, dietary variety of the individuals and family etc. Being habitual to the improper food plan leads to malnutrition and acts as a hazard element for the progress of chronic illness like diabetes mellitus etc. (Nahar et al., 2013).

The prevalence of low birth weight children in Bangladesh is 22% and more than one third of the children suffer from lack of nutrition. The prevalence of stunting, wasting and underweight children in Bangladesh is 41%, 16% and 36% respectively. More than one fourth of the women have malnutrition problem and 50% of them suffer from iodine and zinc deficiency. The prevalence of diabetes mellitus is about 8.4 million. The prevalence of low birth weight, anaemia in children under 5 years old, zinc deficiency in children under 5 years old, zinc deficiency in women, iodine deficiency in women, diabetes mellitus and obesity (BMI>25) is 22%, 33.1%, 44%, 57.3%, 42.1%, 7.9%, and 17.9% respectively (Nahar et al., 2013).

Table 5.1: Dietary guidelines for diabetic patients in Bangladesh (Nahar et al., 2013).

Features	Description
Eating proper balanced diet including a diversity of foods at each meal	Devouring rice or wheat or a mixture of cereals round 270-450g that's equivalent to 9-15 servings each day, eating brown rice as well as wheat as it consists of nutrients inclusive of protein, mineral, vitamin and dietary fiber etc.
Decreased consumption of food that contain high fat	-Consumption of food including high fat may lead to obesity, diabetes and cardiovascular diseases etc. -Vegetable oil for example soybean and mustard oil need to be used every day in preference to palm oil and butter.

	<ul style="list-style-type: none"> -Restriction in the consumption of fried meat as well as oily snacks.
Less salt intake and consumption of ionized salt only	<ul style="list-style-type: none"> -Intake of salt should be restricted to one teaspoon daily. -Less intake of foods that contain high amount of salt or sodium such as chips, wafers etc.
Intake of decreased amount of sugar, soda drinks and sweets	<ul style="list-style-type: none"> -It is necessary to intake less amount of sugar for diabetic patients for better glycemic management -It is encouraged to consume natural sugars from various seasonal fruits -Stevia, tagatose, coconut palm sugar and monk fruit extract can be consumed as alternative sugars for diabetic patient. -Decreased intake of food containing high amount of sugar for example cake, jelly, chocolates etc.
Intake of fresh and safe foods and vegetables	<ul style="list-style-type: none"> -Buying food and vegetables from trustworthy sources -Cleaning food and vegetables properly to remove dirt and dust. -A healthy food plan containing fresh fruits and vegetables like apples, carrots, avocados, broccoli, bean, asparagus; whole grains and lean protein are recommended for the diabetic patients.
Maintaining of weight loss plan through regular physical exercise and balanced diet	<ul style="list-style-type: none"> -Weight gain, obesity, lessened exercise etc. are significant danger issues of diabetes. -Maintaining body weight by proper physical exercise and balanced diet.

	<ul style="list-style-type: none">-Maintaining waist hip ratio along with BMI as per the recommendation by the health care professionals.-Maintaining daily physical exercise of 30-45 minutes including jogging, walking, running, swimming, playing outdoor games etc.
Ensuring healthy and nutritional food habit	<ul style="list-style-type: none">-Eating food routinely and refraining from increased eating, avoiding use of fried oil, taking proper clinical checkup etc.

Chapter Six: Diabetes treatment pattern in Bangladesh

6.1 Pattern of anti-diabetic drugs prescribed in Bangladesh

Ahmed, Hafiz, Bari and Akhter (2016) conducted a study regarding the types of anti-diabetic drugs prescribed by the physicians at the outpatient unit of Dhaka Medical College Hospital. Diabetic patients who received treatment for minimum 6 months and patients who were prescribed by the physicians were enrolled. 34.3% of the patients who participated had hypertension. 5.62 drugs were prescribed per prescription for the treatment of diabetes and associated complications. Among 105 participants 62.9% were prescribed only oral drugs whereas 8.6% patients were prescribed injectable preparations only (Ahmed, Hafez, Bari, & Akhter, 2016).

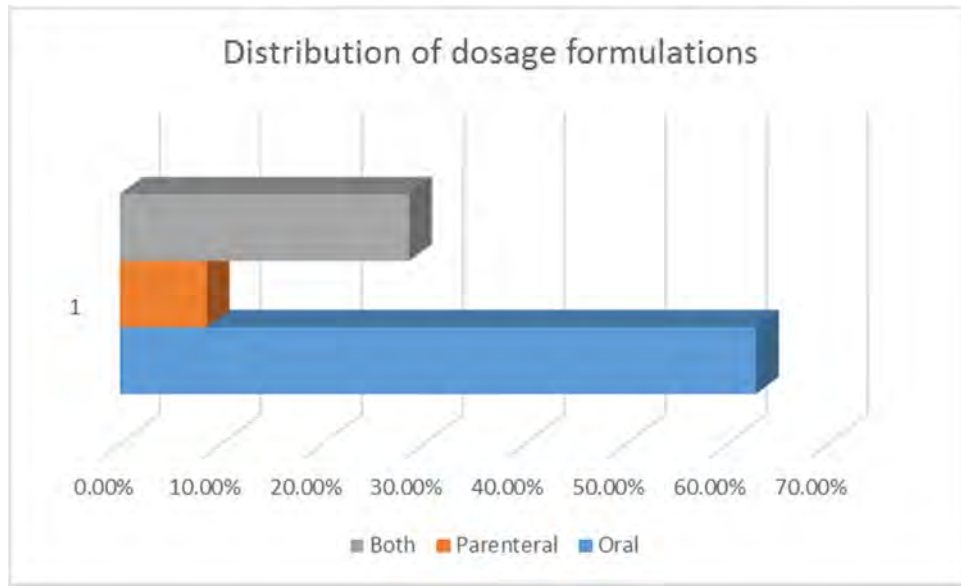


Figure 6.1: Dosage formulations of diabetic drugs in Bangladesh (Ahmed et al., 2016).

Out of 105 subjects, patients who were prescribed only Metformin as well as Metformin and Sitagliptin were 41% and 31.8% respectively. The prevalence of patients who were not advised any oral medicine was 3.1%. 37.1% of the total patients were advised injectable blood glucose lowering agents. Among them, most of the patients (48.7%) were suggested only short acting insulin as well as 35.9% were advised combination of insulin preparation. Among the participants 54.2% patients were advised 4-6 medicines as well as 1.9% patients were prescribed maximum 17 drugs. Among all of the prescribed drugs maximum number of drugs (74.3%) are produced by the local manufacturers whereas 23.8% drugs are produced by the multinational as well as local manufacturers. The study argued that the prescribed drugs were influenced by

doctor's preference in some cases. The study also observed lack of utilization of combined metformin-sulphonylurea and sulphonylurea alone. Finally, the study suggest that doctors and health care professionals should be more careful while selecting or prescribing hypoglycemic drugs (Ahmed et al., 2016).

6.2 Essential drugs in diabetes: South Asian perspective

Kalra, Gupta and Saboo (2015) argued that South Asian countries are the habitats of huge number of populations where the extremely expanding disease diabetes is affecting a significant proportion of people residing in these areas and as a result its treatment receives significant focus. It is extremely important to visualize inclusion of antidiabetic drugs in the National List of Essential Medicines (NLEMs) in these regions to analyze whether the essential anti-diabetic drugs have been provisioned properly. The identification of the included essential antidiabetic drugs in South Asian regions was performed by an online research. The addition of antidiabetic drugs listed in each of the NLEM were discussed depending on their strengths and classification.

Secretagogue: All of the South Asian countries include gibenclamide as an essential antidiabetic drug fixing the dose of 5mg and 2.5mg. Several countries like Myanmar, Afghanistan, Bhutan and Sri Lanka mentioned the 5mg tablet dose alone in their NLEM list (Kalra et al., 2015).

Sensitizers: All the countries included metformin in their NLEM list and pioglitazone is some other insulin sensitizer included in the NLEMs of Thailand (15mg and 30 mg) and Bhutan (15mg) (Kalra et al., 2015).

Alpha glucosidase inhibitors: Acarbose is included in Thai NLEMs as an alpha glucosidase inhibitor but oral antidiabetic included in another classes are not mentioned in any other NLEM (Kalra et al., 2015).

Insulin: All countries in South Asian region included regular insulin in the NLEMs list. The intermediate acting was mentioned by most of the countries where as few countries specified isophane insulin alone. Myanmar included long acting insulin zinc suspension whereas Pakistan, Nepal and India mentioned both Lente as well as NPH. Bangladesh did not include this class of drugs in the NLEMs. Biphasic lispro as well as aspart were listed by Thailand. There is notable differences in the insulin concentrations. India, Bhutan and Nepal mentioned 40IU/ml whereas

Bangladesh, Sri Lanka, Myanmar and Indonesia asked for 100IU/ml. Thailand did not prefer any specified strength whereas Maldives and Afghanistan preferred both strengths. Strength of soluble insulin mentioned by Pakistan was 100U/ml. Insulin syringes were not included by any country (Kalra et al., 2015).

6.3 Common anti-diabetic drugs used in Bangladesh

Islam et al. (2017) conducted a research regarding the comparison of healthcare expenses and medicines used among insulin and non-insulin dependent diabetic patients in Dhaka, Bangladesh. That study found that patients with diabetes mellitus received double time inpatient health services in comparison to the non-diabetic patients. Besides diabetic patients received 1.3 fold higher outpatient care than the non-diabetic patients and intake of medicines were 9.7 instances superior amongst the diabetic subjects than the non-diabetes subjects. The total expenses on health care was 6.1 fold higher among the diabetic patients (US\$635) in comparison to the non-diabetic patients (US\$104) (Shariful Islam et al., 2017).

9.8% of the total participants with diabetic mellitus mentioned that they don't take any type anti-diabetic drugs. The most widely used hypoglycemic agent was metformin which was used by 46.9% diabetic participants. Insulin and sulfonylurea users were 40.8% and 38.7% respectively. 38.7% of the diabetic subjects was found to use anti-hypertensive drugs. The most widely used anti-hypertensive drug was beta-blockers (25.9%). The use of statin and anti-coagulants by the diabetic participants was 14.2% and 7.6% respectively. 20.5% of the diabetic patient were found to take vitamin as well as 57% used another drugs. As health care expenses related with diabetes and diabetes associated complicates accelerates the economic burden of mass people of Bangladesh, proper cost-effective treatment methods should be implemented(Shariful Islam et al., 2017).

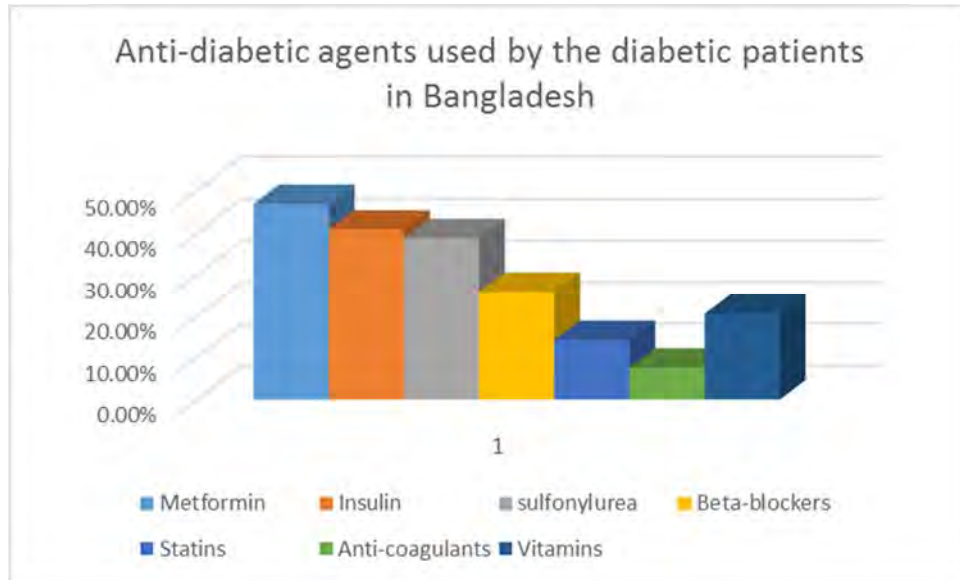


Figure 6.2: Drugs used by the diabetic patients in Bangladesh (Shariful Islam et al., 2017).

6.4 Telemedicine in the treatment of diabetes in Bangladesh

Cell phone technologies have been considered as a significant tool for improving health care systems as well as controlling various diseases in many nations (Peiris, Praveen, Johnson, & Mogulluru, 2014).

Bangladesh government in addition with WHO have accepted information technologies in the health care sector for better management of various diseases. A study observed the impact of cell phone message for regulating glycemia among NIDDM patients in Bangladesh. 236 diabetic sufferers with NIDDM participated in that study who were divided in to the SMS group and control group. Total 90 SMSs (one message daily) were delivered to the intervention group regarding the basic principles and self-management guidelines of diabetes mellitus for 6 months. The study observed that the mean HbA1c level decreased notably in the SMS batch in contrast to the control batch. After a period of 6 months the mean difference in the HbA1c level among the SMS group and control group was -0.85 and -0.18 respectively which indicates better management and control were achieved by the patients included in the SMS group. The study showed the positive impacts of cellphone SMS for improving regulation of glycemia amongst NIDDM patients in Bangladesh (S. M. S. Islam, Niessen, Ferrari, et al., 2015).

6.5 Recommendations to treat and regulate NIDDM in Bangladesh

Mahtab et al. (2003) provide the treatment scheme for NIDDM sufferers in Bangladesh. Selection of methods of treatment is based on the diabetes type, body mass index, hyperglycemic severity as well as other diabetic related complications. Primary steps are alteration in diet and physical exercises. If these steps fail, then medicine intake is required. The aim of diabetic treatment includes enhancement of the activity of beta cells, decreasing the output of hepatic glucose as well as prevention of insulin resistance. There are three types of oral blood glucose lowering agents-secretagogues, decrease in the absorption of glucose as well as sensitizers (Mahtab et al., 2003).

Recommendations:

Fasting plasma glucose <10.0 mmol/L-Dietary modification and physical exercise

Fasting plasma glucose >10.0-<14.0-Dietary modification and physical exercise

If no improvement is observed after 15 to 30 days-Intake of oral hypoglycemic agent

Fasting plasma glucose > 14.0-Insulin therapy (Mahtab et al., 2003).

Table 6.1: Initial and maximum dose of insulin secretagogues drugs (Mahtab et al., 2003).

Insulin secretagogues

Examples	Starting dose	Maximum dose on each day
Glibenclamide (sulfonylurea)	1.25mg-2.5mg	15mg
Glimepiride (sulfonylurea)	0.5mg	6-8mg
Rapaglinide (glinide)	0.5mg 3 times prior to meal	8mg

Table 6.2: Initial and maximum dose of insulin sensitizers (Mahtab et al., 2003).

Insulin sensitizers

Example	Starting dose	Maximum dose on each day
Metformin	500mg One to three separated dose with meal	3000mg 3 separated dose
Pioglitazone	15mg or 30 mg Once in the morning of each day	45mg

Insulin remedy

Insulin remedy is necessary for those individuals who have insulin dependent diabetes mellitus or NIDDM subjects suffering from extreme hyperglycemic incidences in spite of taking high dose of oral glucose lowering agents and dietary modification. It is necessary to initiate low dose of insulin therapy and response of the patient need to be analyzed. The dosage of insulin can be increased gradually as per the requirement of the patient after each three to seven days (Mahtab et al., 2003).

Recommendations for combination treatment

NIDDM subjects with obesity: Starting primarily with biguanides-if it cannot control hyperglycemia then sulfonylurea, glitazone, insulin secretagogues acarbose can be added.

NIDDM subjects with usual body mass index:-Beginning with sulfonylurea, if sulfonylurea fails to prevent severe hyperglycemia then biguanide or glitazone can be added.

Type 2 diabetic patient with decreased body mass index:-Beginning with insulin then adding less amount of sulfonylurea. In this case biguanides should not be used. Biguanides are only suggested for obese patients (Mahtab et al., 2003).

6.6 Future of diabetes treatment in Bangladesh

A new anti-diabetic medicine Dapazin (Dipagliflozin) which has the potency of reducing insulin dependency has been launched by Concord Pharmaceutical Ltd. which has opened a new milestone and opportunities to cure diabetes in Bangladesh. It is a recent oral glucose lowering agent approved by FDA which has been launched as Dipagliflozin (brand name) in Bangladesh.

The inauguration of launching of this new drug was induced by Diabetic specialist professor Dr. A k Azad khan in ‘Dhaka Regency Hotel and Resort’ on 28th August 2015 and many doctors, health professionals and diabetic specialists provide their valuable speech on this new drug Dapazin in the launching ceremony. Doctors and diabetic specialists suggested that Dapazin is effective to manage blood glucose level along with the reduction of high blood pressure and body mass index. Furthermore, it will decrease the dose of insulin as well as insulin dependency among the diabetic patients in the upcoming future (Stethoscope desk, 2015).

In 2014, Novo Nordisk launched new generation insulin ‘Tresiba’ in Bangladesh. This ultra-acting insulin has been introduced in Bangladesh with a view to improve the life quality of diabetic patients. The dose is given once a day. This medicine provides period of activity of greater than 42 hours which has less risk of hypoglycemic agents. This new generation insulin cut down blood glucose level along with the reduction of night time hypoglycemia when compared to insulin glargine. The regional vice president of Novo Nordisk Camilla Stylvest argued that the accessibility of Tresiba in Bangladesh and its effectiveness would facilitate diabetic patients for regulating glycemia properly along with the reduction of diabetes related complications as well as health care cost related to diabetes (Star business report, 2015).

Chapter Seven: Discussion

It can be noted that a significant number of studies had been carried out in order to analyze and determine the risk factors, knowledge, attitude, practice, awareness, treatment, diagnosis, control and management of diabetes mellitus in Bangladesh although it is a poor country and limited resource is available for research purpose. In many of the studies, a unique sampling method was adopted consist of a group of communities including a group of villages, cities, small towns or municipalities, healthcare centers were selected where the sample size was significantly large and ensured the enrollment of all eligible respondents. This unique method also ensured that each study had adequate illustration in age, sex as well as socio-economic status. Studies were also carried out on special populations and socio-economic classes for example health care professionals, slum dwellers, rural and urban people, government officials, obese persons, hypertensive patients as well as ethnic minorities. Including samples and data from different regions of the country allowed some studies to picturize the differences and comparative scenario of the occurrence, consciousness, remedy and regulation of diabetes between these regions. Furthermore, significant number of data regarding the comparative frequency of diabetes as well as pre-diabetes of city and countryside areas between Bangladesh and other South Asian and South-East Asian countries were also available. Furthermore, few studies also revealed the comparison and increasing rate of occurrence of diabetes mellitus in Bangladesh for the last 10 or 15 years (between 1995 and 2010) and showed the existence of significant risk factors and how the these factors are causing diabetes. Besides, the studies also provided eligibility criteria and strong statistical analyses.

However the reviewed studies have some limitations. These are given below:

-Some of the studies included insufficient sample size. Such as, the research directed in Dhaka have registered members either sharing a general residing surroundings for example respondents living in the slum or common career for example health care professionals. This type of samples are not suitable to picturize the actual scenario as well as true judgment of the frequency of diabetes mellitus for a metropolitan which is the habitat of 20 million residents with a wide variety of socio-economic classes. Similarly, some studies included participants from a single village or a few number of villages in a specific geographical area which may not provide the true actual estimation and

assessment of the prevalence of diabetes mellitus of a country consisting of 68000 villages.

-No studies was found to conclude and analyze the effects of nutrition (sugar, sodium etc.), several environmental variables (air pollution, drinking water containing arsenic) on diabetes mellitus in Bangladesh.

-No studies were found to addresses the pharmacovigilance of anti-diabetic drugs. In our country the practice of reporting adverse effects of drugs by the patients to the drug monitoring committee is very uncommon. Hence no studies or no survey has been conducted which include the reporting of adverse effects of anti-diabetic drugs by the participants of the study.

-Bangladesh is a poor country where very limited resource is allocated for research purpose. As a result, there is lack of research for the development of new generation oral glucose lowering agents and new generation insulins and that's why no research paper or study is available on the experiment and development of new anti-diabetic drugs here.

-Some studies could not estimate the effects of variable factors like smoking, dietary intake, physical exercise etc. on the treatment, consciousness as well as regulation of this disease.

-Very few studies and data are available on the prevalence, knowledge assessment and self-management of diabetes mellitus among the ethnic minorities of Bangladesh.

-Some studies lack use of established questionnaire for example Michigan Diabetes Knowledge Scale, IMDSES (Self Efficiency Scale in Diabetes Management) scale etc. which may not allow the true actual assessment of diabetes knowledge and self-management scenario in diabetes mellitus.

Chapter Eight: Conclusion

Various studies provide strong evidence that diabetes frequency is extremely progressing along with its severe complications in Bangladesh. The knowledge on the reason, control and risk factors of diabetes, self-monitoring as well as the treatment of diabetes remain significantly low especially among the people of poor regions, uneducated ones and among the ethnic minorities. By analyzing and reviewing a significant number of studies it can be suggested that proper improvements of diabetes diagnosis, knowledge level, self-monitoring and treatments are required in Bangladesh especially among the underprivileged people. This can be assured by implementing the following measures:

- 1) Health care professionals and health care leaders should provide importance to NCDs especially to the remedy as well as deterrence of diabetes mellitus,
- 2) Providing widespread healthiness insurance or further threat prevention methods in health funding structures to confirm the access of inexpensive care for all people ranging from low socio-economic status to high socio-economic class,
- 3) Improving diabetes knowledge, ensuring lifestyle modification and dietary behaviors by well-designed mass education and patient counseling programs and media campaigns.

In addition, more researches should be conducted by focusing at the root causes, environmental risk factors (arsenic contaminated water, air pollution) etc. on the progress of diabetes, pharmacovigilance data regarding anti-diabetic drugs as well as the prognosis of diabetes. Moreover, widespread Research and survey should be conducted in every districts of Bangladesh on the prevalence, knowledge assessment, self-management and treatment of diabetes mellitus in every 5 or 10 years in order to analyze the improvements and lacking in various parameters or factors and take proper steps to overcome those obstacles for ensuring better health for all people.

Chapter Nine: References

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