Burden of Diabetes Mellitus: Experience from Urban and Rural Communities of Bangladesh

Submitted By

Md. Ziaul Islam

Professor, Department of Community Medicine

National Institute of Preventive and Social Medicine (NIPSOM)

Mohakhali, Dhaka, Bangladesh

Registration No: 01
Session: 2010-2011

Faculty of Post-graduate Medical Sciences and Research
University of Dhaka

Declaration

I hereby humbly declare that thesis work entitled "Burden of Diabetes Mellitus: Experience from Urban and Rural Communities of Bangladesh" was carried out as partial fulfillment of requirements of the degree of Doctor of Philosophy (PhD) under the Faculty of Post-graduate Medical Sciences and Research, University of Dhaka. The thesis work was conducted during the period of 2010-2014 under the supervision of Prof. Dr. M. Abu Sayeed PhD, head, department of Community Medicine, Ibrahim Medical College, Dhaka. It is to be mentioned that no part of the thesis work has been submitted for another degree or qualification in any other institute at home or in abroad.

(Dr. Md. Ziaul Islam)
Professor, Department of Community Medicine
NIPSOM, Mohakhali, Dhaka-1212
Registration No: 01 Session: 2010-2011
University of Dhaka.

Certification

This is to certify that the thesis work entitled "Burden of Diabetes Mellitus: Experience from Urban and Rural Communities of Bangladesh" was conducted and submitted by Prof. Dr. Md. Ziaul Islam (Registration No: 01 Session: 2010-2011, University of Dhaka), Department of Community Medicine, National Institute of Preventive and Social Medicine (NIPSOM), Dhaka under my direct supervision as partial fulfillment of requirements of the degree of Doctor of Philosophy (PhD) under the Faculty of Post-graduate Medical Sciences and Research, University of Dhaka.

The thesis work was carried out at the National Institute of Preventive and Social Medicine (NIPSOM), Mohakhali, Dhaka during the period of 2010-2014. To the best of my knowledge, no part of the thesis work has been submitted for another degree or qualification in any other institute at home or in abroad

(Prof. Dr. M. Abu Sayeed PhD)
Head, Department of Community Medicine
Ibrahim Medical College, Dhaka-1000

University of Dhaka

Certificate

The undersigned certify that they have carefully read and recommend to the university of Dhaka, Bangladesh for acceptance of the thesis work entitled "Burden of Diabetes Mellitus: Experience from Urban and Rural Communities of Bangladesh" conducted by Dr. Md. Ziaul Islam (Registration No: 01, University of Dhaka), Professor, Department of Community Medicine, National Institute of Preventive and Social Medicine (NIPSOM), Dhaka for partial fulfillment of requirements of the degree of Doctor of Philosophy (PhD) under the Faculty of Post-graduate Medical Sciences and Research, University of Dhaka for the session: 2010-2011.

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   Name

Abstract

Title of the Thesis
Burden of Diabetes Mellitus: Experience from Urban & Rural Communities of Bangladesh

Name of Researcher
Dr. Md. Ziaul Islam, Professor, Department of Community Medicine,
National Institute of Preventive and Social Medicine (NIPSOM), Mohaklhali, Dhaka-1212

Background

Diabetes mellitus (DM) is one of the major non-communicable diseases need lifelong care otherwise develop multi-systemic complications in human body. It poses enormous economic and disability burden to the victims, society and the country. Burden of the disease is not well addressed in developing countries. This pertinent study intended to unveil the burden of diabetes mellitus in urban and rural communities of Bangladesh.

Methodology

This comparative cross-sectional study was conducted among 2052 (1026 urban and 1026 rural) participants to compare disability and economic burden of diabetes mellitus between urban and rural communities. The study estimated disability burden in terms of Disability Adjusted Life Years (DALY) and economic burden in terms of "Cost of Treatment" approach from patient perspective. The study also ascertained prevalence and risk factors of diabetes mellitus in both communities. Semi-structured questionnaire, checklist, verbal autopsy, and multi-stage sampling technique were used for data collection. Data analysis included descriptive statistics comprising mean, SD, frequency, proportion, range and percentage and inferential statistics comprising χ^2 test,'t' test, and logistic regression.

Findings

Male participants were predominant in both rural (50.88%) and urban (55.07%) communities and majority (70.65%) of the participants of the communities were in productive age group (30-59 years). Out of all, 24.17% rural and 20.27% urban participants had overweight (by BMI) while 26.7% rural and 27.6% urban participants had central obesity (by waist-hip ratio). Off all, 46.82% rural and 52.24% urban participants were tobacco-users while 11.7% rural and 28.9% urban participants did not perform any physical work. Family history of DM was found among 20.47% rural and 21.15% urban participants. Among all, 10.53% rural and 14.91% urban participants were known cases of DM but 16.61% cases of the communities were undetected and diagnosed by this study. Prevalence of DM was 12.67% and 17.84% in the rural and urban community. Prevalence of IFG was 2.14% and 6.14% while prevalence of IGT was 4.09% and 5.85% in rural and urban community respectively. Prevalence of DM was significantly higher among the elderly patients in comparison to the younger patients and the middle aged patients [$\chi^2_{(2)}$=50.89, p=0.00]. Risk of occurrence of DM was 2.37 times higher in urban community than in rural community (p<0.001, OR=2.37, 95% CI, 1.88-2.99).

Risk of occurrence of DM was around 2 times higher among the participants who had the family history than those who had no family history of DM ($p<0.001$, OR=1.99, 95% CI, 1.62-2.43). Risk of occurrence of DM was found around 13 times higher among the obese (36.98%) than the normal participants (7.16%) ($p<0.001$, OR=12.97, 95% CI, 10.66-15.79). The risk of occurrence was also found around 5 times higher among the participants who didn't perform physical work than those who performed physical work ($p<0.001$, OR=5.05, 95% CI, 4.21-6.07). More than half of the both rural and urban participants had different types of complications of DM. Risk of complication was 1.24 times higher in rural (57.41%) than in the urban (52.94%) community ($p=0.03$, OR=1.24, 0.56-1.92) while it was 1.44 times higher among smokers (58.57%) than the non-smokers (53.04%) ($p=0.02$, OR=1.44, 0.69-2.18). Risk of complications was found about 8 times higher among the patients who were on anti-diabetic drugs, exercise and diet-control (57.44%) than those who were on only diet-control (21.05%) ($p<0.01$, OR=7.95, 2.06-30.72).

Average treatment cost was significantly higher (Tk.3415±3001) in the urban community than in the rural community (Tk.2465±1614), [$t_{(259)}$, $p=0.003$)]. Both direct and indirect costs were significantly higher in the urban community (Tk.2115±1998 and Tk.1601±1868) than in the rural community (Tk.1593±1159 and Tk.984±870), [$p=0.015$ and $p=0.003$]. Cost of treatment was significantly higher [$\chi^2_{(9)}=18.67$ $p=0.028$] among the urban diabetic patients with longer duration but it was not significant in rural community. Disability burden i.e. average disability adjusted life years (DALY) was 4.42±0.78 and 4.70±1.30 in the rural and urban community respectively. Combined disability burden (DALY) of DM and its complications was slightly higher in the urban community (7.06±3.03) than in the rural community (6.97±3.10). DALY loss of the patients with complications was significantly higher than the patients without complication in both rural [$\chi^2_{(2)}=87.71$, $p=0.000$] and urban community [$\chi^2_{(2)}=87.09$, $p=0.000$]. DALY was significantly lower in the patients who performed physical work in the rural community [$\chi^2_{(2)}=6.24$, $p=0.043$]. Mean DALY loss of diabetic patients was significantly higher in the urban (4.42±0.78) community than in the rural (4.70±1.30) community ('t',$_{(311)}=2.191$, $p=0.029$).

Conclusion

Both economic and disability burden of diabetes mellitus varied between countries and communities. Diabetes mellitus was more prevalent in the urban community, among the obese people with positive family history and who didn't perform physical work. A remarkable segment of the participants were undetected cases of DM who were detected by this current study. Both economic and disability burden of DM were higher in the urban community and among the patients having complications of DM. The study recommends community based screening program for early diagnosis of DM and treatment. The study also recommends periodic follow-up facilities for the patients at all levels to avert the rising burden of diabetes mellitus and its complications.

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Acknowledgement

At first, I would like to express my deepest gratitude to the Almighty Allah for giving me the opportunity to accomplish the study entitled "Burden of Diabetes Mellitus: Experience from Urban and Rural Communities of Bangladesh" and to pursue the PhD course under the University of Dhaka.

I would like to convey my humble gratitude and obliged appreciation to my respected supervisor Prof. Dr. M. Abu Sayeed PhD, head, department of Community Medicine, Ibrahim Medical College, Dhaka for his expert supervision, continuous support and kind suggestions during the entire period of study. I am grateful to him for provision of valuable time out of his very busy schedule otherwise I could never complete the study in due time.

I would like to articulate my sincere gratitude to Prof. Dr. Saroj Kumar Mazumder, former director of National Institute of Preventive and Social Medicine (NIPSOM) for his sincere cooperation for this thesis work. My best regards and humble admiration must be forwarded to Prof. Dr. Akhtarun Naher present director, NIPSOM for her whole hearted support in conduction seminar and other different aspects of the study.

My humble gratitude must be forwarded to Prof. Md. Abul Faiz PhD for his close assistance and scientific guidelines at different stages of the study. I would also like to extend my best regards to Prof. Shushil Ranjan Hawlader PhD, Institute of Health Economics, University of Dhaka, for his kind cooperation and guidelines for estimation of economic burden of Diabetes Mellitus, an integral part of the thesis.

I would like to express my best regards and appreciation to my beloved wife Dr. Sharmin Farjana for her close cooperation and moral support at different phases of the study. Finally, I would like to forward my warm thanks for the participants of this study for their active participation and providing necessary information.

(Prof. Dr. Md. Ziaul Islam)
Department of Community Medicine
NIPSOM, Mohakhali, Dhaka-1212

Abbreviation

BBS	Bangladesh Bureau of Statistics
BIRDEM	Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders
BMI	Body Mass Index
CVD	Cardiovascular Disease
DALY	Disability Adjusted Life Years
DCC	Dhaka City Corporation
DCCT	Diabetes Control and Complications Trial
DM	Diabetes Mellitus
FBG	Fasting Blood Glucose
GBD	Global Burden of Disease
GDM	Gestational Diabetes Mellitus
GDP	Gross Domestic Product
IDF	International Diabetes Federation
IFG	Impaired Fasting Glucose
IGL	Impaired Glucose Tolerance
LADA	Latent Autoimmune Diabetes of Adults
NCD	Non-communicable Disease
NCSS	Number Cruncher Statistical System
NIDDM	Non-insulin Dependent Diabetes Mellitus
NIPSOM	National Institute of Preventive and Social Medicine
OGTT	Oral Glucose Tolerance Test
SEAR	South East Asian Region
UK	United Kingdom
UKPDS	United Kingdom Prospective Diabetes Study
UPHCP	Urban Primary Health Care Project
USA	United States of America
WHO	World Health Organization
WHR	Waist Hip Ratio
YLD	Years Lived with Disability
YLL	Years of Life Lost

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Background

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(36.98%) than the normal participants (7.16%) (p<0.001, OR=12.97, 95% CI, 10.66-15.79). The risk of occurrence was also found around 5 times higher among the participants who didn't perform physical work than those who performed physical work (p<0.001, OR=5.05, 95% CI, 4.21-6.07). More than half of the both rural and urban participants had different types of complications of DM. Risk of complication was 1.24 times higher in rural (57.41%) than in the urban (52.94%) community (p=0.03, OR=1.24, 0.56-1.92) while it was 1.44 times higher among smokers (58.57%) than the non-smokers (53.04%) (p=0.02, OR=1.44, 0.69-2.18). Risk of complications was found about 8 times higher among the patients who were on anti-diabetic drugs, exercise and diet-control (57.44%) than those who were on only diet-control (21.05%) (p<0.01, OR=7.95, 2.06-30.72).

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Conclusion

Both economic and disability burden of diabetes mellitus varied between countries and communities. Diabetes mellitus was more prevalent in the urban community, among the obese people with positive family history and who didn't perform physical work. A remarkable segment of the participants were undetected cases of DM who were detected by this current study. Both economic and disability burden of DM were higher in the urban community and among the patients having complications of DM. The study recommends community based screening program for early diagnosis of DM and treatment. The study also recommends periodic follow-up facilities for the patients at all levels to avert the rising burden of diabetes mellitus and its complications.

1.1 Introduction

Diabetes has been recognized as one manifestation of the "metabolic syndrome", a condition characterized by insulin resistance or impaired insulin production and associated with a range of risk factors. Epidemiological transition has led a major shift in cause of death and disability due to diabetes mellitus. Emerging epidemics of diabetes is a major challenge for finances and capacities of global health system of 21st century.[1] Global Burden of Disease study has addressed diabetes mellitus as a rising public health problem worldwide.[2,3]

The prevalence of diabetes has been increasing worldwide since last few decades and is now epidemic in nature in developed world.[4] The worldwide prevalence of diabetes in all age-groups was estimated to be 2.8% in 2000 and is predicted to be 4.4% by 2030.[5] The number of deaths from diabetes in 2000 was estimated to be 2.9 million, equivalent to 5.2% of all deaths globally.[6] High prevalence of diabetes is associated with various risk factors including environmental factors, physical inactivity, obesity, biological factors, genetic factors, old age, race or ethnicity and family history.[7,8] Studies in Sweden reported that the increase in life expectancy was the main reason for the increasing prevalence of diabetes.[9,10] Recent U.S. studies have suggested that the rapid increase in obesity was a major factor for increase in the prevalence of diabetes.[11,12] It has been estimated that the prevalence of diabetes in the developing world will increase by 48% and over 75% of diabetes cases will be in the developing world by the year 2025.[4]

Type-2 diabetes has been addressed as a major public health problem worldwide.[13] Recent epidemiological reports indicated an increased prevalence of diabetes in Turkey (7.2%), India (8.2%), Pakistan (11.1%), and Hawaii (20.4%).[14-17] It is estimated that the developing countries will bear the brunt of diabetes epidemics in the 21st century.[18] Diabetes mellitus accounts for 0.8% DALY loss globally where 0.9% DALY loss was in developed and 0.7% DALY loss was in developing countries. Disease burden study of WHO estimated DALYs attributable to diabetes to be 20.72 lakh in 2000 while DALY loss in India was 22.63 lakh in 2004.[2]

Evidences show that the epidemiological transition is underway in Bangladesh and burden of diabetes is increasing rapidly in the country.[19,20] Under Health, Nutrition and Population

Sector Programme, the government is endeavoring to ensure equitable distribution of basic health care services to the people of the country with a special attention to diabetes mellitus.[21] Some population-based studies have revealed an increasing trend of diabetes prevalence ranging from 1.5 to 3.8% in the rural communities.[22-26] A study conducted by Sayeed MA et.al estimated the prevalence of DM 11.2% in urban population of Bangladesh[27] while another study conducted by Rahim MA et.al estimated the prevalence of DM 6.8% in rural population.[28] It was also reported that Bangladeshis are more susceptible to develop diabetes, hyperinsulinemia, and coronary heart disease compared with other South Asian migrants settled in the U.K. The risk factors related to diabetes were more prevalent in Bangladeshis than in the native population.[29,30] It is to be noted here that no data regarding DALY loss due to diabetes mellitus is available in context of Bangladesh. But a study conducted by Islam MZ among the patients attending the outpatient department of BIRDEM hospital in 2003 estimated average YLD as 3.07.[31]

DM may fabricate serious economic damage to the patients because its medical care is usually very expensive. Sometimes patients do not avail modern care in fear of unaffordable expenditure and seek health care from cheap & traditional sources, which often poses additional burden of complications.[32] Increased burden of DM in Bangladesh will have serious implications for the management and financing of the health sector.

At present the health sector in Bangladesh is basically oriented towards primary health care to eradicate/reduce burden of communicable diseases. The strategies may have to be shifted and health sector activities may have to be reformed to combat increasing burden of non-communicable diseases like DM. It is, therefore imperative to estimate both disability and economic burden of diabetes mellitus for rational allocation of scarce health resources of the country. Unfortunately, no comprehensive and rigorous study along this line is available at present in the context of Bangladesh. The purpose of this study is to address burden of diabetes and to compare its magnitude between of urban and rural communities. Thus it will contribute to invent realistic and effective strategies to reduce the escalating burden of the disease through provision of cost-effective and need based health care services to the people.

1.2 Background

Diabetes was first recognized around 1500 B.C.E. by the ancient Egyptians, who considered it a rare condition in which a person urinated excessively and lost weight. The term diabetes mellitus, reflecting the fact that the urine of those affected had a sweet taste, was first used by the Greek physician Aretaeus, who lived from about 80 to 138 B.C.E. It was not until 1776, however, that Matthew Dobson actually measured the concentration of glucose in the urine of such patients and found it to be increased[33]. Diabetes was a recognized clinical entity when the New England Journal of Medicine and Surgery was founded in 1812. Its prevalence at the time was not documented, and essentially nothing was known about the mechanisms responsible for the disease. No effective treatment was available, and diabetes was uniformly fatal within weeks to months after its diagnosis owing to insulin deficiency.[33]

Ironically, although scientific advances have led to effective strategies for preventing diabetes, the pathway to cure has remained elusive. In fact, if one views diabetes from a public health and overall societal standpoint, little progress has been made toward conquering the disease during the past 200 years, and we are arguably worse off now than we were in 1812. Two centuries ago, severe insulin deficiency dominated the clinical presentation of diabetes. Although it is possible that some people had milder forms of hyperglycemia at that time, they largely escaped clinical detection. In 2012, the commonly encountered spectrum of diabetes is quite different. Although severe insulin deficiency still occurs, it now accounts for only about 10% of cases overall and can be readily treated with insulin. The vast majority of patients with diabetes is overweight and has a combination of insulin resistance and impaired insulin secretion. The prevalence of this form of diabetes has been increasing dramatically, particularly in the past three to four decades, resulting in a pandemic that has made diabetes one of the most common and serious medical conditions humankind has had to face.[34]

Like other non communicable diseases (NCDs), diabetes is a primary concern of human life and its development. In developing countries approximately eight to fourteen million people die every year prematurely because of NCDs that are preventable. The most commonly occurring NCDs are cardiovascular diseases, diabetes mellitus, chronic respiratory disease and cancer. Due to these NCDs people are dying prematurely which are caused by

modifiable risk factors such as harmful diet, risk behavior and personal habit, all of which can be prevented.[35]

The prevalence of diabetes mellitus appeared to be increasing with time which was apparently linked to modifiable risk factors, such as sugar intake. Diabetes prevalence was also associated with urbanization, which was used as a proxy for various risk factors, such as increased consumption of junk food, obesity and physical inactivity. There is a need to address this issue on the global level, because its impact is substantial, and together with its complications, it will result in disability and premature deaths around the world. This global burden of diabetes is in turn, hampering both physical health the economic growth and stability, throughout the world.[36]

The effects of diabetes mellitus include long– term damage, dysfunction and failure of various organs. In its most severe forms, ketoacidosis or a non–ketotic hyperosmolar state may develop and lead to stupor, coma and, in absence of effective treatment, death. Often symptoms are not severe, or may be absent, and consequently hyperglycemia sufficient to cause pathological and functional changes may be present for a long time before the diagnosis is made. The long–term effects of diabetes mellitus include progressive development of the specific complications of retinopathy with potential blindness, nephropathy that may lead to renal failure, and/or neuropathy with risk of foot ulcers, amputation, Charcot joints, and features of autonomic dysfunction, including sexual dysfunction. People with diabetes are at increased risk of cardiovascular, peripheral vascular and cerebrovascular disease.[36]

During this period of 1980-2010, the number of diagnosed cases of diabetes increased from 5.6 million to 20.9 million, representing 2.5% and 6.9% of the population, respectively. Nearly 27% of persons over 65 years of age have diabetes. If current trends continue, 1 in 3 U.S. adults could have diabetes by 2050. The American Diabetes Association estimated that the cost of diagnosed diabetes in the United States was $174 billion in 2007 and efforts to prevent and treat diabetes threaten to overwhelm health systems throughout the world.[37]

Functional disability is increasing among the people with diabetes mellitus as a study conducted by Gregg EW revealed that functional disability was 9.8% among women with diabetes and 4.8% among women without diabetes.[38]

Given the surge in the burden of diabetes, timely prevention by early detection and prompt treatment of this disease at the population level is essential. Rigorous scientific methods will be needed to estimate and combat the burden of the disease. Policy and legislative initiatives should be taken to eliminate food items of high-calorie, high-fat foods and sugar-sweetened beverages. Lifestyle modification will undoubtedly play a key role in the ultimate solution to the problem of diabetes, but the necessary modifications have not been easy to implement, and more definitive solutions will depend on the ability of basic science to point prevention and treatment in new directions. As the disease poses enormous economic burden to the patients, families, society and state, so, innovative and effective financial interventions and measures are essential to enable the poor and disadvantaged victims to cope up the economic burden of the disease.[38]

It was estimated that in the year 2011, 366 million people worldwide had diabetes, of whom about 80% (291 million) reside in low- and middle-income countries. If these trends continue, by 2030, 552 million people, or one in 10 adults, will have diabetes, of whom 458 million will reside in emerging economies compared with a mere 94 million in developed countries.[39]

In countries classified by the World Bank as upper middle-income, lower middle-income, and low-income countries, the prevalence of diabetes in 2011 was 10.1%, 8.6%, and 5.8%, respectively, among individuals in the age group of 20–79 years. Of the top 10 countries listed by International Diabetes Federation in 2011 in terms of the number of individuals with diabetes, eight are classified as developing countries- namely, China, India, the Russian Federation, Brazil, Mexico, Bangladesh, Egypt, and Indonesia. The highest number of people with diabetes in the world currently is in China (90.0 million in 2011), and these numbers are expected to swell to 129.7 million by 2030, whereas the corresponding figures for India are 61.3 million in 2011, which is expected to increase to 101.2 million by 2030.[39]

There are also significant differences between and within developing countries because of the geographical diversity in socioeconomic growth rates, demographic and lifestyle changes, and perhaps differences in genetic susceptibility to diabetes. The prevalence of diabetes in Sub-Saharan Africa ranges from 1% in rural Uganda[40] to 12% in urban Kenya[41] and 2% in Ethiopia.[42] It was 4.6% in Indonesia,[43] 11.6% in Malaysia,[44] and 7.5% in Thailand.[45]

Though the prevalence of diabetes is currently lower in low income countries compared with high-income countries, the number of deaths due to diabetes in low-income countries (492,000) is nearly as high as in high-income countries (544,000).[39]

In Tamilnadu, the prevalence of diabetes in urban areas (13.7%) is almost double the rates found in rural areas (7.8%). In Jharkhand, the prevalence of diabetes in urban areas is fourfold higher than in rural areas (13.5% for urban vs. 3% for rural, Chandigarh, the prevalence of diabetes in urban is higher than the rates in rural (actually a peri-urban area, as this is a union territory) areas (14.2% for urban vs. 8.3% for rural). In Maharashtra also, the prevalence of diabetes in urban is higher than the rates in rural areas (10.9% for urban vs. 6.5% rural).[39]

WHO has reported that diabetes mellitus (DM) is one of the twenty leading causes of disease burden in terms of disability adjusted life years (DALY) and the disease shared 2.1% and 2.0% DALY globally and in SEAR respectively in 2011. In respect of years lived with disability (YLD), diabetes mellitus shared 3.0% and 2.3% YLD globally and in SEAR respectively in 2011. Regarding years of life lost due to premature death (YLL), DM shared 1.7% and 1.9% YLL globally and in SEAR respectively in 2011.[46]

The costs associated with diabetes include increased use of health services, lost productivity, and disability which can be a considerable burden to the individual, to families and to society. When people have undiagnosed diabetes the opportunities and potential benefits of early diagnosis and treatment are lost. Furthermore, the costs related to undiagnosed diabetes are considerable. One study from the USA found that undiagnosed diabetes was responsible for an additional USD 18 billion in healthcare costs in one year.[47]

Diabetes imposes a large economic burden on the individual, national healthcare systems, and countries. Healthcare expenditures due to diabetes account for 11% of the total healthcare expenditures in the world in 2011. About 80% of the countries covered in this report are estimated to spend between 5% and 18% of their total healthcare expenditures on diabetes. Healthcare expenditures include spending on diabetes by the health system as well as by people living with diabetes.[48]

Estimated global healthcare expenditures to treat diabetes and prevent complications totaled at least US dollars (USD) 465 billion in 2011. By 2030, this number is projected to exceed some USD 595 billion. Expressed in 2008 International Dollars (ID), which correct for differences in purchasing power, global healthcare expenditures on diabetes are estimated to be at least ID 499 billion in 2011 and ID 654 billion in 2030. An estimated average of USD 1,274 (ID 1,366) per person with diabetes was spent globally on treating and managing the disease in 2011. Healthcare expenditures due to diabetes are not evenly distributed across age groups and genders. The estimates showed that more than three-quarters of the global healthcare expenditure due to diabetes in 2011 were for people between the ages of 50 and 79 years.[47]

There is a large disparity in healthcare spending on diabetes between regions and countries. Only 20% of global healthcare expenditures due to diabetes were made in low- and middle-income countries, where 80% of people with diabetes live. On average, the estimated healthcare spending due to diabetes was USD 5,063 (ID 4,888) per person with diabetes in high-income countries compared to USD 271 (ID 456) in low- and middle-income countries. The United States of America spent USD 201 billion of its healthcare dollars on diabetes or 43% of global healthcare expenditure due to diabetes, while China, the country with the most people living with diabetes spent just USD 17 billion, or less than 4% of the global total. Similarly, Luxembourg spent an average of USD 9,341 on diabetes care per person with diabetes while countries such as Eritrea, Democratic People's Republic of Korea, and Myanmar spent less than USD 20 in 2011.[47]

Those living in low- and middle-income countries pay a larger share of healthcare expenditure because they lack access to health insurance and publicly available medical

services. In Latin America, for instance, families pay 40-60% of medical care expenditures from their own pocket. In some of the poorest countries, people with diabetes and their families bear almost the total cost of medical care. The huge economic burden of diabetes can be reduced by implementing inexpensive, easy-to-use interventions. Many of these interventions are cost-effective or cost-saving, even in the poorest countries. Nonetheless, these interventions are not widely used in low- and middle-income countries.[48]

Information regarding both disability and economic burden of diabetes mellitus is very scarce in Bangladesh. It is very imperative to estimate the burden of diabetes mellitus in the country in respect of urban and rural communities to provide cost-effective preventive and curative health care services to the victims of the disease.

1.3. Justification

The conspicuous worldwide increase in the prevalence of diabetes mellitus is posing a massive health problem.[49] Interestingly, in developed countries, lower socioeconomic groups are most affected, while, in developing countries, the reverse scenario is observed as most of people of affluent society suffer from diabetes.[50] It is also evidenced that urban peoples are more victims of the disease than the rural population in the developing world due to a consequence of increasing urbanization and lifestyle changes.[51]

Diabetogenic process begins in fetal life, low birth weight and poor nutrition combining with sedentary lifestyle and dietary factors produce an insulin-resistant phenotype.[52] The magnitude of the health problem of diabetes results not just from the disease itself but also from its association with other diseases like neuropathy, retinopathy, nephropathy, obesity, dyslipidaemia, cardiovascular diseases.[53] Several studies reported that migrant Bangladeshis had greater risk for diabetes compared with the Europeans and other South Asians migrant.[54] Several relevant studies depicted that prevalence of diabetes is increasing in a rapid pace in Bangladesh.[24-28] In this regard it is to be recommended that more emphasis should be planted to estimate the burden of DM for rational allocation of scarce resources. Some studies have already been carried out regarding prevalence of DM in Bangladesh but information about disability and economic burden of DM are very scarce.

To fight with the challenge of burden of DM, health care facilities will have to be radically developed, which is a costly affair. For this the government will have to allocate more resources for DM. On the other hand, variable cost of treatment of DM is usually very high, and this requires huge amount of private expenditure on the part of patients. Existing financing mechanism will not be able to cope up with the emerging challenge and new mechanism will have to be devised. Health resources in most of the developing countries like Bangladesh are very limited with around 5% of GDP being spent on healthcare.[55] Therefore careful planning based on economic burden is necessary in order to maximize the use of funds for treatment and prevention of diabetes.

The proposed study intends to explore the basic issues regarding burden of DM. The study will follow the approach and method used in the Global Burden of Disease study by

WHO, so that it will quantify the disability posed by DM, which may be comparable with the estimates of other countries. The study will also estimate economic burden of DM shared by the patients along with the sources of funding, which can be critically reviewed in comparison with other funding and cost sharing models in the world. The study will have profound academic and policy implications. At the academic level, it may upgrade the knowledge regarding burden of DM in context of Bangladesh. Besides its academic significance, the study can portray useful policy implications to reduce the escalating burden of DM in Bangladesh. It is essential for health sector to reorganize the role and activities of the health facilities to combat the increasing burden of DM. At primary level, clinical services for DM should be incorporated and at secondary and tertiary level, it should be expanded and improved to combat the burden of DM.

This study intends to collate information regarding disability burden in terms of disability adjusted life years (DALY) and economic burden in terms of treatment cost incurred by the patients along with the sources of fund for treatment and its coping ways. The study findings will contribute to formulation of precise and effective strategies to combat disability burden of DM. It will also inspire to develop and implement innovative health service financing system to reduce economic burden of the DM patients. Moreover, the study will encourage future comprehensive study in the relevant field along with other non-communicable diseases to prioritize diseases on the basis its burden for rational allocation of meager resources in the health sector of the country.

2.1 Research Question

- Is there any difference of burden of diabetes mellitus between urban and rural communities of Bangladesh?

2.2 Hypothesis

2.2.1 Research Hypothesis

- There is difference of burden of diabetes mellitus between urban and rural communities of Bangladesh.

2.2.2 Statistical Hypothesis

- **Null Hypothesis (H0):** Burden of diabetes mellitus in the urban community is equal to the burden in the rural community of Bangladesh.

- **Alternative Hypothesis (H1):** Burden of diabetes mellitus is more in the urban community than in the rural community of Bangladesh.

2.3 Objectives of the Study

2.3.1 General Objective

To compare the burden of diabetes mellitus between urban and rural communities of Bangladesh

2.3.2 Specific Objectives

- To estimate the prevalence of Diabetes Mellitus (DM) in urban and rural communities.
- To measure disability burden of DM in terms of Disability Adjusted Life Years (DALY) loss in urban and rural communities.
- To estimate the economic burden incurred by the DM patients (Using 'Cost of Treatment' approach) in both communities.
- To find out the risk factors and complications of diabetes mellitus in the communities.
- To compare the burden of the disease in respect of socio-demographic characteristics of the communities, risk factors and complications of DM.

2.4 Variables of the study

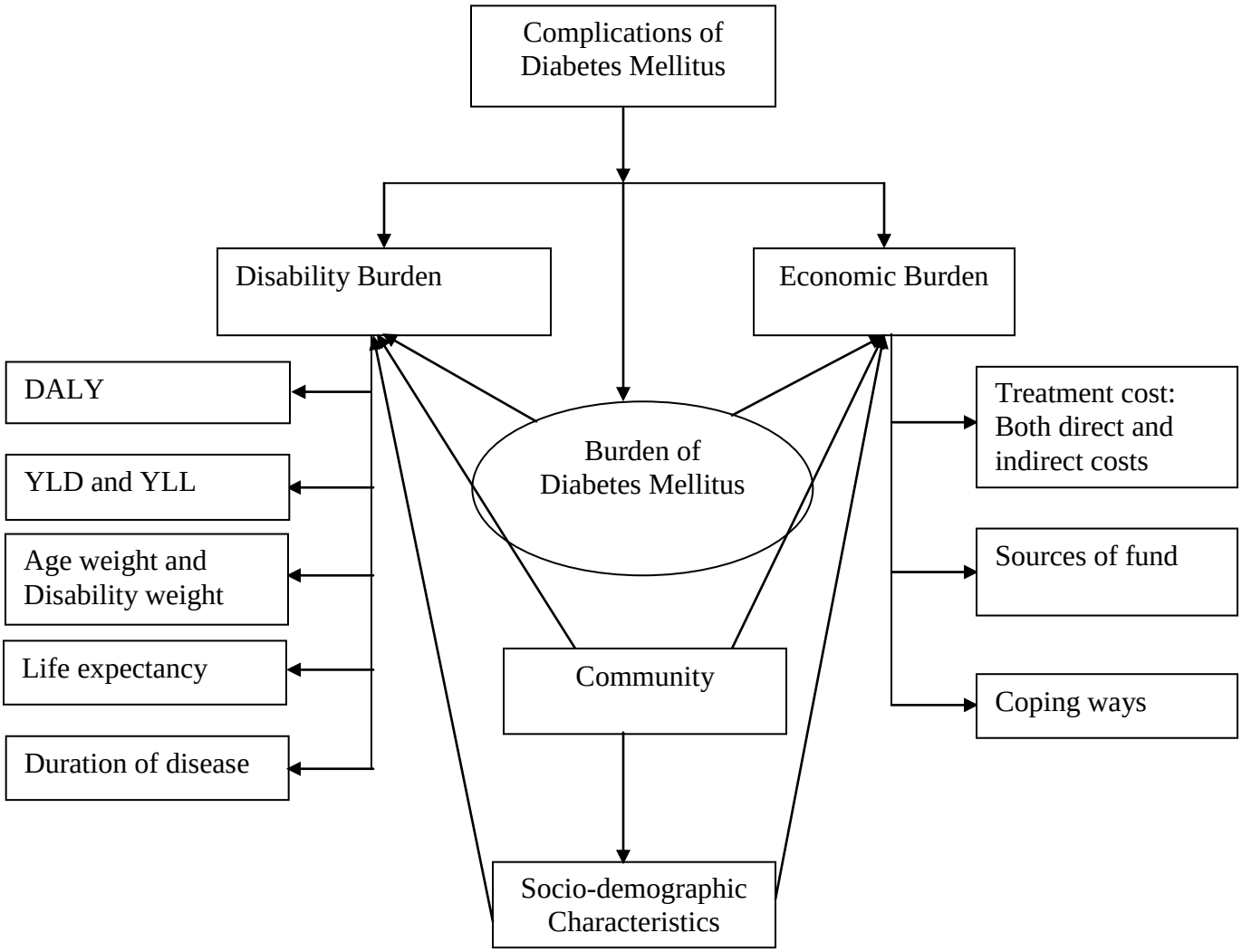
2.4.1 Dependent variable:

- Burden of Diabetes Mellitus

2.4.2 Independent variables:

- Socio-demographic characteristics:
    - Age, sex, education, occupation, religion, marital status, family member, residing place (urban/rural), monthly family income
- Prevalence of diabetes mellitus
- Variables related to disability burden:
    - Disability adjusted life years (DALY)
    - Years lived with disability (YLD)
    - Years of life lost due to premature death caused by the disease (YLL)
    - Duration of the disease
    - Life expectancy at birth
    - Age at the onset of the disease
    - Age at the time of death
    - Age weight and disability weight
- Risk factors of DM:
    - BMI, obesity, physical activity, food habit, family history, drug intake etc.
- Complications of diabetes mellitus:
    - Retinopathy, cataract, nephropathy, neuropathy, diabetic foot etc.
- Variables related to economic burden (Treatment cost):
    - Direct costs: Consultation fee, hospital expense, cost of drug, cost of investigation, cost of monitoring, cost of treating complications, travel cost, cost of attendant, and tips for treatment.
    - Indirect costs: Wage loss, disability payment, social security, tax rebate.
    - Sources of fund: Household saving, Govt. subsidy, insurance, Loan from relative/employee, selling wealth/property.
    - Coping ways: compensate with food consumption, life style, education and treatment of family member.

2.5 Conceptual Framework



DALY: Disability Adjusted Life Years
YLD: Years of Life Lived with Disability
YLL: Years of Life Lost due to Premature Death

3.0 Literature Review

Like other non communicable diseases (NCDs), diabetes is a primary concern of human life and its development. In developing countries approximately eight to fourteen million people die every year prematurely because of NCDs that are preventable. The most commonly occurring NCDs are cardiovascular diseases, diabetes, chronic respiratory disease and cancer. Due to these NCDs people are dying prematurely which are caused by modifiable risk factors such as harmful diet and other risk factors, all of which can be prevented.[36,56]

Definition

Diabetes is a non-communicable chronic disease with raised blood glucose levels (hyperglycemia) due to decreased production of insulin by the pancreas or the inability of cells to utilize insulin properly.[57]

The term, diabetes mellitus describes a metabolic disorder with heterogeneous aetiologies, characterized by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both. This high blood sugar produces the classical symptoms of polyuria (frequent urination), polydipsia (increased thirst) and polyphagia (increased hunger).

Pathophysiology

The fluctuation of blood sugar and the sugar-lowering hormone insulin in humans occurs during the course of a day with three meals. Mechanism of insulin release in normal pancreatic beta cells - insulin production is more or less constant within the beta cells. Its release is triggered by food, chiefly food containing absorbable glucose. Insulin is the principal hormone that regulates uptake of glucose from the blood into most cells (primarily muscle and fat cells, but not central nervous system cells). Therefore, deficiency of insulin or the insensitivity of its receptors plays a central role in all forms of diabetes mellitus.

Humans are capable of digesting some carbohydrates, in particular those most common in food; starch, and some disaccharides such as sucrose, are converted within a few hours to simpler forms, most notably the monosaccharide glucose, the principal carbohydrate energy source used by the body. The rest are passed on for processing by gut flora largely in the

colon. Insulin is released into the blood by beta cells (β-cells), found in the islets of Langerhans in the pancreas, in response to rising levels of blood glucose, typically after eating. Insulin is used by about two-thirds of the body's cells to absorb glucose from the blood for use as fuel, for conversion to other needed molecules, or for storage.[57]

Insulin is also the principal control signal for conversion of glucose to glycogen for internal storage in liver and muscle cells. Lowered glucose levels result both in the reduced release of insulin from the β-cells and in the reverse conversion of glycogen to glucose when glucose levels fall. This is mainly controlled by the hormone glucagon, which acts in the opposite manner to insulin. Glucose thus forcibly produced from internal liver cell stores (as glycogen) re-enters the bloodstream; muscle cells lack the necessary export mechanism. Normally, liver cells do this when the level of insulin is low (which normally correlates with low levels of blood glucose).[57]

Higher insulin levels increase some anabolic ("building up") processes, such as cell growth and duplication, protein synthesis, and fat storage. Insulin (or its lack) is the principal signal in converting many of the bidirectional processes of metabolism from a catabolic to an anabolic direction, and vice versa. In particular, a low insulin level is the trigger for entering or leaving ketosis (the fat-burning metabolic phase).

If the amount of insulin available is insufficient, if cells respond poorly to the effects of insulin (insulin insensitivity or resistance), or if the insulin itself is defective, then glucose will not have its usual effect, so it will not be absorbed properly by those body cells that require it, nor will it be stored appropriately in the liver and muscles. The net effect is persistent high levels of blood glucose, poor protein synthesis, and other metabolic derangements, such as acidosis.[58]

When the glucose concentration in the blood is raised to about 9-10 mmol/L (except certain conditions, such as pregnancy), beyond its renal threshold (i.e. when glucose level surpasses the transport maximum of glucose reabsorption), reabsorption of glucose in the proximal renal tubuli is incomplete, and part of the glucose remains in the urine (glycosuria). This increases the osmotic pressure of the urine and inhibits reabsorption of water by the kidney,

resulting in increased urine production (polyuria) and increased fluid loss. Lost blood volume will be replaced osmotically from water held in body cells and other body compartments, causing dehydration and increased thirst.[58]

Classification

Diabetes mellitus is classified into four broad categories:

Type 1 Diabetes Mellitus

The term "type 1diabetes" has replaced several former terms, including childhood-onset diabetes, juvenile diabetes, and insulin-dependent diabetes mellitus (IDDM) results from the body's failure to produce insulin, and currently requires the person to inject insulin or wear an insulin pump.[59]

Type 1 diabetes mellitus is characterized by loss of the insulin-producing beta cells of the islets of Langerhans in the pancreas, leading to insulin deficiency. This type can be further classified as immune-mediated or idiopathic. The majority of type 1 diabetes is of the immune-mediated nature, in which beta cell loss is a T-cell-mediated autoimmune attack.[58] There is no known preventive measure against type 1 diabetes, which causes approximately 10% of diabetes mellitus cases in North America and Europe. Most affected people are otherwise healthy and of a healthy weight when onset occurs. Sensitivity and responsiveness to insulin are usually normal, especially in the early stages. Type 1 diabetes can affect children or adults, but was traditionally termed "juvenile diabetes" because a majority of these diabetes cases were in children.[59]

"Brittle" diabetes, also known as unstable diabetes or labile diabetes is a term that was traditionally used to describe the dramatic and recurrent swings in glucose levels, often occurring for no apparent reason in insulin-dependent diabetes. This term, however, has no biologic basis and should not be used.[59] There are many reasons for type 1 diabetes to be accompanied by irregular and unpredictable hyperglycemia, frequently with ketosis, and sometimes serious hypoglycemia, including an impaired counter regulatory response to hypoglycemia, occult infection, gastroparesis (which leads to erratic absorption of dietary

carbohydrates), and endocrinopathies (e.g., Addison's disease).[5] These phenomena are believed to occur no more frequently than in 1% to 2% of persons with type 1 diabetes.[60]

Type 2 Diabetes Mellitus

Likewise, the term "type 2diabetes" has replaced several former terms, including adult-onset diabetes, obesity-related diabetes, and noninsulin-dependent diabetes mellitus (NIDDM) and results from insulin resistance, a condition in which cells fail to use insulin properly, sometimes combined with an absolute insulin deficiency.[61]

Type 2 diabetes mellitus is characterized by insulin resistance, which may be combined with relatively reduced insulin secretion.[61] The defective responsiveness of body tissues to insulin is believed to involve the insulin receptor. However, the specific defects are not known. Diabetes mellitus cases due to a known defect are classified separately. Type 2 diabetes is the most common type.

In the early stage of type 2, the predominant abnormality is reduced insulin sensitivity. At this stage, hyperglycemia can be reversed by a variety of measures and medications that improve insulin sensitivity or reduce glucose production by the liver. [61]

Gestational Diabetes

Gestational diabetes mellitus (GDM) resembles type 2 diabetes in several respects, involving a combination of relatively inadequate insulin secretion and responsiveness. It occurs in about 2–5% of all pregnancies and may improve or disappear after delivery. Gestational diabetes is fully treatable, but requires careful medical supervision throughout the pregnancy. About 20–50% of affected women develop type 2 diabetes later in life.[57]

Though it may be transient, untreated gestational diabetes can damage the health of the fetus or mother. Risks to the baby include macrosomia (high birth weight), congenital cardiac and central nervous system anomalies, and skeletal muscle malformations. Increased fetal insulin may inhibit fetal surfactant production and cause respiratory distress syndrome. Hyperbilirubinemia may result from red blood cell destruction. In severe cases, perinatal death may occur, most commonly as a result of poor placental perfusion due to vascular impairment. Labor induction may be indicated with decreased placental function. A

Caesarean section may be performed if there is marked fetal distress or an increased risk of injury associated with macrosomia, such as shoulder dystocia[57].

A 2008 study completed in the U.S. found the number of American women entering pregnancy with pre-existing diabetes is increasing. In fact, the rate of diabetes in expectant mothers had more than doubled from 1999 to 2005.[62] This is particularly problematic as diabetes raises the risk of complications during pregnancy and increases the potential for the children of diabetic mothers to become diabetic in the future

Other Specific Types

The "other specific types" are a collection of a few dozen individual causes.[61] Other forms of diabetes mellitus include congenital diabetes, which is due to genetic defects of insulin secretion, cystic fibrosis-related diabetes, steroid diabetes induced by high doses of glucocorticoids, and several forms of monogenic diabetes.[61]

Prediabetes indicates a condition that occurs when a person's blood glucose levels are higher than normal but not high enough for a diagnosis of type 2 DM. Many people destined to develop type 2 DM spend many years in a state of prediabetes which has been termed "America's largest healthcare epidemic.[37]

Latent autoimmune diabetes of adults (LADA) is a condition in which type 1 DM develops in adults. Adults with LADA are frequently initially misdiagnosed as having type 2 DM, based on age rather than etiology.

Some cases of diabetes are caused by the body's tissue receptors not responding to insulin (even when insulin levels are normal, which is what separates it from type 2 diabetes); this form is very uncommon. Genetic mutations (autosomal or mitochondrial) can lead to defects in beta cell function. Abnormal insulin action may also have been genetically determined in some cases. Any disease that causes extensive damage to the pancreas may lead to diabetes (for example, chronic pancreatitis and cystic fibrosis). Diseases associated with excessive secretion of insulin-antagonistic hormones can cause diabetes (which is typically resolved once the hormone excess is removed). Many drugs impair insulin secretion and some toxins damage pancreatic beta cells. The ICD-10 (1992) diagnostic entity, malnutrition-related

diabetes mellitus (MRDM or MMDM, ICD-10 code E12), was deprecated by the World Health Organization when the current taxonomy was introduced in 1999.[37]

Causes and Risk Factors of Diabetes Mellitus

The cause of diabetes depends on the type. Type1 diabetes is partly inherited, and then triggered by certain infections, with some evidence pointing at Coxsackie B4 virus. A genetic element in individual susceptibility to some of these triggers has been traced to particular HLA genotypes (i.e., the genetic "self" identifiers relied upon by the immune system). However, even in those who have inherited the susceptibility, type 1 DM seems to require an environmental trigger. The onset of type 1 diabetes is unrelated to lifestyle.[62]

Type 2 diabetes is due primarily to lifestyle factors and genetics.[63] A number of lifestyle factors are known to be important to the development of type 2 diabetes, including: obesity (defined by a body mass index of greater than thirty), lack of physical activity, poor diet, stress, and urbanization.[64] Excess body fat is associated with 30% of cases in those of Chinese and Japanese descent, 60-80% of cases in those of European and African descent, and 100% of Pima Indians and Pacific Islanders. Those who are not obese often have a high waist–hip ratio.[61]

Dietary factors also influence the risk of developing type2 diabetes. Consumption of sugar-sweetened drinks in excess is associated with an increased risk.[65,66] The type of fats in the diet are also important, with saturated fats and trans fatty acids increasing the risk and polyunsaturated and monounsaturated fat decreasing the risk.[63] Eating lots of white rice appears to also play a role in increasing risk. A lack of exercise is believed to cause 7% of cases.[67]

Studies in native urban Asian Indians have noted that hypertension was not associated with insulin resistance.[68] Despite the fact that obesity is a well-known risk factor for Type 2 diabetes, we have not observed any important association of obesity and diabetes in our population following FBG or OGTT, either among the rural or urban subjects. Rather a significant protective effect was observed for those with BMI 16.0–18.4 compared with BMI 18.5–24.9 (normal) in the urban population.[68]

Waist-to-hip ratio appeared to be significantly associated with diabetes in men for both urban and rural subjects, but this association was not apparent for women. The association between WHR and DM was also observed in previous studies in Bangladesh.[69] Many epidemiological studies have shown an association between WHR and Type 2 diabetes[70].Studies on South Asians migrants also showed that the WHR ratio was higher than in European populations of equal BMI.[71]

Further, in the early 1990s Barker made his hypothesis that low birth weight (LBW) is associated with later health events. Forsen and colleagues determined that Type 2 diabetes is programmed in utero in association with low rates of fetal growth.[72] It is known that the rural poor generally migrate to urban slums, and poverty is related to LBW babies. Therefore, it is not irrational to speculate that LBW babies carry a high risk for the development of DM and possibly CHD, irrespective of their obese status in adulthood.[72]

List of other causes of diabetes[73]

• Genetic defects of β-cell function -Maturity onset diabetes of the young -Mitochondrial DNA mutations • Genetic defects in insulin processing or insulin action -Defects in proinsulin conversion -Insulin gene mutations • Insulin receptor mutations Exocrine pancreatic defects -Chronic pancreatitis -Pancreatectomy -Pancreatic neoplasia -Cystic fibrosis -Hemochromatosis -Fibrocalculous pancreatopathy	• Endocrinopathies -Growth hormone excess (acromegaly) -Cushing syndrome -Hyperthyroidism -Pheochromocytoma -Glucagonoma • Infections -Cytomegalovirus infection -Coxsackievirus B • Drugs -Glucocorticoids -Thyroid hormone -β-adrenergic agonists

Diagnosis

Diabetes diagnostic criteria[74,75]:

Condition	2 hour glucose	Fasting glucose	HbA_{1c}
	mmol/l(mg/dl)	mmol/l(mg/dl)	%
Normal	<7.8 (<140)	<6.1 (<110)	<6.0
Impaired fasting glycaemia	<7.8 (<140)	≥ 6.1(≥110) & <7.0(<126)	6.0–6.4
Impaired glucose tolerance	≥7.8 (≥140)	<7.0 (<126)	6.0–6.4
Diabetes mellitus	≥11.1 (≥200)	≥7.0 (≥126)	≥6.5

Diabetes mellitus is characterized by recurrent or persistent hyperglycemia, and is diagnosed by demonstrating any one of the following:[36]

- Fasting plasma glucose level ≥ 7.0 mmol/l (126 mg/dl)
- Plasma glucose ≥ 11.1 mmol/l (200 mg/dL) two hours after a 75 g oral glucose load as in a glucose tolerance test
- Symptoms of hyperglycemia and casual plasma glucose ≥ 11.1 mmol/l (200 mg/dl)
- Glycated hemoglobin (Hb A1C) ≥ 6.5%.[76]

A positive result, in the absence of unequivocal hyperglycemia, should be confirmed by a repeat of any of the above methods on a different day. It is preferable to measure a fasting glucose level because of the ease of measurement and the considerable time commitment of formal glucose tolerance testing, which takes two hours to complete and offers no prognostic advantage over the fasting test. According to the current definition, two fasting glucose measurements above 126 mg/dl (7.0 mmol/l) is considered diagnostic for diabetes mellitus.[77]

People with fasting glucose levels from 110 to 125 mg/dl (6.1 to 6.9 mmol/l) are considered to have impaired fasting glucose.[21] Patients with plasma glucose at or above 140 mg/dL (7.8 mmol/L), but not over 200 mg/dL (11.1 mmol/L), two hours after a 75 g oral glucose load are considered to have impaired glucose tolerance. Of these two prediabetic states, the latter in particular is a major risk factor for progression to full-blown diabetes mellitus, as

well as cardiovascular disease.[78] Glycated hemoglobin is better than fasting glucose for determining risks of cardiovascular disease and death from any cause.[26]

Complications

Untreated, diabetes can cause many complications. Acute complications include diabetic ketoacidosis and nonketotic hyperosmolar coma. Serious long-term complications include cardiovascular disease, chronic renal failure, and diabetic retinopathy (retinal damage). Adequate treatment of diabetes is thus important, as well as blood pressure control and lifestyle factors such as stopping smoking and maintaining a healthy body weight.[79]

All forms of diabetes increase the risk of long-term complications. These typically develop after many years (10–20 years), but may be the first symptom in those who have otherwise not received a diagnosis before that time. The major long-term complications relate to damage to blood vessels. Diabetes doubles the risk of cardiovascular disease.[80] The main "macrovascular" diseases (related to atherosclerosis of larger arteries) are ischemic heart disease (angina and myocardial infarction), stroke and peripheral vascular disease.[80]

Diabetes also damages the capillaries (causes microangiopathy).[81] Diabetic retinopathy, which affects blood vessel formation in the retina of the eye, can lead to visual symptoms including reduced vision and potentially blindness. Diabetic nephropathy, the impact of diabetes on the kidneys, can lead to scarring changes in the kidney tissue, loss of small or progressively larger amounts of protein in the urine, and eventually chronic kidney disease requiring dialysis.[81]

Another risk is diabetic neuropathy, the impact of diabetes on the nervous system — most commonly causing numbness, tingling and pain in the feet, and also increasing the risk of skin damage due to altered sensation. Together with vascular disease in the legs, neuropathy contributes to the risk of diabetes-related foot problems (such as diabetic foot ulcers) that can be difficult to treat and occasionally require amputation. Additionally, proximal diabetic neuropathy causes painful muscle wasting and weakness.[81]

Several studies suggest a link between cognitive deficit and diabetes.[82] Compared to those without diabetes, the research showed that those with the disease have a 1.2 to 1.5-fold greater rate of decline in cognitive function, and are at greater risk.[82]

People (usually with type 1 diabetes) may also present with diabetic ketoacidosis, a state of metabolic dysregulation characterized by the smell of acetone, a rapid, deep breathing known as Kussmaul breathing, nausea, vomiting and abdominal pain, and altered states of consciousness. A rare but equally severe possibility is hyperosmolar nonketotic state, which is more common in type 2 diabetes and is mainly the result of dehydration.[82]

History of Diabetes

Diabetes was first recognized around 1500 B.C.E. by the ancient Egyptians, who considered it a rare condition in which a person urinated excessively and lost weight.[83] The term diabetes mellitus, reflecting the fact that the urine of those affected had a sweet taste, was first used by the Greek physician Aretaeus, who lived from about 80 to 138 C.E. It was not until 1776, however, that Matthew Dobson actually measured the concentration of glucose in the urine of such patients and found it to be increased.[33]

The first described cases are believed to be of type 1 diabetes. Indian physicians around the same time identified the disease and classified it as madhumeha or "honey urine", noting the urine would attract ants. The term "diabetes" or "to pass through" was first used in 230 BCE by the Greek Appollonius of Memphis. The disease was considered rare during the time of the Roman Empire, with Galen commenting he had only seen two cases during his career.[84] This is possibly due the diet and life-style of the ancient people, or because the clinical symptoms were observed during the advanced stage of the disease. Galen named the disease "diarrhea of the urine" (diarrhea urinosa). The earliest surviving work with a detailed reference to diabetes is that of Aretaeus of Cappadocia (2nd or early 3rd century CE). He described the symptoms and the course of the disease, which he attributed to the moisture and coldness, reflecting the beliefs of the "Pneumatic School". He hypothesized a correlation of diabetes with other diseases and he discussed differential diagnosis from the snakebite which also provokes excessive thirst. His work remained unknown in the West until the middle of the 16th century when, in 1552, the first Latin edition was published in Venice.[85]

Type 1 and type2 diabetes were identified as separate conditions for the first time by the Indian physicians Sushruta and Charaka in 400-500 CE with type 1 associated with youth and type 2 with being overweight.[84] The term "mellitus" or "from honey" was added by the Briton John Rolle in the late 1700s to separate the condition from diabetes insipidus, which is also associated with frequent urination. Effective treatment was not developed until the early part of the 20th century, when Canadians Frederick Banting and Charles Herbert Best isolated and purified insulin in 1921 and 1922. This was followed by the development of the long-acting insulin in the 1940s.[84]

Prevalence of Diabetes Mellitus

Diabetes was a recognized clinical entity when the New England Journal of Medicine and Surgery was founded in 1812. Its prevalence at the time was not documented, and essentially nothing was known about the mechanisms responsible for the disease. No effective treatment was available, and diabetes was uniformly fatal within weeks to months after its diagnosis owing to insulin deficiency. In the intervening 200 years, major fundamental advances have been made in our understanding of the underlying causes of diabetes and the approach to its prevention and treatment. Although diabetes is still associated with a reduced life expectancy, the outlook for patients with this disease has improved dramatically, and patients usually lead active and productive lives for many decades after the diagnosis has been made. Many effective therapies are available for treating hyperglycemia and its complications. The prevalence of this form of diabetes has been increasing dramatically, particularly in the past three to four decades, resulting in a worldwide epidemic that has made diabetes one of the most com Diabetes has been found to be more prevalent in urban than in rural populations.[86] Urbanization and urban migration have been established as a risk factor for an increased occurrence of diabetes.[87] The trend has been authenticated by the World Health Organization (WHO).[14]

Most rural migrants settle in urban slums and are exposed to a number of unhealthy life conditions like vector and water-borne infections, overcrowding and stress. It is likely that as an accumulated effect of all the adverse conditions, the slum dwellers suffer from a variety of health problems from communicable to non-communicable diseases. Under these hostile living settings it is less likely that the inhabitants will develop obesity which may result in the

observed higher prevalence of chronic diseases like diabetes mellitus (DM), coronary heart disease (CHD) and hypertension (HTN). Some small-scale previous studies in Bangladesh have indicated low body mass indexes (BMI) in the investigated population.[23,24] In a recent study in Bangladesh, family history of diabetes, wealth, age, physical activity, BMI and waist/hip ratio (WHR) were identified as risk factors for diabetes in a rural population.[88] However, the study did not compare the risk factors with a comparable urban population to identify factors associated with the increased occurrence of Type 2 DM.[88]

The prevalence of DM was significantly higher in urban (8.1%) than in rural (2.3%) areas. Diabetes prevalence increased with increasing age, both for urban and rural areas, but the increment was almost three to five folds higher among the urban population compared with the rural in all age strata both among male and females. Females had significantly higher prevalence of diabetes in all age categories, both in urban and rural areas.[89]

The rural population had statistically significant higher age, systolic and diastolic blood pressure compared with the urban population despite of lower levels of DM following FBG. Age, sex and waist-to-hip ratio for males were significant risk factors for the development of diabetes, both in urban and rural subjects following both FBG and 2-h BG criteria.[89] Systolic blood pressure had a marginally significant association with DM following only FBG in rural subjects. However, this association was not observed with 2-h BG values. However, the risk of DM was notably higher for obese individuals but the apparent significant association was not noted, possibly because of fewer subjects belonging to this group.[89]

Waist-to-hip ratio (WHR > 0.9) was found to be significantly associated with diabetes only in men both in rural and urban areas after adjusting for a number of potential confounding factors.[42] There was higher prevalence of diabetes among females in all age categories, both in urban and rural areas. The finding of female predominance is consistent with most previous studies in Bangladesh.[26]

A study from Bangladesh describes an increased prevalence of type 2 diabetes in an affluent population when corrected for other major diabetes risk factors. Seven studies investigating the relation between the incidence of type1 diabetes and socioeconomic status have generally found little evidence of a relation. That study showed, in either urban or rural areas, the

highest prevalence of Non Insulin Dependent Diabetes Mellitus (NIDDM) was observed among the rich, and the lowest prevalence was observed among the poor socioeconomic classes. The rural rich had much higher prevalence of Impaired Glucose Tolerance (IGT) than their urban counterpart (16.5 vs. 4.4%, CI 6.8 -17.4). Increased age was an important risk factor for IGT and NIDDM in both rural and urban subjects, whereas the risk related to higher Body Mass Index (BMI) and waist-to-hip ratio (WHR) was less significant in rural than urban subjects. The urban subjects had no excess risk for NIDDM. In contrast, an excess risk for glucose intolerance (2-h BG > or = 7.8 mmol/l) was observed in the rural subjects. Adjusting for age, sex, and social class, the prevalence of NIDDM among urban subjects did not differ significantly from that among rural subjects. Increased age, higher socioeconomic class, and higher WHR were proven to be independent risk factors for glucose intolerance in either area. Women with type2 diabetes face a higher risk of cardiovascular disease than do men with type2 diabetes according to Abu et al (1997). Obesity, physical inactivity, smoking, and low birth weight have all been described as risk factors for type2 diabetes. In 1994, Health Survey of England pointed that in Western societies these factors are associated with low socioeconomic status. Here an attempt has been made to study the association between prevalence of diabetes of the patients of BIRDEM with urban and rural areas of Bangladesh.[26]

A highly significant relationship was found between blood glucose level of patients living in both urban and rural Bangladesh with all the variables or factors considered here in developing diabetes, but it is significantly higher in the urban areas compared with the rural ones as we found p value< 0.001 for all the cases in our study. This trend can be related to the differential occupations, working conditions and also the motivation for better living which are absent in the rural areas. Diabetic patients in the year of 2000 mostly were obtained in the age group ≥ 40 years. Males were more likely of developing diabetes than females. In case of socio economic variables, highly educated person with high annual income had the tendency to experience diabetes. This do not certainly mean that the educated and highly paid persons suffer from diabetes more than the less educated people, but it indicates that less educated and with less income people were not aware of this disease. People with “no” physical work tended to develop this disease. Obesity or overweight,

growing blood pressure level also indicates positive signs in developing diabetes. This trend was significantly higher in the urban areas of Bangladesh.[90]

Urbanization plays a significant role in the occurrence of metabolic syndrome because it has its role in changed life style of people.[91] Hussain and co researchers in 2005 demonstrated significant results of increased prevalence of type2 diabetes mellitus in urban population in comparison to rural population in the Bangladesh. This risk was about three to four folds more in urban slum for both sexes. This research is in accord with other researches in the India and Bangladesh.[88] Another recent study of Mohan V and collaborators in 2008 also states that, there is a major role of urbanization in the epidemiological health transition. People of urban area have higher prevalence of diabetes in comparison to slums and rural residents. Even the non obese and physically active urban people have an increased risk of diabetes compared to the rural people in India.[92] Moreover, wealth has its influential effect, as it is evident that urban people have higher prevalence of diabetes than people of slum areas, and people of slum areas in turn have the higher prevalence of diabetes than rural people.[92] Marked lifestyle changes were also observed in the Kuwait along with hasty rise in financial well being which resulted in the increasing of chronic NCDs such as diabetes, CVDs, hypertension and stroke.[93] In Tanzania a study showed similar results of the increased prevalence of diabetes and impaired glucose tolerance in population of urban area as compared to that of rural area. There was also a difference of the risk factors for type2 diabetes mellitus among urban and rural populations. People living in urban areas have more prevalence of the risk factors for diabetes such as physical inactivity, overweight and obesity than people in rural areas.[94]

Morbidity and Mortality Associated with Diabetes Mellitus

Approximately four million deaths attributed to diabetes were estimated around the globe, among the people of age 20-79 years, in 2010. This figure is about 6.8% of the total deaths among all age groups in the world during 2010. Diabetes caused 6% of deaths in the Africa and accounted 15.7% of deaths in the North America, among adults, in the same year.[95.96] Premature deaths are increasing due to diabetes and this condition appears to become worse, especially in the low and middle income countries. These premature deaths are of same extent, to the deaths from infectious diseases in this age group. Most populated countries like

China, India, USA and Russia are expected to have the highest numbers of deaths attributed to the diabetes, because they have the largest numbers of the diabetic patients in the world.[95,96]

Mortality attributable to diabetes ranges from 6.1% of all deaths in those aged 20-79 years in the Africa Region to over 15% in the Western Pacific Region. Beyond 49 years of age, diabetes constituted a higher proportion of all deaths in women than in men in all regions, reaching over 20% of all deaths in some regions and age groups (Section 2.4). These estimates suggest that diabetes is a considerable cause of death and investing in reducing this burden is justified and necessary. Recent studies have reported that the women with diabetes have relatively higher risk of death than the diabetic men. Diabetic women were anticipated to have the higher share of deaths because of diabetes and its complications than the diabetic men, in 2010. This higher share of female deaths was present in all regions of the world, attaining 25% of all deaths among the middle aged women in some regions.[95,96]

Burden of Diabetes Mellitus

The global burden of disease (GBD) is a comprehensive assessment of mortality and disability from specific diseases, injuries and risk factors. A scientific, evidence-based approach to health issues that objectively quantifies the burden of disease, disability-adjusted life years (DALYs) is a comprehensive measurement of health gaps which combines premature mortality in populations along with the extent and severity of morbidity.[97]

Disability-adjusted life years for a disease are years of life lost (YLL) due to premature death, plus years lost to disability (YLD), thus DALYs represent both mortality and morbidity. One DALY is one lost year of "healthy" life, and the burden of disease is a measurement of the gap between current health status and an ideal situation, in which everyone lives to old age free of disease and disability.[97]

Measurement of DALYs considers mortality with age at death, incidence of various types of adverse health conditions with age at onset, prevalence of morbidities with severity, duration and sequelae and remission rates. These have been obtained for over 130 causes. The use of DALYs is a large step towards standardization and comparability of the burden of disease.[97]

Any death earlier than the highest expectation of life is considered premature, and contributes to YLL. Similarly, the period of various disabilities during the entire life is equated to the loss of years of healthy life. In addition, years lost from the most productive and active periods of life are valued more than loss during childhood or old age, and future years lost are discounted for equivalence to the current year. A practical guide for carrying out such studies is available in WHO's National burden of disease manual.2 If everyone were to live in full health throughout their maximum potential lifespan, the loss of DALYs would be zero. In 2002, the world average of all DALYs was 239 per 1000 population, of which 148 (62%) are YLL due to premature mortality, and the remaining 91 (38%) are YLD. The decline in global DALYs since 1990 has been less than 1% per annum, even when adjusted for population growth.[97]

Diabetes is a major source of morbidity, mortality, and economic cost to society. Patients with diabetes are at risk of the development of acute metabolic complications such as diabetic ketoacidosis, hyperglycaemic hyperosmolar nonketotic coma, and hypoglycaemia. They are also at risk of experiencing chronic complications such as atherosclerotic diseases, retinopathy, nephropathy, neuropathy, and foot ulceration, as well as other general medical conditions unrelated to the acute or chronic complications specific to diabetes. It has been estimated that the annual per capita health care expenditure in the United States in 1997 was four-fold for people with diabetes when compared with the general population.[98]

Global Overview[99]

- 366 million people have diabetes in 2011; by 2030 this will have risen to 552 million
- The number of people with type 2 diabetes is increasing in every country
- 80% of people with diabetes live in low- and middle-income countries
- The greatest number of people with diabetes are between 40 to 59 years of age
- 183 million people (50%) with diabetes are undiagnosed
- Diabetes caused 4.6 million deaths in 2011
- Diabetes caused at least USD 465 billion dollars in healthcare expenditures in 2011; 11% of total healthcare expenditures in adults (20-79 years)
- 78,000 children develop type 1 diabetes every year

Diabetes is among the most common chronic non communicable diseases around the world. It is ranked between fourth or fifth of the foremost causes of death nearly in all affluent countries, and it is also becoming an epidemic in many middle and low income countries. There is an escalating disability and substantial economical burden in almost every country because of diabetes and its complications. Diabetes has become one of the leading health issues in this century.[99].

In 2007 countries which have the highest prevalence of diabetes mellitus of 14% to 20% are UAE and Saudi Arabia, Countries which have the prevalence of 10% to 14% are Egypt, Oman, Jordan, Lebanon, Malaysia, Mexico, Jamaica, Nicaragua, Suriname and French Guiana. Countries which have the prevalence of diabetes mellitus between the ranges of 8% to 10% are Pakistan, Afghanistan, Israel, Algeria, Morocco, Guyana, Belize, Honduras, El Salvador and Cuba.[100]. It is possible that low prevalence also could be the result of low diabetes screening activity. There are many countries that have the prevalence of diabetes mellitus between 6% to 8%, some of them are India, USA, Canada and Russia. Many countries have the prevalence between an array of 4% to 5% like China and Australia. Countries that have the lowest prevalence of less than 4% includes majority of the African countries together with Mongolia and UK.[100]

Regional Overview[100]

- Africa: 78% of people with diabetes are undiagnosed
- Europe: the highest prevalence of type 1 diabetes in children
- Middle East and North Africa: 6 of the top 10 countries by diabetes prevalence
- North America and Caribbean: 1 adult in 10 has diabetes
- South and Central America: 12.3% of all deaths were due to diabetes
- South-East Asia: almost one-fifth of the world's people with diabetes live in just seven countries
- Western Pacific: 132 million adults have diabetes, the largest number of any region

Most people with diabetes live in the economically less developed regions of the world. Even in the region with the lowest prevalence (Africa) it is estimated that around 280,000 deaths are attributable to diabetes in 2011. While more than 80% of people with diabetes live

in low- and middle-income countries only 20% of global healthcare expenditures on diabetes were spent in these countries, reflecting huge disparities.[100]

An overview of each of the seven IDF regions is presented here to allow for a better understanding of the diabetes burden and its consequences. Each region is highly diverse not only in socio-economic and geographical terms but also in diabetes prevalence, mortality and healthcare. On the following pages more information is provided about each region.

Global Estimates of Diabetes Mellitus

The global burden of diabetes has been estimated several times.[96-99] In 1994, the International Diabetes Federation (IDF) Directory[99] included type 1 and type 2 diabetes estimates supplied by member nations. Using these data, IDF estimated that over 100 million people worldwide had diabetes. Also in 1994, McCarty et al[101] used data from population-based epidemiological studies and estimated that the global burden of diabetes was 110 million in 1994 and that it would likely more than double to 239 million by 2010. WHO[96] also produced a report using epidemiological information and estimated the global burden at 135 million in 1995, with the number reaching 299 million by the year 2025. In 1997, Amos et al[97] estimated the global burden of diabetes to be 124 million people, and projected that this would increase to 221 million people by the year 2010. In the 2006 3rd edition of the Diabetes Atlas the estimates were of 246 million people worldwide with diabetes for 2007, and an anticipated 380 million for 2025.[50] This edition is an update of those 2006 estimates, based principally on the same studies, but with 34 more recent studies included. Despite using different methodologies, and at times showing large differences in country-specific estimates, these reports have arrived at remarkably similar global figures of diabetes.

The South-East Asian Region comprises only seven countries. The adult population of India in 2010 will account for 85% of that of the region. Mauritius has the highest per capita GDP at USD12,400, while the other countries all have per capita GDPs of less than USD5,000, although India which has had an annual growth of 7.3% was experiencing economic development at a faster pace than almost anywhere in the world, except its neighbor, China.[102]

Global		
	Year	
	2010	2030
Total world population (billions)	7.0	8.4
Adult population (20- 79 years, billions)	4.3	5.6
Diabetes mellitus in (20-79 years old)		
Global prevalence (%)	6.6	7.8
Age adjusted prevalence (%)	6.4	7.7
Number of people with diabetes (millions)	285	438
South East Aisa		
Total population (millions)	1,439	1,788
Adult population (millions) (20-79 years)	838	1,200
Diabetes and IGT (20-79 age group)		
Regional prevalence (%)	7.0	8.4
Comparative prevalence (%)	7.6	9.1
Number of people with diabetes (millions)	58.7	101.0
IGT		
Regional prevalence (%)	5.8	6.4
Comparative prevalence (%)	6.2	6.9
Number of people with IGT (millions)	48.6	76.4

There will be an estimated 58.7 million people, or 7.0% of the adult population, with diabetes in the region in 2010. Economic progress is inevitably associated with increasing urbanization, and it appears that features of urban life tend to increase the prevalence of diabetes among people of Indian ethnic background to a greater extent than for other populations.[103] The second edition of the Diabetes Atlas used data from a single report,[104] based on a population-based survey from the six largest Indian cities, and extrapolated these results nationwide; applying a 4:1 urban/rural ratio from these findings for diabetes prevalence (the majority of the Indian population is classified as rural). For this report, as with the third edition, two additional reports of population data collected on a nationwide

basis[47,105] were used, which suggest that diabetes prevalence in smaller urban centres (100,000–1,000,000 inhabitants) tends to be about half of the larger cities, but still twice that of rural areas (less than 100,000 people).[105]

The anticipated increase in regional diabetes prevalence from 7.0% for 2010 to 8.4% in 2030 is very much a consequence of the increasing life expectancy in India (the proportion of the population over 50 years is expected to increase from 16% to 23% between 2010 and 2030[106]), and of the urbanization of the population (the proportion living in urban settings will increase from 33% to 46%.[107] Evidence suggests that in more affluent parts of the country, the rural prevalence is higher than in less affluent rural areas,[108] indicating that increasing economic growth will increase diabetes prevalence in India even more than these possibly conservative estimates have indicated.

It is estimated that approximately 285 million people, or 6.4%, in the age group 20-79 will have diabetes worldwide in 2010. About 70% of these live in low-and middle-income countries. The worldwide estimate is expected to increase to some 438 million, or 7.7% of the adult population, by 2030. The largest increases will take place in the regions dominated by developing economies. The Western Pacific Region with 77 million and the South-East Asian Region with 59 million will have the largest number of people with diabetes in 2010. However the comparative prevalence rate (adjusted to the world population) of 4.7% for the Western Pacific Region is significantly lower than 9.3% for the Middle East and North African Region, and 10.2% in the North America and Caribbean Region.[109]

It was estimated that in the year 2011, 366 million people worldwide had diabetes, of which about 80% (291 million) reside in low- and middle-income countries. If these trends continue, by 2030, 552 million people, or one in 10 adults, will have diabetes, of whom 458 million will reside in emerging economies compared with a mere 94 million in developed countries.[58] In countries classified by the World Bank as upper middle-income, lower middle-income, and low-income countries, the prevalence of diabetes in 2011 was 10.1%, 8.6%, and 5.8%, respectively, among individuals in the age group of 20–79 years.[4] Of the top 10 countries listed by International Diabetes Federation in 2011 in terms of the number of individuals with diabetes, eight are classified as developing countries-namely, China, India,

the Russian Federation, Brazil, Mexico, Bangladesh, Egypt, and Indonesia. The highest number of people with diabetes in the world currently is in China (90.0 million in 2011), and these numbers are expected to swell to 129.7 million by 2030, whereas the corresponding figures for India are 61.3 million in 2011, which is expected to increase to 101.2 million by 2030.[58] Although this burden of greater absolute numbers of diabetes may be partially explained by larger population size, the rates at which diabetes is increasing in the developing economies amid rapid epidemiological and nutritional transition are much steeper when compared with in the more developed affluent countries.[110]

There are also significant differences between and within developing countries because of the geographical diversity in socioeconomic growth rates, demographic and lifestyle changes, and perhaps differences in genetic susceptibility to diabetes.[111] The prevalence of diabetes in Sub-Saharan Africa ranges from 1% in rural Uganda to 12% in urban Kenya,[40,41] 2% in Ethiopia,[42] and 8.1% in urban and 2.3% in rural Bangladesh.[45] In Sri Lanka the prevalence was 10.3%,[112] whereas it was 4.6% in Indonesia,[43] 11.6% in Malaysia,[44] and 7.5% in Thailand.[45] In the rural area of the Baluchistan Province of Pakistan there was a twofold increase in the prevalence of diabetes from 7.2% in 2002 to 14.2% in 2009.[113] A recent study from China reported the age-standardized prevalence of diabetes to be 9.7%.[114] In India, the prevalence of diabetes is growing rapidly in both urban and rural areas.[115] The national prevalence of diabetes in India according to the 5th edition of the Diabetes Atlas published by the International Diabetes Federation is estimated at 8.3%, although there are significant differences across geographic areas and socioeconomic classes. The national prevalence of diabetes in India was estimated to be 2.1% from a survey of six cities and adjacent rural areas by the Indian Council of Medical Research (ICMR) in 1972–1975.[116] There have been five other multicenter studies in India. The 2001 National Urban Diabetes Survey showed age-standardized prevalence of 12.1% in India's six largest cities.[110] The Prevalence of Diabetes in India Study, published in 2004, reported urban prevalence of diabetes to be 5.9% and 2.7% in small towns and rural areas, respectively.[117]

Risk Factor Surveillance Study conducted by WHO between 2003 and 2005 in urban and rural areas in six different states, reported an overall prevalence of self-reported diabetes of 4.5%.[46] Recently the first representative study of four states in the country has been

completed.[118,119] This study, called the ICMRINdia DIABetes (ICMR-INDIAB) study, looked at three states and the Union territory of Chandigarh and reported that the prevalence of diabetes (both known and newly diagnosed) was 10.4% in Tamilnadu, 8.4% in Maharashtra, 5.3% in Jharkhand, and 13.6% in Chandigarh. In Tamilnadu, the prevalence of diabetes in urban areas (13.7%) is almost double the rates found in rural areas (7.8%). In Jharkhand, the prevalence of diabetes in urban areas is fourfold higher than in rural areas (13.5% for urban vs. 3% for rural, $P < 0.001$). In Chandigarh, the prevalence of diabetes in urban is higher than the rates in rural (actually a peri-urban area, as this is a union territory) areas (14.2% for urban vs. 8.3% for rural, $P < 0.001$). Finally, in Maharashtra also, the prevalence of diabetes in urban is higher than the rates in rural areas (10.9% for urban vs. 6.5% rural, $P < 0.001$). The overall number of people with diabetes in India in 2011 based on the ICMR-INDIAB Study was estimated to be 62.4 million,[119] and this was confirmed by the 5th edition of the Diabetes Atlas, which gave a figure of 61.3 million people with diabetes in India in the age group of 20–79 years.[39]

The prime drivers of the rapid increase in diabetes (and to a large extent CVD also) are the rapid demographic and epidemiological transitions occurring in developing countries as a consequence of increasing urbanization and industrialization of developing regions.[120] Indeed, diabetes has now reached epidemic proportions, and because of associated factors such as increase in adult population, longevity, behavioral changes, poverty, illiteracy, and lack of access to health care, the social, economic, and human costs of diabetes are likely to be quite formidable in developing countries. This will also result in a parallel growth of diabetes precursors (impaired fasting glucose and impaired glucose tolerance) and the ensuing health consequences.[121] In most emerging economies, diabetes exhibits higher prevalence among the higher socioeconomic groups than the lower socioeconomic groups.[122,123]

This pattern is evident in urban Chennai in India, where in the late 1990s; a middle-income group had twice as high a prevalence compared with the lower-income group.[50] Unfortunately, this pattern is now changing, and a more recent report done on the same two residential sites showed a convergence of the prevalence rates of diabetes in the same two residential colonies representing the middle- and lower income groups.[124] What is more

disheartening is the fact that the majority of individuals with diabetes in developing countries are in the productive and economically active population (45–64 years), which is in contrast to developed countries, where the majority of the individuals with diabetes are over 64 years of age. Poorly managed individuals and those who do not have access to proper care are more likely to miss work because of the consequences of the disease, which could adversely affect the productivity and the economy of these countries.[124]

Thus it is fair to state that diabetes will be a far bigger health problem in developing, compared with the developed, countries.[125] One of the unfortunate aspects about diabetes is that more than 50% of the people with diabetes are unaware of their disorder. The rate of undiagnosed diabetes is high in most developing countries. In the Screening India's Twin Epidemic (SITE) Study, conducted in 10 Indian states, 7.2% had undiagnosed diabetes.[126] In the ICMR-INDIAB study, conducted in four states of India, the prevalences of undiagnosed diabetes among urban residents of Tamilnadu, Maharashtra, Jharkhand, and Chandigarh were 5.2%, 7.2%, 5.1%, and 7.6% and those among rural residents were 3.8%, 4.9%, 2.3%, and 5.2%, respectively.[118,119] Undiagnosed diabetes has substantial public health implications as it could lead to higher rates of complications.

Morbidity and mortality due to diabetes exerts a significant burden in developing countries as individuals with diabetes face significant challenges with respect to earlier diagnosis and treatment, which could result in increased morbidity and mortality, decreased life expectancy, and reduced quality of life, as well as individual and national income losses. Although diabetes is often not recorded as a cause of death, diabetes is already the fifth leading cause of mortality globally (4 million deaths annually), out numbering global deaths from human immunodeficiency virus/AIDS; 80% of this mortality occurs in low- and middle income countries[127]. Diabetes also leads to other disease conditions and complications, which subsequently become the cause of death. According to the recent Diabetes Atlas, even though the prevalence of diabetes is currently lower in low income countries compared with high-income countries, the number of deaths due to diabetes in low-income countries (492,000) is nearly as high as in high-income countries (544,000).[127]

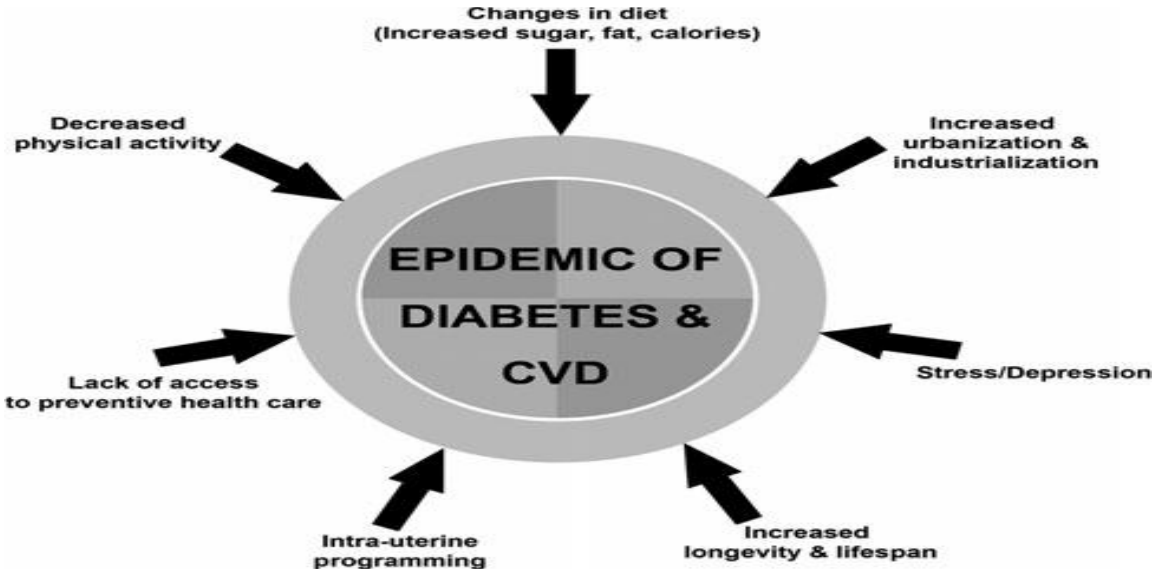
Among people with diabetes, the majority of deaths worldwide are due to CVDs and cerebrovascular diseases and end-stage renal diseases.[128] One of the studies conducted in south India, called the Chennai Urban Population Study (CUPS), provided some evidence on the effect of type 2 diabetes on mortality rates in a population.[129] The overall mortality rates were nearly threefold higher in subjects with diabetes compared with individuals without diabetes (18.9 vs.5.3 per 1,000 person-years). The hazards ratio for all-cause mortality for diabetes was found to be 3.6 compared with subjects without diabetes. The study also showed that the leading cause of mortality in subjects with diabetes was cardiovascular (52.9%) and renal (23.5%) complications. In another study done by Zargar et al.[130] of the 234,776 admissions to their center, 16,690 (7.11%) died, of whom 741 had diabetes mellitus, as recorded in the death certificate. The causes contributing to death were infections (40.9%), chronic renal failure (33.6%), coronary artery disease (16.9%), cerebrovascular disease (13.2%), chronic obstructive pulmonary disease (6.9%), acute renal failure (6.2%), malignancy (4.2%), hypoglycemia (3.5%), and diabetic ketoacidosis (3.4%). Diabetes increases the risk of both macrovascular diseases (CVDs, which comprise coronary heart disease and cerebrovascular disease or ‘‘stroke,’’ and peripheral vascular disease) and microvascular (retinopathy, nephropathy, and neuropathy) diseases. These complications are associated with considerable morbidity, reduced quality of life, disability, premature mortality, and high economic costs.[130]

There are geographic differences in both the magnitude of these problems and their relative contributions to overall morbidity and mortality. In white populations, macrovascular complications such as coronary artery disease and amputations are major causes of disability. In contrast, end-stage renal disease and stroke are prevalent among Chinese and Asian ethnic groups. The increased vulnerability of Pacific Island populations to neuropathy and metabolic problems and of South Asians to coronary artery disease has also been reported. Population based data on diabetes complications in India, from the Chennai Urban Rural Epidemiology study (CURES) and the CUPS, have reported interesting differences in the patterns of complications seen in Asian Indians. For instance, the prevalences of retinopathy, nephropathy, and peripheral vascular disease appear to be lower, the prevalence of CVD was higher, and that of neuropathy was similar to that reported in the West. In the least developed countries, diabetic ketoacidosis continues to be the commonest emergency in diabetes, often

precipitated by infections, and its contribution to mortality rates ranges from 3.4% in India 34 to 25% in Tanzania and 33% in Kenya. The Diabcare Africa project, which was conducted across six Sub-Saharan African countries, reported that background retinopathy (18%) and cataract (14%) were the most common eye complications and that 48% had neuropathy, although macrovascular disease was rare in that population.[115-119]

Burden of Type 2 Diabetes and Cardiovascular Disease in Emerging Economies[131-135]

- Both diabetes and CVD have assumed alarming levels in emerging economies.
- China and India have the highest numbers of people with diabetes and CVD in the world.
- High prevalence and exploding population contribute to the increasing burden of diabetes and CVD.
- Major drivers are demographic changes with altered population age profiles, lifestyle changes due to recent urbanization, delayed industrialization, and overpowering globalization.
- Diabetes and CVD are major contributors to global morbidity and mortality.
- The low-income countries bear the highest cost burden of management with development of complications.
- Emerging economies need to set national goals and targets for early diagnosis and effective management and improve primary prevention to reduce the burden of disease in the coming decades
- Improved control of diabetes and CVD is possible but requires population-based, multisectoral, multidisciplinary, and culturally relevant approaches to stem the tide of the epidemic of these two disorders.



Disability Burden of Diabetes Mellitus

Mortality data are the most widely used source of information for identifying most important health problems for a population.[131,132] However, during the 20th century, death rates in economically developed countries have fallen substantially. Correspondingly, many persons live many years with serious illness and disability. Therefore, causes of deaths are increasingly viewed as inadequate measures of the health of a population.[133] Assessments that include more than mortality data to measure population health are frequently called "burden" of disease and injury studies. Such analyses frequently include incidence, prevalence, years of life lost due to premature death, the direct monetary costs of medical care, and the indirect costs related to lost wages and productivity.[134,135] A growing body of literature describes the use of summary measures of population health. These reflect both the length of life lost to premature death as well as the time spent in unhealthy states.[136] One such metric, called the disability-adjusted life year (DALY) was introduced by the World Bank in 1993.[137] Subsequently, the World Health Organization (WHO) and Harvard University published a more detailed assessment that used the DALY to enumerate the burden associated with 100 different diseases and injuries.[2] This work, entitled Global Burden of Disease (GBD) primarily assessed burden at the regional, rather than country-specific, level. WHO continues to publish regular updates on the GBD as a statistical annex to the World Health Report.[138]

The three primary goals in applying DALYs to the United States were: (1) provide an analytic framework that includes nonfatal as well as fatal events in the analysis and presentation of U.S. health data; (2) develop a comprehensive, credible, and internally consistent set of epidemiologic estimates for major health conditions using methods similar to those executed in the GBD; and (3) establish a set of DALYs to place the general health status of the United States in a growingly interdependent, global context.[139]

In 1996, there were 2.3 million deaths in the United States that contributed to over 33 million DALYs. The greatest number of deaths and DALYs were attributed to chronic disease conditions that occur in adulthood. The leading source of DALYS for both males and females was ischemic heart disease. Other chronic diseases, such as cerebrovascular disease, cancer, and dementias, dominated the list of major causes. Injuries from road traffic events and violence were also prominent causes of DALYs and deaths, especially for males. Among the top 20 major health conditions, the rank order of their contribution to DALYs was similar to the rank order of their contribution to deaths (Spearman's rank correlation 0.87). However, notable differences were found between the major sources of DALYs and deaths for both genders. Among males, respiratory cancers were the underlying cause for almost 9% of deaths, but resulted in only 4.6%of DALYs. Conversely, few deaths among males were attributed to alcohol use, unipolar major depression (UMD), or osteoarthritis, whereas these conditions resulted in 4.1%, 2.6%, and 2.4%, respectively, of all DALYs.[139]

Among females, UMD was the second leading source of DALYs (5.9% of the total). Osteoarthritis and alcohol use also had a substantial impact on the health of females, accounting for 3.3% and 2.7%, respectively, of all DALYs. The majority of the DALYs linked to UMD, osteoarthritis, and alcohol for both males and females resulted from the nonfatal disability associated with this conditions.[140]

The total number of DALYs declined 45%, from 956,000 for both genders in 1996, to 534,000 in 1998. There was substantial variation in the major sources of DALYs among racial/ethnic subgroups. These differentials were especially notable when compared to the major sources of burden in developed and developing regions of the world. Only Asian and Pacific Islander males in the United States and people living in the developing world did not

have large numbers of DALYs attributed to alcohol use. Finally, perinatal conditions, which include poor outcomes associated with prematurity and limited prenatal care, accounted for over 3% of the DALYs among blacks in the United States. No other racial/ethnic subgroup in the United States, or in any international region, had such a large proportion of DALYs attributed to this set of conditions. Conditions associated with middle age accounted for the greatest number of DALYs in all the racial/ethnic groups in the United States. Half of the total disease burden was among people aged 25 to 64 years, the other half being almost evenly split between younger and older age groups: 23% among those aged 25 years, and 27% among those aged 65 years (data not shown). In sharp contrast, the number of deaths gradually increased with age. More than half of all deaths occurred among people aged 75 years.[140]

Economic Burden of Diabetes Mellitus and Its Complications

Substantial economic burden is imposed by diabetes, globally. Approximately, 11.6% of the entire health spending of the world is expected to be used for treating diabetic patients alone, in 2010. In the same year, nearly 376 billion US dollars expenditure was predicted for the treatment and prevention of diabetes and its complications. It was also predicted that by 2030 this amount will increase by 490 US dollars, globally.[141,142] If this amount is given in International dollars (ID), so that the difference in purchasing power is corrected, then the total world expenditure estimated for diabetes was around 418 billion ID in 2010, and expected rise is 561 billion ID in 2030. Studies predicted that, on average every person will spend 703 USD or 878 ID in the world during the year 2010 on diabetic care. In addition to this financial burden, diabetes becomes more cumbersome because of the loss of efficiency or workability of a diabetic person, which in turn hampers the global economic growth.[141]

According to the American diabetes association there was a loss of 58 billion US dollars in 2007. This is equivalent to 50% of direct health spending on diabetes, due to fewer working days, constrained workability, less efficiency, death and everlasting disability of the diabetic persons in US. This economic burden due to diabetes is higher in the low income countries compared to the rich countries because of early deaths in young age group.[141]

Total losses as predicted by the WHO on countries income due to diabetes and CVDs are as follows; China about 557.7 billion ID, Russia 303.2 billion ID, and 236.6 billion ID in India. In the Brazil it is about 49.2 billion ID and 2.5 billion ID in Tanzania, during the years 2005 and 2015. Thus it is clear that diabetes and its complications which results in premature deaths and disabilities plays an important role in this significant economic burden.[141,142]

Diabetes mellitus is a major and increasing cause of chronic ill health and premature mortality in almost all Asian countries,[143] and results in rising costs because of absence from work and health care expenses. To facilitate service planning and to allocate public health resources appropriately, there should be reliable estimates and projections of the economic costs associated with diabetes mellitus, its complications, and its co-morbidities. This is especially true in Asian countries where there is a dynamic, growing epidemic of diabetes.[143,144] There are two main approaches to investigating the economic impact of diabetes mellitus and its complications.

The first approach uses disability-adjusted life-years (DALYs) to measure the intangible costs associated with the disease, and combines the healthy life-years lost as a result of premature mortality with those lost due to disability or ill health. This method is valuable, because a substantial portion of health care expenditure is directed towards improving the quality of life and life expectancy in diabetic individuals. The largest relevant study that has been published so far was performed by the World Bank in 1993.[137] Their global study investigated the DALYs lost due to various diseases, including diabetes, and estimated that 1362 million DALYs were lost worldwide as a result of all illnesses in 1990. Of these, diabetes mellitus and its complications accounted for 7.97 million DALYs. The majority of losses were incurred in developing nations (eg China and India).[137]

When comparing the DALYs lost with per capita health expenditures in different countries, the data suggested that the countries in which 80% of the DALYs lost were attributable to diabetes mellitus shared only 13% of the world's health care expenditures.[145] For example, with an annual per capita expenditure on health care of US$21, the population of India lost 1.9 million DALYs because of diabetes mellitus. In contrast, established market economies such as the Organization for Economic Cooperation and Development nations, which

account for 15% of the world's population and 87% of its health care resources, together lost only 1.3 million DALYs because of diabetes mellitus.[145] In short, the heavy economic burden of this life-long condition due to loss of quality of life and premature mortality is concentrated in those countries with the lowest health care budgets, many of which are in Asia.[137,145] Despite some criticisms and caveats about methodological issues, the World Bank study provides strong support for the need to improve the provision of diabetic health services in Asian countries, particularly in those undergoing rapid demographic and economic development.[137] The second and most frequently employed technique used to evaluate the economic implication of diabetes is the cost-of-illness approach, which examines the direct and indirect costs associated with the condition.

In Asia, there has been little systematic effort to conduct comprehensive examinations of the economic consequences of diabetes mellitus. In the United States, direct medical expenditures attributable to diabetes mellitus in 1997 totaled US$44.1 billion. The breakdown was as follows: US$7.7 billion because of diabetes and acute glycaemic care, US$11.8 billion because of the excess prevalence of related microvascular and macrovascular complications, and US$24.6 billion because of the excess prevalence of general medical conditions.[146] Of these direct costs, 62%, 25%, and 13% were related to in-patient care, ambulatory services, and long-term care, respectively. Two thirds of all medical costs were borne by the elderly (aged >65 years) population. Attributable indirect costs totaled US$54.1 billion and comprised US$17.0 billion due to premature mortality and US$37.1 billion due to disability. Furthermore, total medical expenditure incurred by diabetic patients was US$10 071 per capita, compared with US$2669 for the non-diabetic population.[146] Likewise, the economic burden of diabetes mellitus in Asia is enormous, anticipated by the prevalence and incidence of the disease and is predicted to increase more in Asia than in the industrialized western nations in the next few decades. It has been estimated that the overall health care costs due to diabetes mellitus in the year 2010 will be doubled when compared with 1990.[137]

Implications of Public Health and Health Care

Given the very serious clinical and economic ramifications of diabetes mellitus, it is imperative that doctors, public health practitioners, and policy makers vigorously pursue health care strategies and medical innovations that can delay the onset and slow the progression of the disease and its complications. One strategy is 'to reduce the incidence of diabetes mellitus in Asia'. While genetic factors have a definite role in the development of the disease, there are also environmental and lifestyle risk factors, such as a high saturated fat diet, obesity, and lack of physical activity.[141] These three risk factors are currently recognized as the most potentially modifiable. Although implementing lifestyle changes, as with any behavioural change, poses a difficult challenge, doing so is essential to improving public health and lessening the impact of the Asian diabetes epidemic. A second, complementary strategy is to focus on the primary and secondary prevention of diabetic complications in individuals who have already developed diabetes mellitus. The DCCT and UKPDS have shown that optimal glycaemic control is the most ideal primary preventive measure against the development of complications.[147,148]

It is also well known that treating complications such as eye and limb diseases, heart disease, neuropathy, and nephropathy contribute the most to the costs of diabetes care.[149] Once complications develop, the indirect costs of disability and premature mortality increase exponentially; hence, the secondary prevention of diabetic complications may be highly effective in reducing the health care burden of diabetes mellitus in general.[150] Such secondary preventive measures include a policy of strict blood pressure control,[151] institution of ACE inhibition in microalbuminuric patients,[152] normalization of hyperlipidaemia, smoking cessation, and regular screening for all diabetic complications.[153] A third major component in combating the diabetes epidemic in Asia involves health promotion and patient education. The reasons are two-fold. Firstly, there are many undiagnosed cases of diabetes mellitus in Asia. For example, the ratio of undiagnosed to diagnosed cases in Vietnam and Bangladesh is as high as 4:1.[141] There is thus a serious potential for severe diabetic complications to occur because of prolonged undiagnosed hyperglycaemia. Secondly, the clinical presentation of type 2 diabetes mellitus and its complications are usually insidious and have a long latent period.[141]

As a consequence, patient compliance with regular follow-up and screening may be poor because the conditions are asymptomatic. Patients therefore need to be adequately informed of the necessity and benefits of these clinical interventions. Financial constraints in some developing Asian economies, however, may render optimal diabetes care impossible. Even when the services are provided, they may be inadequate or inaccessible to patients.[154] Finally, increases in both the cost of providing quality diabetes care and the number of people developing the disease have led to a search for more cost effective models of care. One such model is the 'shared care' approach, the efficacy of which has been well documented.[155] In this approach, both specialists and primary care doctors participate in the planned delivery of care; they also exchange information over and above routine discharge and referral notes. Hallmarks of effective and efficient shared-care schemes include computerized central recall with prompts for patients and their family doctors, shared records, improved communication between doctors and patients, flexible and agreed management plans, the possibility of patients moving up and down the levels of care, and a fail-safe system of coordinated care.[156]

Diabetes is a group of metabolic disorders due to relative insulin deficiency which can cause serious health complications including heart disease, blindness, kidney failure, and lower-extremity amputations**.** It is quite shocking that 51 per cent of people in Bangladesh are unaware that diabetes exists. The lack of knowledge highlights the major health problems faced by people in Bangladesh, and the immense knowledge gap that needs to be filled to increase diabetes awareness in the country.[24-27] The number of diabetic patients is annually growing at a rate of three percent in the country and if the present rate continues, the number of diabetics will double to 10.4 million by 2030.[101]

Diabetes mellitus plays an instrumental role in causing diseases like hypertension, cardiovascular diseases, diseases of skin appendages and gangrene. Other serious complications include retinopathy, neuropathy, nephropathy, and lower-extremity amputations. Although diabetes mellitus is an incurable disease, it can be managed very well. Training in self-management is integral to the treatment of diabetes. Proper management requires patients to be aware of the nature of the disease, its risk factors, its treatment and its complications

Diabetes mellitus along with its complications contribute a significant amount of burden on the society. Lack of awareness has resulted in an increased number of diabetics over the years. This has resulted in a less efficient workforce and a huge economic burden in South East Asia. Female diabetic patients were found to be far less aware of diabetes mellitus when compared with the males. One reason for this finding could be the low female literacy rate. Again, it emphasizes that future studies should be carried out to determine the link between education and diabetes awareness. Diabetics belonging to poor socioeconomic status were less aware than those belonging to the higher class.

4.0 Materials and Methods

4.1 Study design

The study was a Comparative Cross-sectional study and the study findings were compared between selected urban and rural communities of Bangladesh.

4.2 Study places

The study was conducted in urban and rural communities of Bangladesh. Rationality for choosing the areas was to estimate the prevalence of diabetes mellitus and to compare its disability and economic burden between the two communities. Both the communities were selected randomly by multi-stage sampling technique. In the urban community, data were collected from the participants by gathering them at the City Health Centre (CHC) under Urban Primary Health Care Project (UPHCP) of the respective selected City Corporation Ward. On the contrary, in the rural community, data were collected from the participants by gathering them at the Union Health and Family Welfare Centre or community clinic of the respective village. The urban and rural communities were selected following the population census 2011 conducted by Bangladesh Bureau of Statistics.[157]

A. In rural area, data were collected from the following communities of Dhamrai Upazila:

Name of the Union	Ward No	Name of the Mowza
Sombhag	3	1. Sombhag 2. Uttor Naogaon
Kulla	3	1. Kulla 2. Khatra
Kushura	8	1. Bannal 2. Durgapur Garail

B. In urban area, data were collected from the following communities of Dhaka city:

Name of the Thana	Ward No	Name of the Moholla
Tejgaon	38	1. Paschim Nakhal Para 2. Purba Nakhal Para
Mohammadpur	42	1. Bijlee Mahallah 2. Tikka Para
Mirpur	16	1. Dakshin Ibrahimpur 2. Dakshin Kafrul

4.3 Study period

The study was conducted during the period of October 2010 to July 2014. Initially the protocol was corrected and modified, ethical clearance was obtained form BMRC and permission was obtained from the Ministry of Health and Family Welfare. Research instrument development, pre-testing, finalization and data collection were done over the period of one year (July 2012 to June 2013) followed by data processing, data analysis and report writing were carried out during the period July 2013 July 2014.

4.4 Study subjects

Adult individuals with age of ≥20 years were regarded as the study subjects and included in the study. All the households (HHs) in the urban community were given number by Dhaka City Corporation (DCC) while the households in the rural community were given Geographical Recosenence (GR) number. Considering the specific inclusion & exclusion criteria, one member from each house hold (HH) were included in the study.

4.5 Sampling unit: Sampling unit of the study was each household member.

4.6 Sample size: The sample size was estimated considering following attributes:

- The prevalence rate of type2 DM in the urban population of 11.2% from the previous study conducted in an urban population.[79]
- The prevalence rate of type2 DM in the rural population of 6.8% from the previous study conducted in a rural population.[80]
- On the basis of relative precision, the sample size of the study is calculated by using specific formula as depicted below.

Sample size determination: Sample size was calculated separately for the urban and rural community using the specific sample size calculation software on Two Proportions Power Analysis of NCSS.[158]

Numeric Results:

Null Hypothesis: P1=P2. Alternative Hypothesis: P1<>P2. Continuity Correction Used.

Allocation						Odds		
Power	**N1**	**N2**	**Ratio**	**P1**	**P2**	**Ratio**	**Alpha**	**Beta**
0.90002	931	931	1.000	0.11200	0.06800	0.578	0.05000	0.09998
0.80006	707	707	1.000	0.11200	0.06800	0.578	0.05000	0.19994

Report Definitions:

- Power is the probability of rejecting a false null hypothesis. It should be close to one.
- Ni is the size of the sample drawn from the population.
- N1 denotes the sample size for the urban community
- N2 denotes the sample size for the rural community
- Allocation Ratio is N1/N2 so that N2 = N1 x R.
- Alpha is the probability of rejecting a true null hypothesis. It should be small.
- Beta is the probability of accepting a false null hypothesis. It should be small.
- P1 is the proportion for the urban community.
- P2 is the proportion for the rural community under the alternative hypothesis.
- Odds Ratio is [P2/ (1-P2)] / [P1/ (1-P1)].

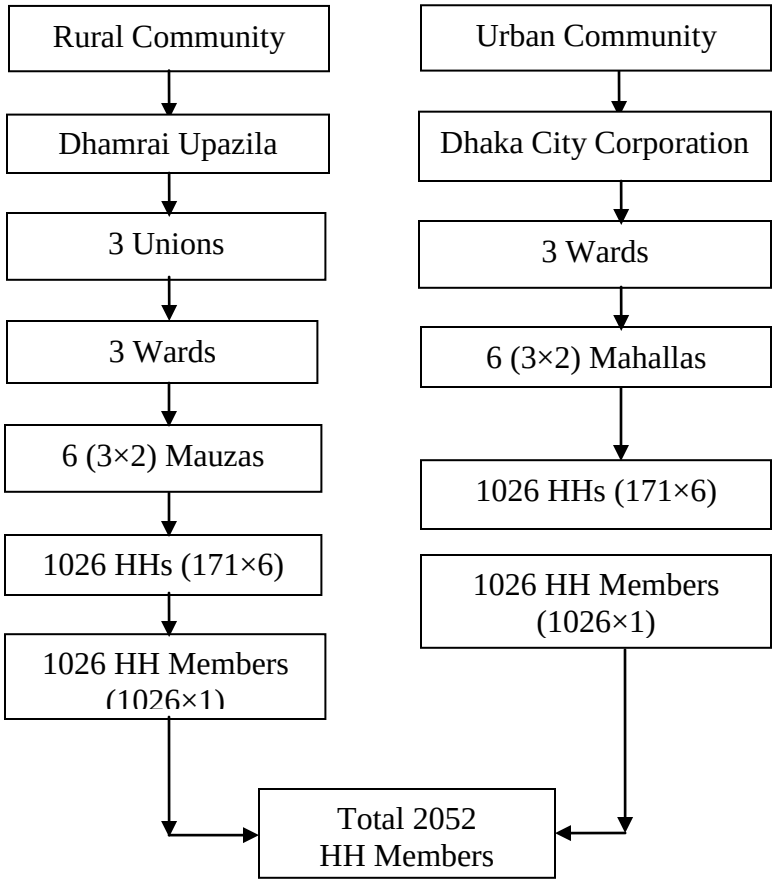
Summary Statements:

Group sample sizes of 931 and 931 for the urban and rural community respectively achieve 90% power to detect a difference of 0.04400 between the null hypothesis that both group proportions are 0.11200 and the alternative hypothesis that the proportion in group 2 is 0.06800 using a two-sided Chi-square test with continuity correction and with a significance level of 0.05000. Considering 10% non-response and rounding finally sample size was calculated (931+95) 1026 and 1026 for the urban and rural community respectively. So, the sample size of the study was 2052 of which each 1026 was of urban and rural community.

4.7 Sampling Technique

Dhamrai Upazila and Dhaka City Corporation (DCC) as rural and urban community were selected conveniently. After then following multi-stage sampling technique, 3 Wards and 6 Mahallas (2 Mahallas from each Ward) were selected randomly from Dhaka City Corporation. Followed by 1,026 households (171 HHs from each Mahalla) were selected and finally 1,026 household members (1 member from each HH) were included randomly from the urban community. For the rural community, 3 Unions and 3 Wards (1 Ward from each Union) were selected randomly from Dhamrai Upazila. Followed by 6 Mauzas (2 Mauzas from each Ward) and 1,026 households (171 HH from each Mauza) were selected randomly and finally 1,026 household members (1 member from each HH) were included randomly from the rural community. Holding number of DCC and GR number were used for selection of urban and rural HHs respectively. Thus total 2,052 household members were included in the study from both urban and rural communities.

Sampling Technique (Schematic Diagram)



4.8 Selection criteria

4.8.1 Inclusion criteria

- Household members aged ≥20 years
- Both male and female HH members were included
- HH members were included only by obtaining informed consent
- Only one member from each HH was included in the study

5.8.2 Exclusion criteria

- Relative of the household who came for short duration
- Tourist who came to visit the study place for short period
- HH members who were in abroad or in other areas during data collection
- HH member who took out consent for participation in the study

4.9 Data collection technique and instruments:

Variable	Source of information	Data collection technique	Data collection tools & instrument
Socio-demographic characteristics	Participant (HH member)	Face-to-face interview	Semi-structured Questionnaire
Anthropometry (Weight, height, waist and hip)	Participant (HH member)	Measuring specific parameter of the participant	Checklist Bathroom scale Centimeter tape
Diabetes profile (Blood glucose level & complications)	Participant (HH member)	Clinical examination, Capillary blood examination & Reviewing medical records	Checklist & Glucometer
Age at onset and duration of diabetes mellitus	Participant (HH member)	Face-to-face interview	Semi-structured Questionnaire
Health care expenditure & sources of fund	DM Patient	Face-to-face interview using "Cost of Illness" approach	Semi-structured Questionnaire
Disability weight for DM & its complications, and Life expectancy at birth	Literature	Reviewing documents and Literature	Checklist
Death caused by the disease and age at the time of death	HH Head or Representative	In-depth interview	Verbal Autopsy Questionnaire

4.10 Data management: Data management comprised followings

(a) Registration of interview schedules

(b) Data cleaning

(c) Data processing and

(d) Data entry in to computer for analysis.

4.11 Data processing

Data processing involved editing, grouping and post-coding and computerization of data. It also included quality control check during data entry.

4.12 Data analysis

Collected data were used for calculating the prevalence of diabetes mellitus along with disability and economic burden posed by the disease and to compare the findings between the urban and rural communities. Data were analyzed by computer with the help of SPSS software (Version 20.0). The prevalence rate of DM was estimated by simple percentage and the characteristics of the patients were extracted by differential and multivariate analysis along with other necessary statistical tools and techniques. Both descriptive and inferential statistics were determined according statistical analysis plan.

Statistical analysis plan: Data were analyzed following data analysis plan

Variable	Type of statistics	Statistical tool/test
Qualitative variables: Sex, occupation, education, religion, marital status, family history of DM, physical activity, obesity, residing place etc.	Descriptive statistics	Frequency distribution by tables and graphs
Quantitative variables: Age, monthly income, family member, blood glucose, DALY, YLD, YLL, health care expenditure, BMI, prevalence of DM etc.	Descriptive statistics	Mean, Standard deviation & frequency distribution by tables and graphs
To compare between two means like mean of Blood glucose, DALY, YLD, YLL,	Inferential statistics	't' test

Variable	Type of statistics	Statistical tool/test
treatment cost and age, income and BMI etc.		
To compare association between two qualitative/categorical variables like sex, education, occupation, religion, diabetes mellitus, marital status, complications of DM, economic status, physical activity, obesity, family history of DM etc.	Inferential statistics	χ^2 test
To correlate among DALY, YLL, YLD, treatment cost, BMI, income, age, duration of disease etc.	Inferential statistics	Logistic regression

4.13 Ethical consideration

The study was conducted maintaining all kinds of ethical considerations. Informed written consent of each of the household member was obtained before data collection by explaining the purpose and methods of the study, duration and frequency of clinical examination, procedure of blood glucose estimation, risks and benefits of participation in the study. Consent was taken and interview was conducted in Bengali. During interview and clinical examination, privacy was maintained strictly. Two drops of blood was taken aseptically by finger pricking under aseptic precautions for examination by Glucometer free of cost by qualified physician. Any complication due to finger pricking was managed by the researcher.

Identified cases of DM were provided medical advices in the field by the physician and were referred to the nearby diabetic hospital for follow-up and treatment. The study subjects were informed about their rights to withdraw from the study at any stage or to restrict their data from analysis. The protocol was approved by the ethical committee of Bangladesh Medical Research Council (BMRC) and accordingly Ethical Clearance Certificate was obtained from BMRC. Confidentiality of data was ensured strictly as data were dealt with anonymity in computer and were used only for this study purpose.

4.14 Quality assurance

At the beginning, ethical clearance of the study was obtained from Bangladesh Medical Research Council (BMRC). The study was conducted in both urban and rural communities and respective community leaders (Ward Commissioner for urban community and Union Parishad chairman/Member for rural community) was invited for a meeting with the research team to inform them about the purpose of the study and for collection of their opinion or comments regarding the study. Their co-operation was sought in a participatory manner. They were given specific tasks like organizing, collecting voter's list & household number, co-ordination with the field team, and feedback based on their background and interest.

Two teams of two volunteers from the local community and one research assistant in each team was recruited (One team for each community) and trained by the researcher. Field workers were trained for 3 days (both theoretical and field) were interviewed regarding socio-demographic characteristics and different risk factors like family history of diabetes, physical activity, disease duration, complications, health care expenditure & sources of funding etc. Research assistant estimated blood glucose by Glucometer and around 10 subjects were investigated per day. Blood Glucose examination was done twice in a week on government holidays (Friday and Saturday) over the period of 6 months. Informed written/verbal consent was taken from the individual participant and they were informed about the objectives and methods of the study including their approval by the locally recruited volunteers. Every one was made aware of the fasting state for at least 12 hours prior to the test. The investigating team moved in the community and the selected people were reminded of the importance of the fasting state prior to the day of investigation and verbal confirmation was made prior to blood glucose estimation. They were also be informed about the site and procedural details of the investigation and were requested to attend the selected nearby site at a specific time in the morning (Preferably 8.00 AM) for blood examination. At first, fasting blood sugar was examined followed by they were ingested 75 gm glucose and kept at the center for 2 hours and finally blood sugar 2 hours after 75 gm glucose was examined.

For diagnosis of DM, whole capillary blood was taken from the participant by finger pricking under strict aseptic precaution in both fasting state and 2 hours after 75 gram glucose intake. Collected blood was examined by Glucometer in the field and findings were recorded by a

checklist. Collected data were cleaned for any inconsistency and irrelevancy and were stored by maintaining confidentiality. Finally data were processed for quality control and were entered in to computer for analysis by SPSS (recent available version) software.

4.15 Operational definitions

Following operational definitions were considered for this specific study:

I) Diagnostic criteria for diabetes mellitus

For diagnosis of DM, WHO diagnostic criteria[36] was used. Capillary whole blood was taken twice from each individual participant: in fasting state and 2 hours after 75 gram glucose intake. Fasting Blood Glucose (FBG) ≥6.1 mml/l (≥110 mg/100 ml) or Blood Glucose 2 hours after 75 gm glucose ≥11.1 mml/l (≥200 mg/100 ml) were used to classify Diabetes Mellitus cases. Fasting Blood Glucose 5.6–6.0 mml/l (>100-<110 mg/100 ml) was diagnosed as Impaired Fasting Glucose (IFG), while Blood Glucose 2 hours after 75 gm glucose 7.8-11.0 mml/l (140-199 mg/100 ml) was diagnosed as Impaired glucose tolerance (IGT). Blood glucose estimation was performed by the manual glucose analyzer in the field. The machine was calibrated everyday with the calibration cuvette prior to estimations. The microcuvette was stored in a refrigerator in the field and ice bags were used during transport of the cuvettes. Open packs were used within 3 weeks. The sensitivity and specificity of the Glucometer was reported in previous studies.[159]

Selection of blood glucose analyzer: To find out the reliable blood glucose analyzers, three Glucometers available in the market was used for estimation for blood glucose of a sample of 20 DM patients attending BIRDEDM hospital. Finally, the more reliable Glucometer was selected on the basis of Coefficient of Variation (CV) as follows:

$$\text{CV} = \frac{\text{SD}}{\text{Mean}} \times 100$$

II) Prevalence of Diabetes Mellitus: Prevalence of DM was calculated using following formula[159]:

$$\text{Prevalence of DM} = \frac{\text{Number of all current cases of DM at a given point in time}}{\text{Estimated population at the same point in time}} \times 100$$

III) Burden of diabetes mellitus

For this specific study, burden of DM denotes:

- Disability burden due to DM and its complications in terms of Disability Adjusted Life Years (DALY).
- Economic burden in terms of health care expenditure incurred by the diabetic patients.
- Burden in terms of prevalence of diabetes mellitus

IV) Duration of time lost due to death at each age

To measure DALY, duration of time lost due to death at each age is essential to measure years of life lost due to premature death (YLL). This measurement required defining the potential limit of life in case of DALYs, standard years of life lost were used. The standard was chosen to match the highest national life expectancy at birth for both sexes observed. For this study, life expectancy of Bangladesh estimated by BBS (2011) was used as follows[160]:

Life expectancy at birth for male = 65.4 yrs.

Life expectancy at birth for female = 67.9 yrs.

Duration of time lost due to death at each was calculated by subtracting the age at time death from the life expectancy at birth by sex.

V) Disability weight

Sufferings associated with different non-fatal conditions of the disease, which are necessary to estimate the disability due to diabetes mellitus itself and to make comparisons across the complications or sequelae of the disease. The Global Burden of Disease (GBD) used six disability classes to measure the extent of loss of physical functioning associated with a certain disease condition. Subsequently, a group of independent international experts established a weight, ranging from 0 (perfect health) to 1 (death), for each of six disability classes. Considering different limitations of other studies and for convenience this present study used disability weights some from GBD study and some from Dutch study[93-95].

Diabetes is also a risk factor for coronary heart disease and stroke, but the attributable DALY for these diseases were not included in this study. Similarly, infections and pregnancy complications due to diabetes had not been included here. Sequelae had been generally

modeled as incident many years after incidence of diabetes per se and DALY for sequelae have been discounted back to age at incidence. Co-morbidities between sequelae had not been taken into account, each has been modeled separately. In most cases, the prevalence of sequelae was low and co-morbidity effects were small. Disability weights for diabetes mellitus itself along with its complications/sequelae, used in this study (following GBD) were as follows[161-167]:

Disability weights of sequelaes by sources

Sequelaes	**Weight**	**Source**
Diabetes mellitus	0.070	Dutch weight
Retinopathy - moderate vision loss	0.170	Dutch weight
Retinopathy - severe vision loss	0.430	Dutch weight
Cataract - mild vision loss	0.020	Dutch weight
Cataract - moderate vision loss	0.170	Dutch weight
Cataract - severe vision loss	0.430	Dutch weight
Glaucoma - mild vision loss	0.020	Dutch weight
Glaucoma - moderate vision loss	0.170	Dutch weight
Glaucoma - severe vision loss	0.430	Dutch weight
Neuropathy	0.190	Dutch weight
Nephropathy	0.290	Dutch weight
Diabetic foot	0.220	GBD weight
Amputation - toe	0.064	GBD weight
Amputation - foot or leg	0.300	GBD weight

VI) Age weight

It indicates the relative importance of healthy life at different ages. The age weights used in the World Bank report rise from birth until age 25 and decline slowly thereafter. According to the World Health Organization, the formula to calculate those weights is:

Age-weighting function = $C \times e^{-Bx}$

Where, C = Adjustment constant for age weights & equal to 0.1658

B = Age weighting parameter (constant) equals to 0.04, e = constant & equal to 2.71

VII) Time preference

It is the value of health gains today compared to the value attached to health gains in the future (in standard economic theory, the later is assumed to be lower than the former). It is standard practice in economic appraisal of projects to use the discount rate to discount benefits in the future. The process of discounting future benefits converts them into net-present-value terms. These benefits can then be compared with project costs and also discounted if they are spread over more than one year to determine cost-effectiveness. The discount rate used in the GBD project of WHO was 3 percent. The formula to discount for time preference used in the study:

Discounting function = $e^{-r(x-a)}$

Where, r = Discount rate, fixed at 0.03, x = Age of the patient, e = Constant equal to 2.71, a = Years of onset incase of YLD estimation or Years when the person dies in case of YLL estimation.

VIII) Disability adjusted life years (DALY)

Disability Adjusted Life Years (DALY) is an indicator of time lived with a disability and the time lost due to premature mortality. The disability i.e. reduction in physical capacity due to morbidity is measured using disability weight. The duration of time lost due to premature mortality was calculated using standard expected years of life lost with life expectancy at birth. The value of time lived at different ages was calculated using an exponential function.

Procedure to Calculate DALY**:** The following cases were considered to calculate DALY for this specific study:

- DALYs lost due to immediate death
- DALYs lost due to death following disability
- DALYs lost due to permanent disability

DALY= YLL + YLD

YLL= Years of life lost due to premature death caused by diabetes mellitus

YLD = d x w

d = Duration of disability due to DM

w = Disability weight of DM, which was set by a panel of world experts. If the person lives up to the maximum of his life expectancy with disability, we needed to add up the total number of YLDs from the onset of disability (a) to the age of death (a+l). The following formula was used to calculate DALY for diabetes mellitus:

DALY=

$$\text{DW}\ \{\frac{KCe^{ra}}{(r+B)^2}[e^{-(r+B)(L+a)}[-(r+B)(L+a)-1]-e^{-(r+B)a}[-(r+B)a-1]]+\frac{1-K}{r}(1-e^{rl})\}$$

Where,

DW= Disability Weight, a = Age at the onset of the disease, r = Discount rate (3%).

C = Adjustment constant for age-weights: e.g. C = 0.1658. e = Exponential constant = 2.71.

B = Age weighting parameter (constant) = 0.04 & K = constant = 1.

L = Potential years of life left at age 'a'. In case of YLL calculation, it was calculated using life expectancy at birth and age at death while in case of YLD, years lived with the disability was be considered.

IX) Economic burden

Economic burden of diabetes mellitus was estimated from patient perspective by using "Cost of Treatment" approach and considering both direct and indirect costs incurred by the patients.[168,169] All the costs were calculated monthly.

- Direct costs: Consultation fee, hospital expense, cost of drug, cost of investigation, food cost, cost of motoring, cost of treating complications, travel cost, cost of attendant, and tips for treatment.
- Indirect costs: Wage loss (Income loss), disability payment, social security, tax rebate.
- Sources of fund: Household saving, Govt. subsidy, insurance, Loan from relative/employee, selling wealth/property.
- Coping ways: compensate with food consumption, life style, education and treatment of family member.

Both direct and indirect costs were estimated on the basis of "Cost of Treatment" approach as used by different health economists and researchers globally.

X) Physical activity

Status of physical activity of the participants was assessed in respect of range of physical activity performed. This included all types of physical activities like walking, running, jogging, cycling, rickshaw-pulling, gardening, digging, swimming, playing, washing dishes or cloths, building and construction etc. The activities were graded according to intensity and duration of work as follows[79]:

- Heavy: Equivalent to brisk walk of >90 minutes in 24 hours
- Moderate: Equivalent to brisk walk of 60-90 minutes in 24 hours
- Mild: Equivalent to brisk walk of 30-59 minutes in 24 hours
- Sedentary: Equivalent to brisk walk of <30 minutes in 24 hours

XI) Weight

A weighing machine (Bathroom Scale) having the recording facility for both pound & kilogram was used to measure the weight of the study subjects. The weighing scale was calibrated daily by known standard weight. The subjects were asked to stand unassisted in the centre of the platform without shoes & wearing minimum clothing & the reading was recorded to the nearest 0.1 kg.

XII) Height

Height was measured by using a non-stretch centimeter tape fixed vertically on a wall with the zero exactly at the floor-level. The subject stood straight against the tape such that the Frankfurt plane of head in horizontal, feet together, knees straight & the heels, buttocks and shoulder blades in contact with the wall. Arms were hanging at the sides in a natural manner. Measurement was taken at the level of highest point of vertex and recorded to the nearest 0.1 cm.

XIII) Body Mass Index (BMI)

Body mass index is widely used indices among the weight to height ratios as indirect measures of obesity. This index is best for assessing obesity in adult and it was estimated by using the formula:

$$\text{BMI} = \frac{\text{Weight in kg}}{\text{Height in m}^2}$$

XIV) Obesity on the basis of BMI: Obesity was classified on the basis of BMI as follows[170,171]:

Classification of obesity by BMI

BMI (Kg/m^2)	Remark
<18.50	Underweight
18.5-24.99	Normal Range
25.00-29.99	Overweight
30.00-34.99	Class I (Moderate) Obese
35.00-39.99	Class II (Severe) Obese
≥40.00	Class III (Very Severe) Obese

XV) Obesity on the basis of WHR: Waist girth was measured by placing a plastic tape horizontally mid-way between the lower border of the 12^{th} rib and iliac crest along the mid-axillary line. Similarly, the hip was measured by taking a point at the extreme end on the buttock in stooping posture and the other point on the symphysis pubis. Waist Hip Ratio [Waist/Hip] was calculated. Obesity on the basis of WHR was considered as follows[170,171]:

Classification of obesity by WHR

Sex	WHR (Cm)	Remark
Male	>1.0	Obese
Female	>0.85	Obese

4.16 Limitations of the Study

- The study confronted limitations to ensure participation of the people in the study especially to motivate them to give blood two times for the sake of diagnosis of diabetes.
- Due to resource constraints, the study included limited urban and rural communities as a result the study findings may not represent the real picture of the urban and rural communities of the country.
- The study contained recall bias especially in respect of information on complications of diabetes mellitus.
- Disability weight used in the study for estimation of disability burden was taken following the Global Disease Burden of World Health Organization, which may not be the representative of Bangladeshi people.
- Recall bias was confronted to some extent by the study in respect of estimation of treatment costs especially in calculation of direct and indirect treatment costs.
- Body Mass Index (BMI) and Waist Hip Ratio (WHR) were calculated among the participants without socio-economic clustering as a result discrepancies were revealed between urban and rural communities, which could not be explained specifically.

5.0 Results

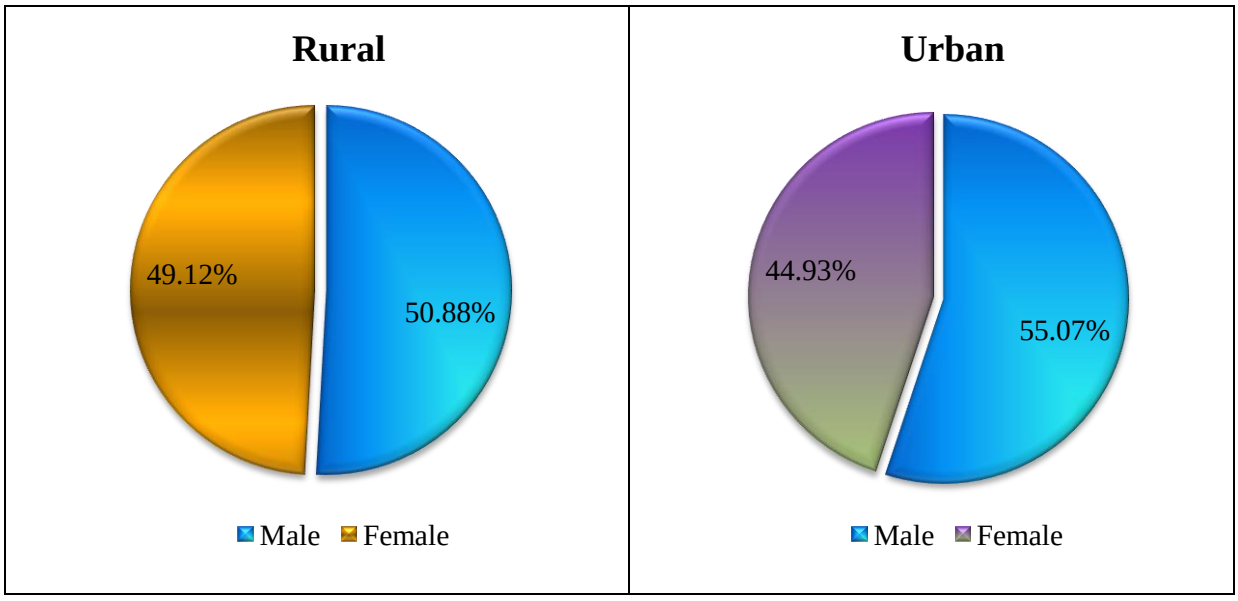
The comparative cross-sectional study was conducted among 2052 participants to estimate the disability and economic burden of diabetes mellitus. Among all the participants, 1026 from urban community and another 1026 participants from rural community were included in the study. The study intended to compare disability and economic burden of diabetes mellitus between urban and rural communities of Bangladesh. The study also anticipated to determine the socio-demographic characteristics of the participants along with the prevalence and risk factors of diabetes mellitus in the communities. The study revealed the following findings.

Section-I: Socio-demographic Characteristics of the Participants by Residing Community

5.1 Sex distribution of the participants by residing community

The study revealed that in the rural community, out 1026 participants, 50.88% were male and the rest 49.12% were female. On the contrary, in the urban community, among 1026 participants, 55.07% were male and the rest 44.93% female, which is depicted in the following figure-1.

Figure-1: Distribution of the participants by sex

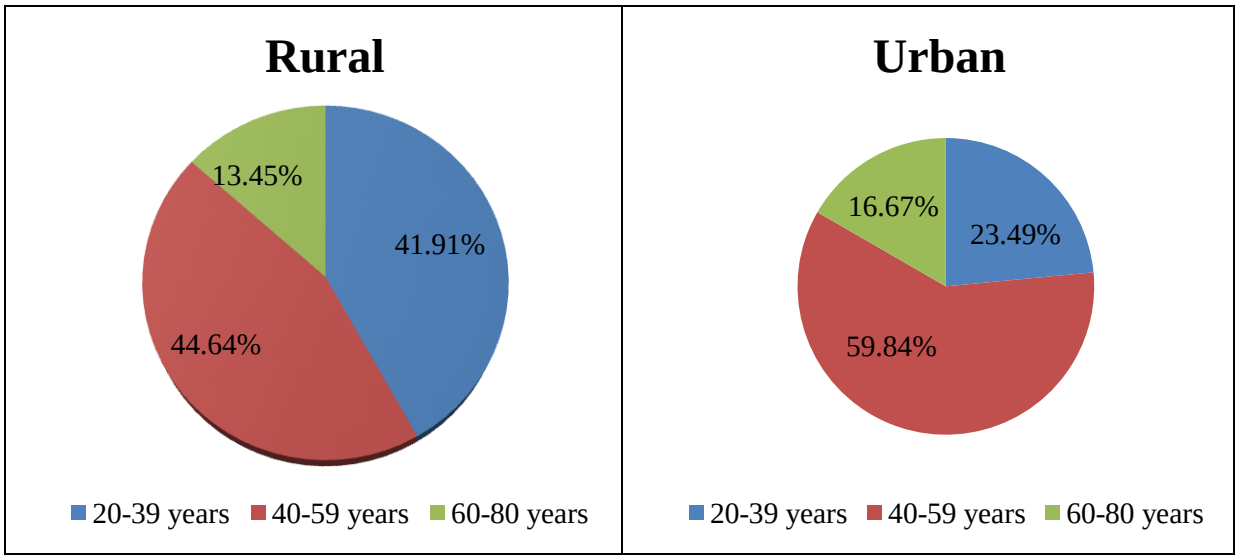


5.2 Age distribution of the participants by residing community

By age group, in the rural community, majority (70.6%) of the participants were in the age group 30-59 years followed by 16.0% were in the age group 20-29 years and the rest 13.4% were in the age group 60-80 years.

On the other hand, in the urban community, majority (70.6%) were in the age group 30-59 years followed by 13.1% were in the age group 20-39 years and the rest 16.3% were in the age group 60-80 years, which are well documented in the figure-2.

Figure-2: Distribution of the participants by age



Mean±SD= 42.54±13.18 **Mean±SD= 45.20±13.22**

5.3 Distribution of the participants by religion and residing community

In the rural community, out of all, most (95.81%) of the participants were Muslim and only 3.7% were Hindu by religion.

On the contrary, in the urban community, 93.08% were Muslims and 5.46% participants were Hindu, which are reflected in the table-1.

Table-1: Distribution of the participants by religion and residing community

Religion	Rural		Urban		Total	
	N	%	N	%	N	%
Muslim	983	95.81	955	93.08	1938	94.44
Hindu	38	3.70	56	5.46	94	4.58
Christian	05	0.49	15	1.46	20	0.97
Total	1026	100.00	1026	100.00	2052	100.00

5.4 Distribution of the participants by educational qualification & residing community

Among all the participants in the rural community, majority (25.44%) had primary level education, followed by 18.32% were illiterate, 16.57% had SSC, 15.98% HSC and 10.62% had secondary level education, which are depicted in the table-2.

On the other hand, among the participants of urban community, majority (21.15%) had SSC level education followed by 19.10% had HSC, 17.4% had primary level education while 12.38% and 8.28% were graduates and illiterate respectively, which are depicted in table-2.

Table-2: Educational qualification of the participants by residing community

Education	Rural		Urban		Total	
	N	%	N	%	N	%
Primary	261	25.44	180	17.54	441	21.49
Secondary	109	10.62	133	12.96	242	11.79
SSC	170	16.57	217	21.15	387	18.86
HSC	164	15.98	196	19.10	360	17.54
Graduate	93	9.06	127	12.38	220	10.72
Masters	41	4.00	88	8.58	129	6.29
Illiterate	188	18.32	85	8.28	273	13.30
Total	1026	100.00	1026	100.00	2052	100.00

5.5 Occupation and monthly income of the participants by residing community

Regarding occupation, among the participants in the rural community, 28.07% were service holders, followed by 25.25% housewives and 21.54% business persons. On the other hand, among the participants of urban community, 35.96% were service holders, followed by 25.54% housewives and 22.22% business persons, which are shown in the table-3.

Regarding monthly income, in the rural community, 39.96% were in Tk.10001-20000 income group and 38.40% were in Tk.2000-10000 group. In the urban community, majority (51.75%) was in Tk.2000-10000 income group while 38.50% in Tk.10001-20000 group. Average monthly income was Tk.15921±9759 in the rural community while it was Tk.13661±9503 in the urban community, which scenario is reflected in the table-3.

Table-3: Distribution of occupation and monthly income of the participants by residing community

Attributes	Rural		Urban		Total	
	N	%	N	%	N	%
Occupation						
Service	288	28.07	369	35.96	657	32.02
Farmer	66	6.43	9	0.88	75	3.65
Student	62	6.04	46	4.48	108	5.26
Housewife	259	25.24	262	25.54	521	25.39
Business	221	21.54	228	22.22	449	21.88
Day labor	53	5.17	63	6.14	116	5.65
Unemployed	77	7.50	49	4.78	126	6.14
Total	1026	100.00	1026	100.00	2052	100.00
Monthly income (Taka)						
2000-10000	394	38.40	531	51.75	925	45.08
10001-20000	410	39.96	395	38.50	805	39.23
20001-40000	222	21.64	96	9.36	318	15.50
40001-60000	0	0.00	4	0.39	4	0.19
Total	1026	100.00	1026	100.00	2052	100.00
Mean±SD	15921±9759		13661±9503		14791±9696	

5.6 Distribution of family type and size of the participants by residing community

In respect of family type, among the participants of rural community, majority (79.53%) was from nuclear family and only 20.47% were from joint family. On the contrary, in the urban community, most (83.33%) of the participants were from nuclear family and only 16.67% were from joint family, which are reflected in the table-4.

By number of family member, majority (56.53%) of the rural participants had 5-7 members with average family member of 5.33±1.64. On the contrary, majority (50.78%) urban participants had 3-4 members with the average of 4.65±1.36, which are shown in the table-4.

Table-4: Distribution of family type and size of the participants by residing community

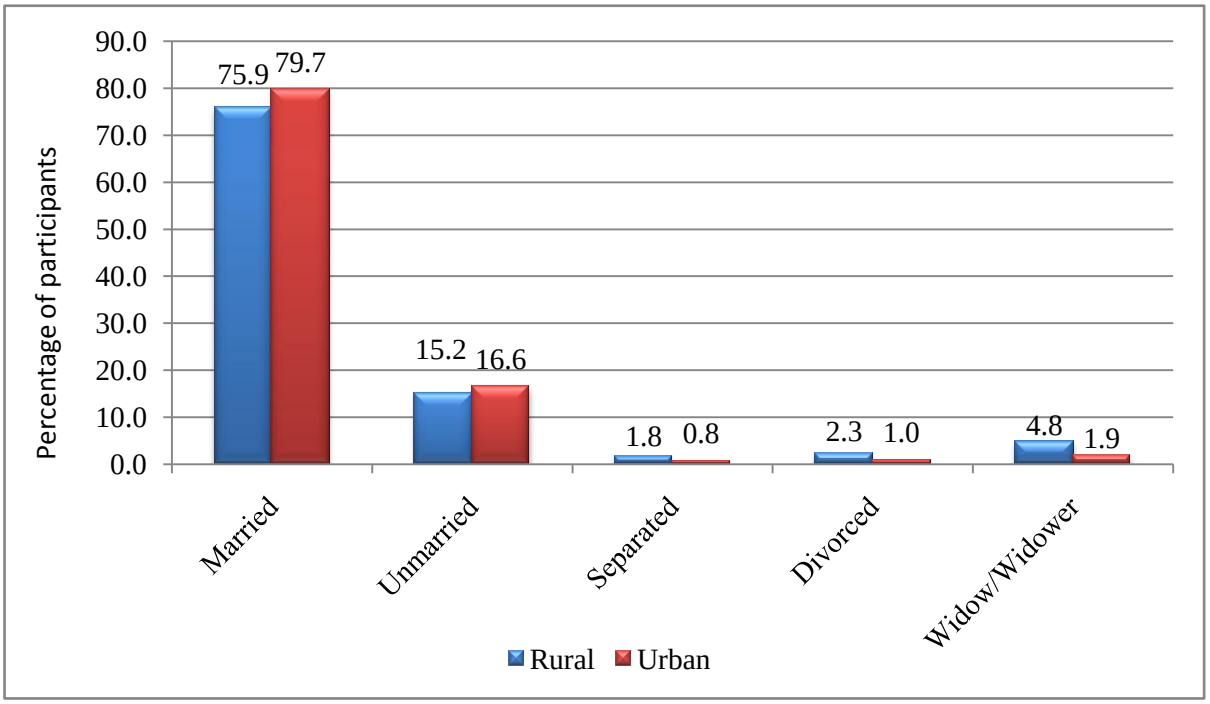
Attributes	Rural		Urban		Total	
	N	%	N	%	N	%
Family type						
Nuclear family	816	79.53	855	83.33	1671	81.43
Joint family	210	20.47	171	16.67	381	18.57
Total	1026	100.00	1026	100.00	2052	100.00
Size of family (No. of member)						
1-2	23	2.24	18	1.75	41	2.00
3-4	323	31.48	521	50.78	844	41.13
5-7	580	56.53	454	44.25	1034	50.39
8-11	100	9.75	33	3.22	133	6.48
Total	1026	100.00	1026	100.00	2052	100.00
Mean±SD=	5.33±1.64		4.65±1.36		4.99±1.54	

5.7 Distribution of the participants by marital status and residing community

Among all the participants in the rural community, majority (75.9%) were married followed by 15.2% unmarried, 4.8% widow/widower, 2.3% divorced and 1.8% separated as shown in the figure-3.

On the other hand, among the participants of urban community, majority (79.7%) were married, followed by 16.6% unmarried, 1.9% widow/widower, 1% divorced and 0.8% separated, which are depicted in the figure-3.

Figure-3: Distribution of the participants by marital status and residing community



5.8 Distribution of height, weight and BMI of the participants by residing community

In respect of height, among the rural participants, majority (53.90%) had height 1.51-1.70 meter and 43.08% had 1.30-1.50. On the other hand, in the urban community, majority (50.19%) had height 1.51-1.70 meter and 44.54% had 1.30-1.50 meter.

Regarding weight of the participants, in the rural community, majority (55.95%) had weight 51-70 kg and 27.68% had 71-90 kg. On the contrary, in the urban community, majority (65.79%) had weight 51-70 kg while 20.57% had 30-50 kg.

Regarding BMI, among the rural participants, majority (73.29%) was in 'normal' limit and 24.17% were 'overweight'. On the other side, in the urban community, majority (73.20%) was in 'normal' limit but 20.27% were 'overweight' but obesity was higher in urban (1.17%) in comparison to rural (0.49%) community, which are shown in the table-5.

Table-5: Distribution of height, weight and BMI of the participants by community

Anthropometry	Rural		Urban		Total	
	N	%	N	%	N	%
Height (m.)						
1.30-1.50	442	43.08	457	44.54	899	43.81
1.51-1.70	553	53.90	515	50.19	1068	52.05
1.71-1.80	31	3.02	54	5.26	85	4.14
Total	1026	100.00	1026	100.00	2052	100.00
Mean±SD=	1.59±0.10		1.59±0.11		1.59±0.10	
Weight (Kg.)						
30-50	168	16.37	211	20.57	379	18.47
51-70	574	55.95	675	65.79	1249	60.87
71-90	284	27.68	140	13.65	424	20.66
Total	1026	100.00	1026	100.00	2052	100.00
Mean±SD=	62.31±11.67		60.64±11.35		61.48±11.54	
BMI						
Underweight (<18.5)	21	2.05	55	5.36	76	3.70
Normal (18.5-24.9)	752	73.29	751	73.20	1503	73.25
Overweight (25-29.9)	248	24.17	208	20.27	456	22.22
Obese (30-34.9)	5	0.49	12	1.17	17	0.83
Mean±SD=	23.60±2.45		23.56±2.94		23.58±2.71	

5.9 Distribution of waist, hip and waist-hip ratio of the participants by community

By waist circumference, most (91.23%) of the rural participants had 71-107 cm while 8.77% had 51-70 cm. On the other hand, in the urban community, majority (67.93%) had 71-107 and 29.92% had 51-70 cm waist circumference. Average waist circumference was 82.59±8.74 cm and 77.34±11.86 cm in rural and urban community respectively.

In respect of hip circumference, most (99.12%) of the rural participants had 71-107 cm and only 0.68% had 51-70 cm group. Whereas in the urban community, 97.37% had 71-107 cm and only 2.44% had 30-50 cm hip circumference. Average hip circumference was 91.13±6.67 cm and 86.01±9.72 cm in rural and urban community respectively.

On the basis of Waist Hip Ratio (WHR), among the rural participants, majority (73.3%) had normal waist-hip ratio and 26.7% had central obesity but in the urban community, 72.4% had normal waist-hip ratio and 27.6% had central obesity, which are depicted in the table-6.

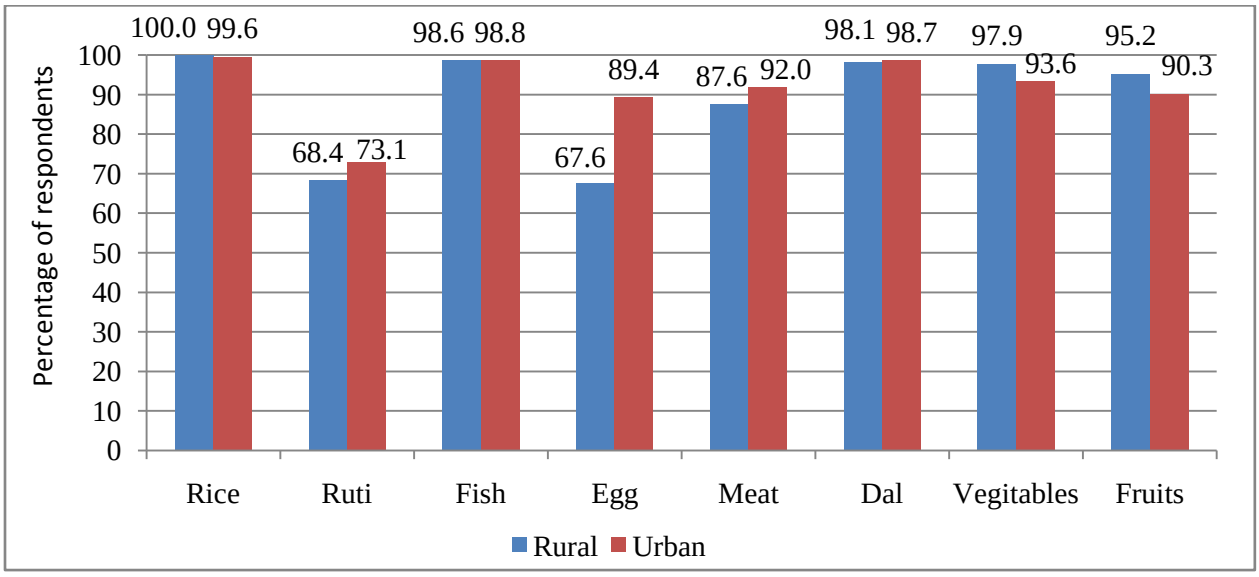
Table-6: Distribution of waist, hip and waist-hip ratio of the participants by community

Anthropometry	Rural		Urban		Total	
	N	%	N	%	N	%
Waist (Cm.)						
30-50	0	0.00	22	2.14	22	1.07
51-70	90	8.77	307	29.92	397	19.35
71-107	936	91.23	697	67.93	1633	79.58
Total	1026	100.00	1026	100.00	2052	100.00
Mean±SD=	82.59±8.74		77.34±11.86		79.97±10.74	
Hip (Cm.)						
30-50	2	0.19	25	2.44	27	1.32
51-70	7	0.68	2	0.19	9	0.44
71-107	1017	99.12	999	97.37	2016	98.25
Total	1026	100.00	1026	100.00	2052	100.00
Mean±SD=	91.13±6.67		86.01±9.72		88.57±8.72	
Waist Hip Ratio (WHR)						
Normal	752	73.3	743	72.4	1495	72.9
Obese	270	26.7	283	27.6	757	27.1
Total	1026	100.00	1026	100.00	2052	100.00

5.10 Distribution of food habit of the participants by residing community

By food habit, most of the rural participants were used to consume 'rice' (100.0%), 'fish' (98.6%), 'dal' (98.1%) and 'vegetables' (97.9%). On the other side, in the urban community, most of the participants were used to take 'rice' (99.6%), 'fish' (98.8%), 'dal' (98.7%) and 'vegetables' (93.6%), which are depicted in the following figure-4.

Figure-4: Distribution of food habit of the participants by residing community



5.11 Distribution of frequency of food intake of the participants by residing community

The study revealed that, 66.47% rural participants took 'rice' 16-21 times per week while and 52.84% urban participants took 'rice' 10-15 times per week. In case of 'ruti' intake, 65.38% rural participants took 1-5 times per week while 63.60% urban participants took 'ruti' 6-10 times per week. In case of vegetables, majority (59.06%) of the rural participants took 'vegetables' 8-11 times per week while majority (42.71%) of the participants took it 12-16 times a week. In case of 'fruits' intake, most (83.32%) of the rural participants took 'fruits' 1-4 times per week whereas 74.62% urban participants took it 1-4 times a week.

Table-7: Distribution of frequency of food intake of the participants by community

	Rural		Urban		Total	
	N	%	N	%	N	%
Rice						
6-9 times	29	2.83	82	8.02	111	5.42
10-15 times	315	30.70	540	52.84	855	41.75
16-21 times	682	66.47	400	39.14	1082	52.83
Total	1026	100.00	1022	100.00	2048	100.00
Mean±SD	16.96±3.25		15.73±3.93		16.34±3.66	
Ruti						
1-5 times	459	65.38	158	21.07	617	42.49
6-10 times	219	31.20	477	63.60	696	47.93
11-15 times	24	3.42	115	15.33	139	9.57
Total	702	100.00	750	100.00	1452	100.00
Mean±SD	4.50±2.75		7.15±3.20		5.87±3.27	
Vegetables						
5-7 times	176	17.53	282	29.38	458	23.32
8-11 times	593	59.06	268	27.92	861	43.84
12-16 times	235	23.41	410	42.71	645	32.84
Total	1004	100.00	960	100.00	1964	100.00
Mean±SD	9.91±2.31		10.53±3.34		10.21±2.88	
Fruits						
1-4 times	814	83.32	691	74.62	1505	79.09
5-9 times	161	16.48	215	23.22	376	19.76
10-14 times	2	0.20	20	2.16	22	1.16
Total	977	100.00	926	100.00	1903	100.00
Mean±SD	2.97±1.98		3.51±2.52		3.23±2.27	

5.12 Distribution of the participants by frequency of food intake & residing community

It was also found that majority (48.36%) of the rural participants took 'dal' 12-16 times while 57.75% urban participants took 'dal' 7-11 times per week. Most (83.72%) of the rural participants and majority (57.91%) of the urban participants took 'egg' 1-3 times per week. Regarding 'fish' intake, 79.01% rural participants and 60.12% urban participants took 'fish' 7-13 times per week. In respect of 'meat' intake, 92.88% rural and 88.45% urban participants took 'meat' 1-3 times per week, which is shown in the table-8.

Table-8: Distribution of the participants by frequency of food intake (Per week)

	Rural		Urban		Total	
	N	%	N	%	N	%
Dal						
2-6 times	78	7.75	313	30.90	391	19.36
7-11 times	442	43.89	585	57.75	1027	50.84
12-16 times	487	48.36	115	11.35	602	29.80
Total	1007	100.00	1013	100.00	2020	100.00
Mean±SD	10.74±2.73		8.27±3.02		9.50±3.13	
Egg						
1-3 times	581	83.72	531	57.91	1112	69.03
4-7 times	105	15.13	346	37.73	451	28.00
8-12 times	8	1.15	40	4.36	48	2.98
Total	694	100.00	917	100.00	1611	100.00
Mean±SD	2.21±1.98		3.53±2.18		2.96±2.19	
Fish						
1-6 times	204	20.69	397	39.78	601	30.29
7-13 times	779	79.01	600	60.12	1379	69.51
14-20 times	3	0.30	1	0.10	4	0.20
Total	986	100.00	998	100.00	1984	100.00
Mean±SD	8.55±2.96		7.57±3.08		8.06±3.06	
Meat						
1-3 times	835	92.88	835	88.45	1670	90.61
4-7 times	44	4.89	77	8.16	121	6.57
8-12 times	20	2.22	32	3.39	52	2.82
Total	899	100.00	944	100.00	1843	100.00
Mean±SD	1.89±1.64		2.30±2.05		2.10±1.87	

5.13 Distribution of the participants by pattern of tobacco consumption & community

The study also revealed that, majority (53.12%) of the rural participants never consumed tobacco. On the other hand, majority (47.76%) of urban participants never consumed tobacco. Regarding frequency of tobacco consumption, majority (43.60%) of the rural participants consumed 6-10 times a day. On the other hand, majority (48.84%) of the urban participants consumed 6-10 times a day. Regarding duration of tobacco consumption, majority (43.31%) of rural participants consumed tobacco for 1-5 years. On the other hand, majority (38.28%) of the urban participants consumed tobacco for 6-10 years. These finding are shown in the following table-9.

Table-9: Distribution of the participants by pattern of tobacco consumption

	Rural		Urban		Total	
	N	%	N	%	N	%
Tobacco consumption						
Not ever been consumed	545	53.12	490	47.76	1035	50.44
Previously consumed	79	7.70	40	3.90	119	5.80
Currently consuming	350	34.11	475	46.30	825	40.20
Occasional consume	52	5.07	21	2.05	73	3.56
Total	1026	100.00	1026	100.00	2052	100.00
Frequency of Tobacco Consumption per day						
1-5 times	144	41.86	83	27.39	227	35.09
6-10 times	150	43.60	148	48.84	298	46.06
11-20 times	50	14.53	67	22.11	117	18.08
21-30 times	0	0.00	5	1.65	5	0.77
Total	344	100.00	303	100.00	647	100.00
Mean±SD	8.87±5.84		11.56±7.20		10.29±6.73	
Duration of tobacco consumption (in years)						
1-5	149	43.31	82	27.06	231	35.70
6-10	112	32.56	116	38.28	228	35.24
11-20	68	19.77	57	18.81	125	19.32
21-30	15	4.36	48	15.84	63	9.74
Total	344	100.00	303	100.00	647	100.00
Mean±SD	10.61±7.45		13.78±7.69		12.28±7.74	

5.14 Distribution of the participants by smoking habit and residing community

In respect of smoking habit, 82.07% rural and 66.37% urban participants were non-smokers while 17.93% rural and 33.63% urban participants had smoking habit. In the rural community, majority (36.96%) of the participants smoked 1-5 times while majority (36.81%) of the urban participants smoked 6-10 times per day. Duration of smoking habit was 1-5 years among majority (36.96%) of the rural participants while it was 6-10 years among majority (36.81%) of the urban participants. Average duration of smoking was 12.60±8.66 years and14.86±7.24 years among rural and urban participants respectively, which is shown in the table-10.

Table-10: Distribution of the participants by smoking habit and residing community

	Rural		**Urban**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**
Smoking habit						
Yes	184	17.93	345	33.63	529	25.78
No	842	82.07	681	66.37	1523	74.22
Total	1026	100.00	1026	100.00	2052	100.00
Frequency of smoking per day						
1-5 times	68	36.96	39	11.30	107	20.23
6-10 times	49	26.63	127	36.81	176	33.27
11-20 times	43	23.37	105	30.43	148	27.98
21-30 times	24	13.04	74	21.45	98	18.53
Total	184	100.00	345	100.00	529	100.00
Mean±SD	9.55±5.18		13.16±7.73		11.91±7.16	
Duration of smoking (in years)						
1-5	68	36.96	39	11.30	107	20.23
6-10	49	26.63	127	36.81	176	33.27
11-20	43	23.37	105	30.43	148	27.98
21-30	24	13.04	74	21.45	98	18.53
Total	184	100.00	345	100.00	529	100.00
Mean±SD	12.60±8.66		14.86±7.24		14.07±7.83	

5.15 Distribution of the participants by pattern of alcohol consumption and community

Regarding alcohol consumption, most of rural (92.59%) and urban (91.13%) participants never consumed alcohol. In the rural community, 4.48% consumed in past, 2.14% were current and 0.78% were occasional alcohol consumer while in the urban community 2.63% were previous consumer, 3.31% current and 2.92% were occasional alcohol consumer.

Among the alcohol consumers, level of consumption was mild among 42.11% rural and 62.64% urban participants while it was moderate among 40.79% rural and 31.87% urban participants. Duration of alcohol consumption was 1-5 years among 67.11% rural and 56.04 urban participants. Average duration was 5.20±3.68 years and 5.14±2.90 years in the rural and urban community respectively, which are depicted in the table-11.

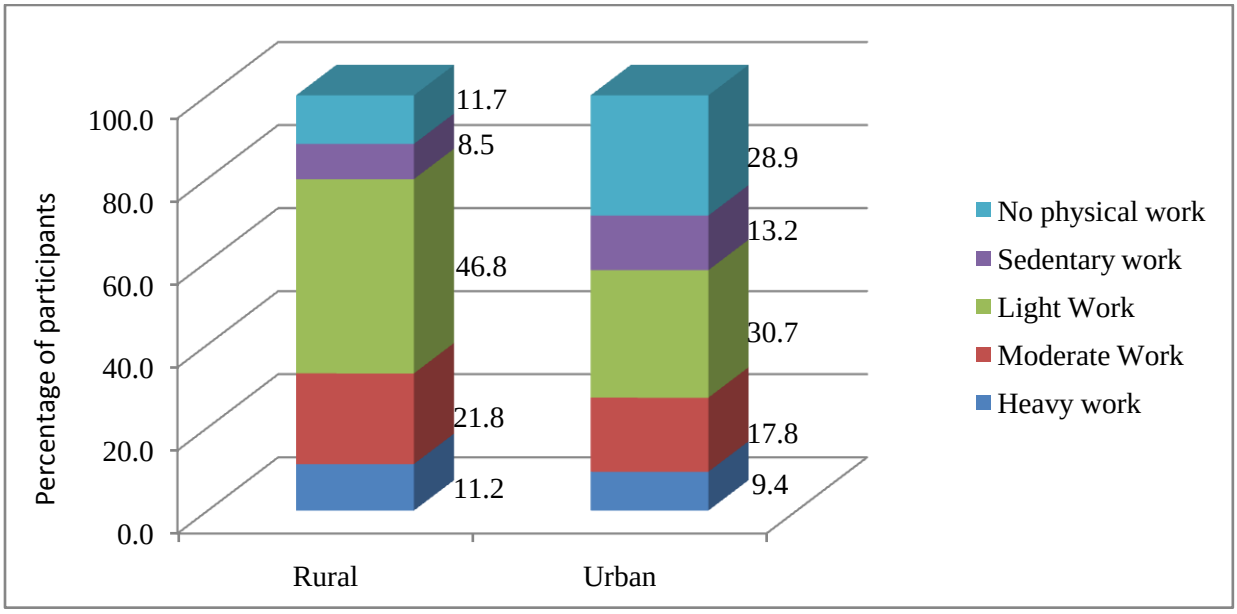
Table-11: Distribution of the participants by pattern of alcohol consumption

	Rural		**Urban**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**
Alcohol consumption						
Never been drinking	950	92.59	935	91.13	1885	91.86
Previous drinking	46	4.48	27	2.63	73	3.56
Currently drinking	22	2.14	34	3.31	56	2.73
Occasional drinking	8	0.78	30	2.92	38	1.85
Total	1026	100.00	1026	100.00	2052	100.00
Level of alcohol consumption						
Mild	32	42.11	57	62.64	89	53.29
Moderate	31	40.79	29	31.87	60	35.93
Severe	13	17.11	5	5.49	18	10.78
Total	76	100.00	91	100.00	167	100.00
Duration of alcohol consumption (in years)						
1-5	51	67.11	51	56.04	102	61.08
6-10	20	26.32	37	40.66	57	34.13
11-15	5	6.58	3	3.30	8	4.79
Total	76	100.00	91	100.00	167	100.00
Mean±SD	5.20±3.68		5.14±2.90		5.17±3.27	

5.16 Distribution of the participants by physical activity and residing community

In respect of level of physical activity, it is found that, 46.8% rural and 30.7% urban participants performed light physical work followed by 21.8% rural and 17.8% urban participants performed moderate physical work. On the contrary, 11.7% rural and 28.9% urban participants did not perform any physical work. On the other hand, 8.5% rural and 13.2% urban participants performed sedentary work, which are shown in the figure-5.

Figure-5: Distribution of the participants by level of physical activity and residing community



Heavy work: Daily rapidly walking 90 minutes or more

Moderate work: Daily rapidly walking 60-90 minutes

Light work: Daily rapidly walking 30-59 minutes

Sedentary work: Daily rapidly walking less than 30 minutes

5.17 Distribution of satisfaction level of the participants by residing community

In respect of satisfaction about working place, 54.87% rural and 59.75% urban participants were 'neither happy nor unhappy', 15.3% rural and 9.45% urban participants were 'unhappy' while 26.02% rural and 28.46% urban participants were 'happy'. In respect of satisfaction about economic conditions, 57.21% rural and 54.87 urban participants were 'neither happy nor unhappy', 20.18% rural and 15.50% urban participants were 'unhappy' whereas 19.98% rural and 27.78% urban participants were 'happy'. In respect of satisfaction about family life, 47.56% rural and 52.14% urban participants were 'neither happy nor unhappy', 11.31% rural and 3.80% urban participants were 'unhappy' while 38.99% rural and 52.14% urban participants were 'happy', which are depicted in the table-12.

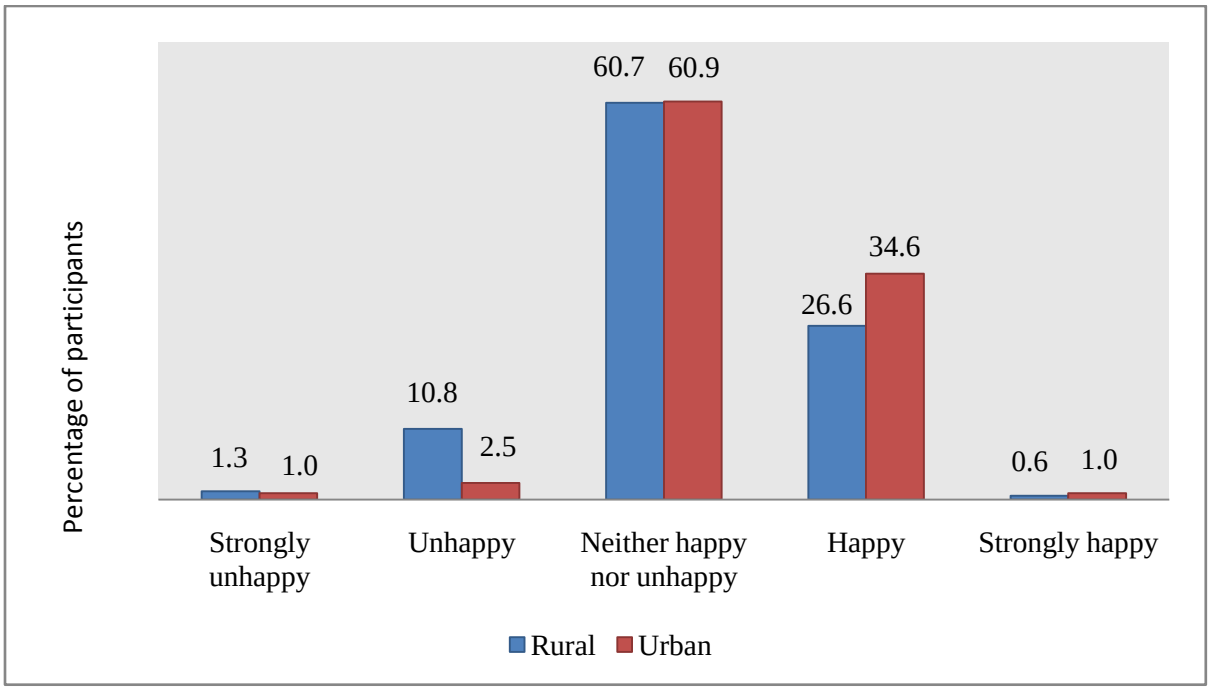
Table-12: Distribution of the participants by level of satisfaction

	Rural		Urban		Total	
	N	%	N	%	N	%
Satisfactions about working places						
Strongly unhappy	28	2.73	13	1.27	41	2.00
Unhappy	157	15.30	97	9.45	254	12.38
Neither happy nor unhappy	563	54.87	613	59.75	1176	57.31
Happy	267	26.02	292	28.46	559	27.24
Strongly happy	11	1.07	11	1.07	22	1.07
Total	1026	100.00	1026	100.00	2052	100.00
Satisfactions of about economic conditions						
Strongly unhappy	21	2.05	10	0.97	31	1.51
Unhappy	207	20.18	159	15.50	366	17.84
Neither happy nor unhappy	587	57.21	563	54.87	1150	56.04
Happy	205	19.98	285	27.78	490	23.88
Strongly happy	6	0.58	9	0.88	15	0.73
Total	1026	100.00	1026	100.00	2052	100.00
Satisfactions about family life						
Strongly unhappy	14	1.36	9	0.88	23	1.12
Unhappy	116	11.31	39	3.80	155	7.55
Neither happy nor unhappy	488	47.56	424	41.33	912	44.44
Happy	400	38.99	535	52.14	935	45.57
Strongly happy	8	0.78	19	1.85	27	1.32
Total	1026	100.00	1026	100.00	2052	100.00

5.18 Distribution of overall life satisfaction of the participants by residing community

Regarding overall satisfaction of life, it was revealed that majority of the rural (60.7%) and urban (60.9%) participants were 'neither happy nor unhappy' followed by 10.8% rural and 2.5% urban participants were 'unhappy' and 26.6% rural and 34.6% urban participants were 'happy' and these findings are documented in the figure-6.

Figure-6: Overall life satisfaction of the participants



5.19 Distribution of the participants by exposure to chemical agents and community

The study revealed that majority of the rural (71.93%) and urban (79.92%) participants were not exposed to any chemical agents while 28.07% rural and 20.08% urban participants were exposed to chemical agents.

In respect of types of chemical agents exposed, 10.43% rural and 4.58% urban participants were exposed to 'pesticides', 6.92% rural and 5.26% urban participants were exposed to 'rodenticide', 3.31% rural and 5.56% urban participants were exposed to 'anenyl dye', 4.09% rural and 1.36% urban participants were exposed to 'fertilizer' and each 3.31% of rural and urban participants were exposed to 'carbide', which are depicted in the table-13.

Table-13: Distribution of the participants by exposure to chemical agents and residing community

	Rural		Urban		Total	
	N	%	N	%	N	%
Exposure to any chemical agent						
Yes	288	28.07	206	20.08	494	24.07
No	738	71.93	820	79.92	1558	75.93
Total	1026	100.00	1026	100.00	2052	100.00
Types of chemical exposure						
Rodenticides	71	6.92	54	5.26	125	6.09
Pesticides	107	10.43	47	4.58	154	7.50
Fertilizer	42	4.09	14	1.36	56	2.73
Carbide	34	3.31	34	3.31	68	3.31
Anenyl	34	3.31	57	5.56	91	4.43
No exposure	738	71.93	820	79.92	1558	75.93
Total	1026	100.00	1026	100.00	2052	100.00

5.20 Distribution of the participants by self medication and residing community

The study revealed that, 35.28% rural and 17.78% urban participants had history of self medication. Regarding types of medication, 10.43% rural and 3.12% urban participants used 'steroid', 8.67% rural and 2.63% urban participants used 'homeopath drug', 7.21% rural and 3.22% urban participants used 'diuretics' while 6.24% rural and 6.34% urban participants used 'oral contraceptive pill', which are reflected in the table-14.

Table-14: Distribution of the participants by self medication and residing community

	Rural		Urban		Total	
	N	%	N	%	N	%
Self medication						
Yes	362	35.28	182	17.74	544	26.51
No	664	64.72	844	82.26	1508	73.49
Total	1026	100.00	1026	100.00	2052	100.00
Types of medication						
Steroid	107	10.43	32	3.12	139	6.77
OCP	64	6.24	65	6.34	129	6.29
Diuretics	74	7.21	33	3.22	107	5.21
Hormone Therapy	28	2.73	25	2.44	53	2.58
Homeopath Drug	89	8.67	27	2.63	116	5.65
No drug intake	664	64.72	844	82.26	1508	73.49
Total	1026	100.00	1026	100.00	2052	100.00

5.21 Distribution of the participants by viral disease and residing community

The study found that 5.95% rural and 15.30% urban participants suffered from viral diseases although most of them (94.05% rural and 84.70% urban) didn't suffer.

Among the sufferer of viral diseases, 3.28% of the rural and 3.82% of the urban participants suffered from 'rubella' while 26.23% rural and 22.93% urban participants suffered from 'mumps'. Each 19.67% of rural participants suffered from 'hepatitis' and 'measles' while 18.47% and 19.11% urban participants suffered 'hepatitis' and 'measles' respectively, which are focused in the table-15.

Table-15: Distribution of the participants by suffering from viral diseases

	Rural		Urban		Total	
	N	%	N	%	N	%
Suffering from any viral disease						
Yes	61	5.95	157	15.30	218	10.62
No	965	94.05	869	84.70	1834	89.38
Total	1026	100.00	1026	100.00	2052	100.00
Types of viral diseases						
Rubella	2	3.28	6	3.82	8	3.67
Mumps	16	26.23	36	22.93	52	23.85
Hepatitis	12	19.67	37	23.57	49	22.48
Measles	12	19.67	29	18.47	41	18.81
Dengue Fever	9	14.75	30	19.11	39	17.89
Chicken Pox	10	16.39	19	12.10	29	13.30
Total	61	100.00	157	100.00	218	100.00

5.22 Distribution of the participants by family history of diabetes mellitus & community

The study depicted that 20.47% rural and 21.15% urban participants had family history of diabetes mellitus (DM) while majority of rural (79.53%) and urban (78.85%) had no family history of DM.

Regarding family members having DM, it is found that, 32.38% rural and 36.41% urban fathers while 24.76% rural and 23.04% urban mothers had DM. On the other hand, 11.43% rural and 11.06% urban brothers while 10.0% rural and 5.53% urban sisters had DM. It was also revealed that, most of the participants' family members were not died from diabetes mellitus rather only 0.39% rural and 1.56% urban family members found died from DM, which are produced in the table-16.

Table-16: Distribution of the participants by family history of diabetes mellitus and residing community

	Rural		Urban		Total	
	N	%	N	%	N	%
Family history of diabetics mellitus						
Yes	210	20.47	217	21.15	427	20.81
No	816	79.53	809	78.85	1625	79.19
Total	1026	100.00	1026	100.00	2052	100.00
Family member suffering from diabetics mellitus						
Father	68	32.38	79	36.41	147	34.43
Mother	52	24.76	50	23.04	102	23.89
Grand father	17	8.10	21	9.68	38	8.90
Grand mother	10	4.76	18	8.29	28	6.56
Brother	24	11.43	24	11.06	48	11.24
Sister	21	10.00	12	5.53	33	7.73
Uncle	18	8.57	13	5.99	31	7.26
Total	210	100.00	217	100.00	427	100.00
Whether any member of your family died from diabetes mellitus in last one year						
Yes	4	0.39	16	1.56	20	0.97
No	1022	99.61	1010	98.44	2032	99.03
Total	1026	100.00	1026	100.00	2052	100.00

5.23 Distribution of the participants by having diabetes mellitus & residing community

It was revealed by the study that 10.53% rural and 14.91% urban participants had previously detected diabetes mellitus (DM). Among the diabetic participants, 82.41% rural and 68.63% urban participants had DM for the duration of 1-5 years while 12.96% rural and 25.49% urban participants had duration of 6-10 years. On the other side, mean±SD duration of DM was 5.81±4.70 and 5.27±3.62 years in the rural and urban community respectively. The study also depicted that majority of the rural (75.4%) and urban (64.5%) patients had the age 30-59 years at onset of DM. Mean±SD age at onset of DM was 45.10±9.09 and 44.84±11.54 years in the rural and urban community respectively. Only 1.95% rural and 0.97% urban participants performed self monishing of DM. These findings are focused in the table-17.

Table-17: Distribution of the participants by having diabetes mellitus and community

	Rural		Urban		Total	
	N	%	N	%	N	%
Suffering from DM at present						
Yes	108	10.53	153	14.91	261	12.72
No	918	89.47	873	85.09	1791	87.28
Total	1026	100.00	1026	100.00	2052	100.00
Duration of diabetes mellitus (years)						
1-5	89	82.41	105	68.63	194	74.33
6-10	14	12.96	39	25.49	53	20.31
11-15	5	4.63	7	4.58	12	4.60
16-20	0	0.00	2	1.31	2	0.77
Total	108	100.00	153	100.00	261	100.00
Mean±SD	5.81±4.70		5.27±3.62		5.49±4.10	
Age at the onset of DM (years)						
20-29	5	3.8	23	12.5	28	8.9
30-59	98	75.4	118	64.5	216	69.1
60-70	27	30.8	42	23.0	69	22.0
Total	130	100.00	183	100.00	313	100.00
Mean±SD	45.10±9.09		44.84±11.54		44.95±10.58	
Whether the participants performed self monitoring of DM						
Yes	20	1.95	10	0.97	30	1.46
No	1006	98.05	1016	99.03	2022	98.54
Total	1026	100.00	1026	100.00	2052	100.00

5.24 Distribution of the participants by treatment of diabetes mellitus & community

Among all the rural participants, majority (49.07%) took only drugs followed by 42.59% took all three types of therapy, i.e. diet, exercise and drug. On the other hand, among the urban participants, majority (60.13%) took only drugs, followed by 25.49% took all three types of therapy. Regarding types of drug, 61.62% rural and 58.78% urban participants took OHA while 17.17% rural and 27.48% urban participants took insulin. Regarding sources of treatment, 31.48% rural and 47.06% urban participants took treatment from local diabetic centers, 28.7% rural and 16.34% urban participants took treatment from government hospital while 16.67% rural and 27.45% urban participants attended private hospitals and a reasonable part (20.37%) of rural participants took treatment from homeopathic doctors, which are depicted in the table-18.

Table-18: Distribution of the participants by treatment of diabetes mellitus and residing community

	Rural		Urban		Total	
	N	%	N	%	N	%
Type of therapy for DM						
Only Diet Control	5	4.63	14	9.15	19	7.28
Only Exercise	4	3.70	8	5.23	12	4.60
Only Drug	53	49.07	92	60.13	145	55.56
All of the Above	46	42.59	39	25.49	85	32.57
Total	108	100.00	153	100.00	261	100.00
Types of drug (Anti Diabetic) intake						
OHA (Oral hypoglycaemic agent)	61	61.62	77	58.78	138	60.00
Insulin	17	17.17	36	27.48	53	23.04
Both OHA and Insulin	21	21.21	18	13.74	39	16.96
Total	99	100.00	131	100.00	230	100.00
Sources of treatment for DM						
Local diabetic centre	34	31.48	72	47.06	106	40.61
Govt. hospital	31	28.70	25	16.34	56	21.46
Non-government hospital/clinics	3	2.78	9	5.88	12	4.60
Private Chamber of Specialist	18	16.67	42	27.45	60	22.99
Homeopathic doctor	22	20.37	5	3.27	27	10.34
Total	108	100.00	153	100.00	261	100.00

5.25 Distribution of the participants by complications of diabetes mellitus & community

Among all the diabetic patients, 57.41% rural and 52.94% urban patients had complications of diabetes mellitus (DM). Regarding type of complications, 24.19% rural and 27.16% urban participants had 'nephropathy', 22.58% rural and 25.93% urban participants had 'diabetic foot' while 20.97% rural and 20.99% urban participants had 'retinopathy'. On the other hand, 17.74% rural and 17.28% urban participants had 'diabetic neuropathy'.

Regarding duration of complication of DM, 75.81% rural and 61.73% urban participants were suffering from complications for 1-5 years while 24.19% rural and 38.27% urban participants were suffering for 6-10 years, which are shown in the table-19.

Table-19: Distribution of the participants by complications of diabetes mellitus & residing community

	Rural		Urban		Total	
	N	%	N	%	N	%
Suffering from any complication of DM						
Yes	62	57.41	81	52.94	143	54.79
No	46	42.59	72	47.06	118	45.21
Total	108	100.00	153	100.00	261	100.00
Types of complication of DM suffered by the participants						
Retinopathy	13	20.97	17	20.99	23	16.08
Nephropathy	15	24.19	22	27.16	36	25.17
Neuropathy	11	17.74	14	17.28	27	18.88
Diabetic Foot	14	22.58	21	25.93	24	16.78
Glaucoma	9	14.52	7	8.64	33	23.08
Total	62	100.00	81	100.00	143	100.00
Duration of complications of DM (Years)						
1-5 years	47	75.81	50	61.73	97	67.83
6-10 years	15	24.19	31	38.27	46	32.17
Total	62	100.00	81	100.00	143	100.00
Mean±SD	4.29±2.77		4.73±2.87		4.54±2.83	

5.26 Distribution of participants by different types of direct costs (monthly)

Average consultation fee was Tk.227±206 and Tk.308±328 in the rural and urban community respectively and most of the rural (96.30%) and urban (88.89%) patients paid Tk.100-500. Average drug cost was Tk.297±212 and Tk.489±400 in the rural and urban community respectively and most of the rural (90.65%) and majority of the urban (71.52%) patients incurred Tk.100-500. Average investigation cost was Tk.259±350 and Tk.315±362 in the rural and urban community respectively and most of the rural (93.62%) and urban (87.42%) patients incurred Tk.50-500. Average hospital cost was Tk.312±589 and Tk.1200±979 in the rural and urban community respectively. Most (90.0%) of the rural and majority (50.0%) of the urban patients incurred Tk.50-500 and Tk.1001-3000 respectively (Shown in table-20).

Table-20: Distribution of the participants by direct costs and residing community

	Rural		Urban		Total	
	N	%	N	%	N	%
Consultation fee (Tk.)						
100-500	104	96.30	136	88.89	240	91.95
501-1000	2	1.85	10	6.54	12	4.60
1001-1500	2	1.85	5	3.27	7	2.68
1501-2000	0	0.00	2	1.31	2	0.77
Total	108	100.00	153	100.00	261	100.00
Mean±SD	227±206		308±328		275±286	
Drug cost (Tk.)						
100-500	97	90.65	108	71.52	205	79.46
501-1000	9	8.41	29	19.21	38	14.73
1001-1500	1	0.93	9	5.96	10	3.88
1501-2000	0	0.00	5	3.31	5	1.94
Total	107	100.00	151	100.00	258	100.00
Mean±SD	297±212		489±400		410±348	
Laboratory investigation cost (Tk.)						
50-500	88	93.62	132	87.42	220	89.80
501-1000	3	3.19	14	9.27	17	6.94
1001-2000	3	3.19	5	3.31	8	3.27
Total	94	100.00	151	100.00	245	100.00
Mean±SD	259±350		315±362		293±358	
Hospital cost (Tk.)						
50-500	27	90.00	11	39.29	38	65.52
501-1000	1	3.33	3	10.71	4	6.90
1001-3000	2	6.67	14	50.00	16	27.59
Total	30	100.00	28	100.00	58	100.00
Mean±SD	312±589		1200±979		741±912	

5.27 Distribution of the participants by different types of direct costs (Monthly)

Average travel cost was Tk.166±309 and Tk.215±344 in rural and urban community respectively. Most of the rural (96.30%) and urban (90.20%) patients had travel cost was Tk.50-500.

Average attendant's cost was Tk.263±240 and Tk.445±400 in rural and urban community respectively. Most of the rural (87.50%) and majority of the urban (66.67%) patients incurred Tk.50-500 travel cost.

Average tips were paid Tk.379±374 and Tk.341±291 in rural and urban community respectively. Majority (42.86%) of the rural patients paid Tk.50-100 while majority (51.72%) of the urban patients paid Tk.101-500, which are shown in the table-21.

Table-21: Distribution of the participants by different types of direct costs (Taka)

	Rural		Urban		Total	
	N	**%**	**N**	**%**	**N**	**%**
Travel cost (Tk.)						
50-500	104	96.30	138	90.20	242	92.72
501-1000	3	2.78	6	3.92	9	3.45
1001-1500	1	0.93	5	3.27	6	2.30
1501-2000	0	0.00	4	2.61	4	1.53
Total	108	100.00	153	100.00	261	100.00
Mean±SD	166±309		215±344		195±330	
Attendant's cost (Tk.)						
50-500	7	87.50	20	66.67	27	71.05
501-1000	1	12.50	8	26.67	9	23.68
1001-2000	0	0.00	2	6.67	2	5.26
Total	8	100.00	30	100.00	38	100.00
Mean±SD	263±240		445±400		407±377	
Cost for Tips (Tk.)						
50-100	3	42.86	9	31.03	12	33.33
101-500	2	28.57	15	51.72	17	47.22
501-1000	2	28.57	5	17.24	7	19.44
Total	7	100.00	29	100.00	36	100.00
Mean±SD	379±374		341±291		348±303	

5.28 Distribution of the participants by different types of direct costs (Monthly) and community

Average self monitoring cost was Tk.265±118 and 235±145among rural and urban patients respectively. Majority of the rural (65.0%) and urban (40.0%) patients shared Tk.100-300. Average cost for complications management was Tk.987±543 and Tk.896±381 in rural and urban community respectively. Majority of the rural (67.74%) and urban (75.31%) patients incurred Tk.400-1000 as cost of complications of DM, which are depicted in the table-22.

Table-22: Distribution of the participants by different types of direct costs (Taka)

	Rural		Urban		Total	
	N	**%**	**N**	**%**	**N**	**%**
Self monitoring cost (TK.)						
50-100	3	15.00	3	30.00	6	20.00
100-300	13	65.00	4	40.00	17	56.67
301-500	4	20.00	3	30.00	7	23.33
Total	20	100.00	10	100.00	30	100.00
Mean±SD	265±118		235±145		255±126	
Cost for complications management (Tk.)						
400-1000	42	67.74	61	75.31	103	72.03
1001-2000	19	30.65	20	24.69	39	27.27
2001-3000	1	1.61	0	0.00	1	0.70
Total	62	100.00	81	100.00	143	100.00
Mean±SD	987±543		896±381		935±459	

5.29 Distribution of different types of indirect costs (monthly) by residing community

Average wage lost was Tk.942±649 and Tk.1265±991 among the rural and urban patients respectively. Majority of the rural (59.79%) and urban (47.58%) patients had Tk.200-1000 wage loss due to illness. Average disability payment was Tk.1500±0 and Tk.1214±545 in the rural and urban community respectively. Average social security cost was Tk.1500±0 and Tk.1104±598 while tax rebate was Tk.1500±0 and Tk.12091±491 in the rural and urban communities respectively, which are depicted in the table-23.

Table-23: Distribution of the participants by different types of indirect costs (Taka)

Types of Indirect costs	Rural		Urban		Total	
	N	%	N	%	N	%
Wage lost due to Illness (Tk.)						
200-1000	58	59.79	59	47.58	117	52.94
1001-3000	38	39.18	58	46.77	96	43.44
3001-5000	1	1.03	7	5.65	8	3.62
Total	97	100.00	124	100.00	221	100.00
Mean±SD	942±649		1265±991		1124±871	
Disability payment (Tk.)						
100-500	0	0.00	2	14.29	2	13.33
501-1000	0	0.00	8	57.14	8	53.33
1001-2000	1	100.00	4	28.57	5	33.33
Total	1	100.00	14	100.00	15	100.00
Mean±SD	1500±0		1214±545		1233±530	
Social security Cost						
100-500	0	0.00	3	25.00	3	23.08
501-1000	1	100.00	6	50.00	7	53.85
1001-2000	0	0.00	3	25.00	3	23.08
Total	1	100.00	12	100.00	13	100.00
Mean±SD	1500±0		1104±598		1096±573	
Tax rebate						
100-500	0	0.00	2	18.18	2	16.67
501-1000	0	0.00	7	63.64	7	58.33
1001-2000	1	100.00	2	18.18	3	25.00
Total	1	100.00	11	100.00	12	100.00
Mean±SD	1500±0		1091±491		1125±483	

5.30 Distribution of total cost of treatment (Monthly) by residing community

Average direct cost was Tk.1593±1159 and Tk.2115±1998 in the rural and urban community respectively. Majority of the rural (67.59%) and urban (65.36%) patients incurred Tk.1001-5000 direct cost. Average indirect cost was Tk.984±870 and Tk.1601±1868 in the rural and urban community respectively. Majority rural (59.79%) and urban (47.58%) patients shared Tk.200-1000 indirect cost. Average treatment cost Tk.2465±1614 and Tk.3415±3005 in the rural and urban community respectively. Most of the rural (86.11%) and majority of the urban (77.12%) patients incurred Tk.1001-5000 treatment cost, which are portrayed in the following table-24.

Table-24: Distribution of the participants by total treatment cost (Monthly)

Total cost	Rural		Urban		Total	
	N	%	N	%	N	%
Total direct cost (Tk.)						
500-1000	33	30.56	38	24.84	71	27.20
1001-5000	73	67.59	100	65.36	173	66.28
5001-10000	2	1.85	15	9.80	17	6.51
Total	108	100.00	153	100.00	261	100.00
Mean±SD	1593±1159		2115±1998		1899±1718	
Total indirect cost (Tk.)						
200-1000	58	59.79	59	47.58	117	52.94
1001-5000	38	39.18	57	45.97	95	42.99
5001-10000	1	1.03	8	6.45	9	4.07
Total	97	100.00	124	100.00	221	100.00
Mean±SD	984±870		1601±1868		1330±1541	
Total cost of treatment (Tk.)						
500-1000	9	8.33	7	4.58	16	6.13
1001-5000	93	86.11	118	77.12	211	80.84
5001-10000	6	5.56	24	15.69	30	11.49
10001-20000	0	0.00	4	2.61	4	1.53
Total	108	100.00	153	100.00	261	100.00
Mean±SD	2465±1614		3415±3005		3022±2563	

5.31 Distribution of the participants by coping ways for economic burden

Regarding sources of fund, majority (59.26%) of the rural participants used family income followed by 40.74% used family savings and 30.37% sold property to get fund for treatment. While in the urban community, 68.63% used family income followed by 22.22% used family savings and 10.46% sold property to get fund for treatment. To cope up the economic burden of diabetes mellitus, 29.63% rural and 52.29% urban patients adopted different coping ways. It was revealed that majority of the rural (40.63%) and urban (35.00%) patients reduced 'cost of food' followed by 25.00% rural and 18.75% urban patients compromised 'treatment of other family members' while 21.88% rural and 15.00% urban patients curtailed 'cost of clothing' to compensate economic burden of DM, which are flourished in the table-25.

Table-25: Distribution of the participants by sources of fund and coping ways to compensate economic burden of DM

Attributes	Rural		Urban		Total	
	N	%	N	%	N	%
Sources of fund for treatment*						
Family savings	44	40.74	34	22.22	78	29.89
Family income	64	59.26	85	68.63	149	57.09
Loan	14	12.97	18	11.76	32	12.26
Donation	12	11.11	16	10.46	28	10.73
Support of relatives	12	11.11	14	9.15	26	9.96
Selling property	22	30.37	16	10.46	38	14.56
Whether adopted any coping way to compensate economic burden						
Yes	32	29.63	80	52.29	112	42.91
No	76	70.37	73	47.71	149	57.09
Total	108	100.00	153	100.00	261	100.00
Distribution of coping ways to compensate economic burden						
Reducing cost of food	13	40.63	28	35.00	41	36.61
Reducing cost of clothing	7	21.88	12	15.00	19	16.96
Compromising standard of living	2	6.25	7	8.75	9	8.04
Compromising treatment of family member	8	25.00	15	18.75	23	20.54
Compromising education of family member	2	6.25	18	22.50	20	17.86
Total	32	100.00	80	100.00	112	100.00

*Multiple Responses

5.32 Distribution of disability burden of diabetes mellitus by residing community

Regarding disability burden of diabetes mellitus, it was found that average years lived with disability (YLD) was 4.29±0.57 and 4.28±0.58 years among the rural and urban patients respectively. Majority of the rural (48.46%) and urban (44.81%) patients had 4.6-5.5 and 3.60-4.50 YLD respectively. Average years of life lost due to premature death (YLL) were 4.38±0.38 and 4.93±0.86 years in the rural and urban community respectively. Majority (75.00%) of the rural patients had 3.20-4.50 YLL while majority (43.75%) of the urban patients had 4.60-5.50 YLL. Average disability adjusted life years (DALY) was 4.42±0.78 and 4.70±1.30 in the rural and urban community respectively. Most of the rural (96.92%) and urban (81.25%) patients had 2.50-6.50 DALY loss, which are depicted in the table-26.

Table-26: Distribution of disability burden of diabetes mellitus by residing community

	Rural		Urban		Total	
	N	%	N	%	N	%
YLD of DM (years)						
2.50-3.50	19	14.62	21	11.48	40	12.78
3.60-4.50	48	36.92	82	44.81	130	41.53
4.60-5.50	63	48.46	80	43.72	143	45.69
Total	130	100.00	183	100.00	313	100.00
Mean±SD	4.29±0.57		4.28±0.58		4.28±0.58	
YLL of DM (years)						
3.20-4.50	3	75.00	6	37.50	9	45.00
4.60-5.50	1	25.00	7	43.75	8	40.00
5.60-6.50	0	0.00	3	18.75	3	15.00
Total	4	100.00	16	100.00	20	100.00
Mean±SD	4.38±0.38		4.93±0.86		4.82±0.81	
DALY of DM (years)						
2.50-4.50	63	48.46	87	47.54	150	47.92
4.60-6.50	63	48.46	80	43.72	143	45.69
6.60-8.50	4	3.08	10	5.46	14	4.47
8.60-10.50	0	0.00	6	3.28	6	1.92
Total	130	100.00	183	100.00	313	100.00
Mean±SD	4.42±0.78		4.70±1.30		4.59±1.12	

5.33 Distribution of disability burden of complications of DM by residing community

Average YLD was 5.30±1.22 and 5.30±1.41 years in the rural and urban community respectively. Majority (54.9%) of the rural patients had 5.10-7.00 YLD while majority (50.72%) of the urban patients had 2.50-5.00 YLD due to complications of DM.

Averages DALY of complications of DM was 5.38±1.36 and 55.32±1.40 years in the rural and urban community respectively. Majority (44.26%) of the rural patients had 5.1-7.0 DALY loss followed while majority (50.72%) of the urban patients had 2.5-5.0 DALY loss due to complications of DM. These findings are depicted in the table-27.

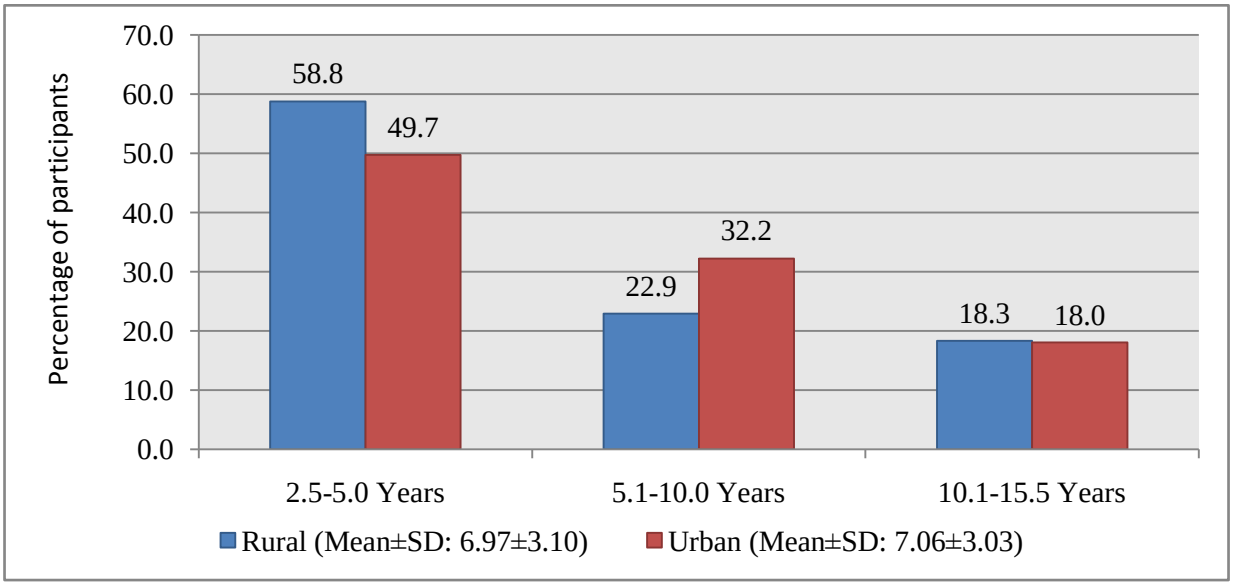
Table-27: Distribution of disability burden of complications of DM by residing community

	Rural		Urban		Total	
	N	%	N	%	N	%
YLD of complications of DM (years)						
2.50-5.00	20	39.22	35	50.72	55	45.83
5.10-7.00	28	54.90	26	37.68	54	45.00
7.10-10.00	3	5.88	8	11.59	11	9.17
Total	51	100.00	69	100.00	120	100.00
Mean±SD	5.30±1.22		5.30±1.41		5.30±1.32	
DALY of complications of DM (years)						
2.50-5.00	20	32.79	35	50.72	55	45.83
5.10-7.00	27	44.26	26	37.68	53	44.17
7.10-10.00	4	6.56	8	11.59	12	10.00
Total	51	83.61	69	100.00	120	100.00
Mean±SD	5.38±1.36		5.32±1.40		5.34±1.38	

5.34 Distribution of disability burden (DALY) of DM and its complications by residing community

Regarding total disability burden of DM and its complications, average DALY loss was 6.97±3.10 and 7.06±3.03 years in the rural and urban community respectively. Majority of the rural (58.8%) and urban (49.7%) patients incurred 2.5-5.0 DALY followed by 22.9% rural and 32.2% urban participants shared 5.1-10.0 DALY loss On the other hand, 18.3% rural and 18.0% urban patients shared 10.1-15.5 DALY loss due to both DM and its complications, which are shown in the figure-7.

Figure-7: Distribution of disability burden (DALY) of DM and complications by residing community



5.35 Distribution of glycaemic status of the participants by residing community

The study found that most (85.19%) of the rural participants had fasting blood glucose level <5.6 mmol/L followed by 12.67% were diabetic with glucose level ≥6.1 mmol/L and only 2.14% had IFG with glucose level 5.6-6.0 mmol/L. On the other hand, among the urban participants, majority (76.02%) of the participants had blood glucose level <5.6 mmol/L, followed 17.84% were diabetic with blood glucose level ≥6.1 mmol/L and 6.14% had IFG with glucose level 5.6-6.0 mmol/L. which are reflected in the table-28.

By blood glucose level 2 hours after 75 gm glucose intake, most (83.24%) of the rural participants had normal blood glucose level (<7.8 mmol/L) followed by 12.67% had DM (blood glucose level ≥11.1 mmol/L) and only 4.09% had IGT (blood glucose level 7.8-11.0 mmol/L). On the other hand majority (76.32%) of the urban participants had normal blood glucose level (<7.8 mmol/L) followed by 17.84% had DM (blood glucose level ≥ 11.1 mmol/L) and the rest 5.85% had IGT (7.8-11.0 mmol/L), which are shown in the table-28.

Table-28: Distribution of glycaemic status of the participants by residing community

	Rural		Urban		Total	
	N	%	N	%	N	%
Fasting blood glucose level						
<5.6 mmol/L (Normal)	874	85.19	780	76.02	1654	80.60
5.6-6.0 mmol/L (IFG)	22	2.14	63	6.14	85	4.14
≥6.1 mmol/L (Diabetics Mellitus)	130	12.67	183	17.84	313	15.25
Total	1026	100.00	1026	100.00	2052	100.00
Mean±SD	4.83±1.66		5.54±3.20		5.18±2.57	
Blood glucose level 2 hours after 75 gm glucose intake						
<7.8 mmol/L (Normal)	854	83.24	783	76.32	1637	79.78
7.8-11.0 mmol/L (IGT)	42	4.09	60	5.85	102	4.97
≥ 11.1 mmol/L (Diabetics Mellitus)	130	12.67	183	17.84	313	15.25
Total	1026	100.00	1026	100.00	2052	100.00
Mean±SD	7.57±3.40		8.21±4.10		7.89±3.78	

5.36 Distribution of the prevalence of diabetes mellitus by residing community

Regarding prevalence of DM, in the rural community, most (81.09%) of the participants had normal blood glucose level followed by 12.67% were diabetic, 2.14% had IFG and 4.09% had IGT. On the other hand, in the urban community, majority (70.18%) had normal blood glucose level followed by 17.84% had DM, 6.14% had IFG and 5.85% had IGT, which are focused in the table-29.

Regarding types of cases of DM, in the rural community, most (83.08%) of the cases were old cases and the rest 16.92% cases were new cases. On the contrary, in the urban community, most (83.61%) of the cases were also old and the rest 16.39% cases were new cases of DM. Overall, 16.61% cases were new cases and detected by this present study. These findings are shown in the table-29.

Table-29: Prevalence of diabetes mellitus by residing community

Detection of DM	Rural		Urban		Total	
	N	%	N	%	N	%
Final diagnosis						
IFG	22	2.14	63	6.14	85	4.14
IGT	42	4.09	60	5.85	102	4.97
Diabetics Mellitus	130	12.67	183	17.84	313	15.25
Normal	832	81.09	720	70.18	1552	75.63
Total	1026	100.00	1026	100.00	2052	100.00
Type of cases of DM						
Old cases (Previously detected)	108	83.08	153	83.61	261	83.39
New cases (Newly detected)	22	16.92	30	16.39	52	16.61
Total	130	100.00	183	100.00	313	100.00

5.37 Association between diabetes mellitus and different characteristics of the participants (logistic regression)

The study revealed significant association between diabetes mellitus and residing place of the participants as it was found that risk of occurrence of DM was 2.37 times higher in the urban community (17.84%) than in rural community (12.67%), ($p<0.001$, OR= 2.37, 95% CI, 1.88-2.99). In respect of family history, risk of occurrence of DM was around two times higher among the participants who had family history (34.71%) of DM than the participants who had no family history (11.70%) of diabetes mellitus ($p<0.001$, OR=1.99, 95% CI, 1.62-2.43). By WHR, Diabetes mellitus was found around 13 times higher among the obese (36.98%) than the normal participants (7.16%) ($p<0.001$, OR=12.97, 95% CI, 10.66-15.79).

In respect of physical work, DM was significantly higher (5.05 times) among the participants who didn't perform physical work (18.23%) than the participants who did physical work (14.5%), ($p<0.001$, OR=5.05, 95% CI, 4.21-6.07). Regarding viral diseases, DM was significantly higher (2.73 times) among the participants suffered (33.49%) from viral diseases than the participants, who didn't suffer (10.46%) from any viral diseases ($p<0.001$, OR=2.73, 95% CI, 1.58-4.71). These findings are depicted in the table-30.

Table-30: Association between diabetes mellitus and different characteristics of the participants (logistic regression)

Attribute	Diabetes Mellitus		P value	Odds Ratio
	Yes	No		
Residing community				
Rural	130 (12.67)	896 (87.33)	0.00	1*
Urban	183 (17.84)	843 (82.16)		2.37 (1.88-2.99)
Family history of diabetes				
Yes	143 (34.71)	269 (65.29)	0.00	1.99 (1.62-2.43)
No	170 (11.70)	1283 (88.30)		1*
Waste/Hip Ratio				
Normal	107 (7.16)	1388 (92.84)	0.00	1*
Obese	206 (36.98)	351 (63.02)		12.97 (10.66-15.79)
Physical work				
Yes	237 (14.50)	1398 (85.50)	0.00	1*
No	76 (18.23)	341 (81.77)		5.05 (4.21-6.07)
Viral diseases				
Yes	143 (33.49)	284 (66.51)	0.00	2.73 (1.58-4.71)
No	170 (10.46)	1455 (89.54)		1*

*Reference category

5.38 Association between complication of diabetes mellitus and different characteristics of the participants (logistic regression)

Risk of developing complications of DM was significantly higher in rural (57.41%) community in comparison to the urban (52.94%) community (p=0.03, OR=1.24, 95% CI, 0.56-1.92). Risk of complications was more among the patients who didn't perform (57.38%) physical works than the patients who performed (54.00%) physical work but the difference was not statistically significant (p=0.6, OR=0.66, 95% CI, 0.32-1.34). Risk of developing complications was around 1.5 times higher among the smokers (58.57%) than the non-smokers (53.04%) (p=0.02, OR=1.44, 95% CI, 0.69-2.18). Risk of developing complications was found about 8 times higher among the patients who were taking anti-diabetic drug (57.44%) than the patients who were on diet control (21.05%) (p<0.01, OR=7.95, 95% CI, 2.06-30.72). Risk of developing complications was significantly among the obese patients (55.81%) than the normal patients (52.81%) but the difference was not statistically significant (p=0.08, OR=0.51, 95% CI, 0.24-1.07). The findings are shown in the table-31.

Table-31: Association between complication of diabetes mellitus and different characteristics of the participants (logistic regression)

Attribute	Complication of DM		P value	Odds ratio
	Yes f(%)	No f(%)		
Residing community				
Rural	62 (57.41)	46 (42.59)	0.03	1.24 (0.56-1.92)
Urban	81 (52.94)	72 (47.06)		1*
Physical work				
Yes	108 (54.00)	92 (46.00)	0.6	0.66 (0.32-1.34)
No	35 (57.38)	26 (42.62)		1*
Smoking habit				
Yes	47 (58.75)	33 (41.25)	0.02	1.44 (0.69-2.18)
No	96 (53.04)	85 (46.96)		1*
Therapy of DM				
Only diet control	4 (21.05)	15 (78.95)	0.003	7.95 (2.06-30.72)
Exercise and drug separately or together	139 (57.44)	103 (42.56)		1*
Waste Hip Ratio (WHR)				
Normal	47 (52.81)	42 (47.19)	0.08	0.51 (0.24-1.07)
Obese	96 (55.81)	76 (44.19)		1*

*Reference category

5.39 Prevalence of diabetes mellitus by age of the participants

In respect of age of the patients, prevalence of DM was 3.5%, 13.5% and 19.7% in the age group 20-29, 30-59 and 60-80 years in the rural community and this variation was statistically significantly [$\chi^2_{(2)}$=49.69, p=0.000]. On the contrary, in the urban community, prevalence was also significantly higher (25.1%) among the elderly patients (60-80 years) than the 20-29 years old younger (17.0%) and the 30-59 years old middle aged (16.3%) patients [$\chi^2_{(2)}$=20.85, p=0.002].

Table-32: Association between diabetes mellitus and age of the participants

Age group	Suffering from diabetes mellitus					
	Rural			Urban		
	Yes	No	Total	Yes	No	Total
	f (%)	f (%)	f(%)	f (%)	f (%)	f(%)
20-39 years	05 (3.0)	160 (97.0)	165 (100.0)	23 (17.0)	122 (83.0)	135 (100.0)
40-59 years	98 (13.5)	626 (86.5)	724 (100.0)	118 (16.3)	606 (83.7)	724 (100.0)
60-80 years	27 (19.7)	120 (80.3)	137 (100.0)	42 (25.1)	125 (74.9)	167 (100.0)
Significance	$\chi^2_{(2)}$=55.67, p=0.000			$\chi^2_{(2)}$=15.76, p=0.005		

5.39 Association between diabetes mellitus and level of physical work

The study revealed that in the rural community, 20.69% of the sedentary workers, 13.96% light workers, 15.0% with no physical work, 9.82% with moderate work and 4.35% with heavy work had DM and this differences were statistically significant [$\chi^2_{(4)}$=15.21, p=0.004], which is shown in the table-33.

On the other hand, in the urban community, 30.63% of the light workers, 19.67% moderate workers, 11.11% sedentary workers, 19.53% with no physical work and 9.38% heavy workers had DM and the differences were also statistically significant [$\chi^2_{(4)}$=11.54 p=0.02], which is shown in the table-33.

Table-33: Association between diabetes mellitus and types by physical activities

Types of physical activities	Suffering from diabetes mellitus					
	Rural			Urban		
	Yes	No	Total	Yes	No	Total
	f (%)	f (%)	f(%)	f (%)	f (%)	f(%)
Heavy work	5 (4.35)	110 (95.65)	115 (100.0)	9 (9.38)	87 (90.62)	96 (100.0)
Moderate Work	22 (9.82)	202 (90.18)	224 (100.0)	36 (19.67)	147(80.33)	183(100.0)
Light Work	67 (13.96)	413 (86.04)	480 (100.0)	65 (20.63)	250 (79.37)	315 (100.0)
Sedentary work	18 (20.69)	69 (79.31)	87 (100.0)	15 (11.11)	120 (88.89)	135 (100.0)
No Physical work	18 (15.00)	102 (85.00)	120 (100.0)	58 (19.53)	239 (80.47)	297 (100.0)
Significance	$\chi^2_{(4)}$=15.21, p=0.004			$\chi^2_{(4)}$=11.54, p=0.02		

5.40 Association between gylcaemic status and age of the participants

Regarding glycaemic status, both DM (19.7%) and IGT (11.7%) were higher among the rural elderly (60-80 years) participants in comparison to other age groups. On the other hand, IFG was higher (2.3%) among the rural adults (30-59 years) than the younger (1.2%) and elderly participants (2.2%). These differences were statistically significant [$\chi^2_{(6)}$=87.91 p=0.000], which are shown in the table-33.

On the contrary, in the urban community, DM was higher (25.1%) among the elderly (60-80 years) participants while both IGT (6.8%) and IFG (7.7%) were higher among adults (30-59 years) and these differences were statistically significant [$\chi^2_{(6)}$=35.55 p=0.000], which are depicted in the table-33.

Table-34: Association between gylcaemic status and age of the participants

Community	Age group (years)	Glycaemic status					Significance
		IFG f(%)	**IGT** f(%)	**DM** f(%)	**Normal** f(%)	**Total f(%)**	
Rural	20-29	02 (1.2)	02 (1.2)	05 (3.0)	156 (94.6)	165 (100.0)	$\chi^2_{(6)}$= 49.69, p=0.000
	30-59	17 (2.3)	24 (3.3)	98 (13.5)	585 (80.8)	724 (100.0)	
	60-80	3 (2.2)	16 (11.7)	27 (19.7)	91 (66.4)	137 (100.0)	
Urban	20-29	04 (3.0)	06 (4.4)	23 (17.0)	102 (75.6)	135 (100.0)	$\chi^2_{(6)}$= 20.85 p=0.002
	30-59	56 (7.7)	49 (6.8)	118 (16.3)	501 (69.2)	724 (100.0)	
	60-80	3 (1.8)	5 (3.0)	42 (25.1)	117 (70.1)	167 (100.0)	

5.41 Association between gylcaemic status and sex of the participants

With regard to the sex of the participants, it was revealed that DM (15.1%), IGT (5.4%) and IFG (2.5%) all were significantly higher in the males than their counterpart female (10.1%, 2.8% and 1.8% respectively), [$\chi^2_{(3)}$=12.06 p=0.007] as it is depicted in the table-35.

On the other hand, in urban community, both the DM (19.6%) and IGL (6.4%) were higher among the male participants than the female participants (15.6% and 5.2% respectively). On the other side, IFG was higher among the female (6.5%) than the male (5.8%) participants, but the differences were not statistically significant [$\chi^2_{(3)}$=3.82 p=0.28], which is depicted in the table-35.

Table-35: Association between gylcaemic status and sex of the participants

Community	Sex	Glycaemic status					Significance
		IFG f(%)	IGT f(%)	DM f(%)	Normal f(%)	Total f(%)	
Rural	Male	13 (2.5)	28 (5.4)	79 (15.1)	402 (77.0)	522 (100.0)	$\chi^2_{(3)}$=12.06, p=0.007
	Female	9 (1.8)	14 (2.8)	51 (10.1)	430 (85.3)	504 (100.0)	
Urban	Male	33 (5.8)	36 (6.4)	111 (19.6)	385 (68.1)	565 (100.0)	$\chi^2_{(3)}$=3.82, p=0.281
	Female	30 (6.5)	24 (5.2)	72 (15.6)	335 (72.7)	461 (100.0)	

5.42 Association between gylcaemic status and occupation of the participants

In respect of occupation of the participants, in the rural community, DM was more prevalent among the farmer (18.18%) followed by businessmen (18.10%), housewives (15.06%) and service holders (11.46%). On the other hand, IGT was higher among farmers (10.61%) and unemployed (6.49%) while IFG was more prevalent among businessmen (3.17%) and farmers (3.03%). These differences were statistically significant. [$\chi^2_{(18)}$=50.02 p=0.000], which are depicted in the table-36.

In the urban community, DM was more prevalent among farmers (33.3%), day laborer (31.75%), service holders (19.24%), businessmen (17.98%) and housewives (14.50%). Whereas IGT was higher among the service holders (8.67%) and housewives (6.87%) but the IFG was higher among the day laborer (12.70%) and businessmen (7.02%). These differences were statistically significant. [$\chi^2_{(18)}$=43.95 p=0.001], which is shown in table-36.

Table-36: Association between gylcaemic status and occupation of the participants

Community	Occupation	Glycaemic status					Significance
		IFG f (%)	IGT f(%)	DM f(%)	Normal f(%)	Total f(%)	
Rural	Service	6 (2.08)	7 (2.43)	33 (11.46)	242 (84.03)	288 (100.0)	$\chi^2_{(18)}$=50.02, p=0.000
	Farmer	2 (3.03)	9 (10.61)	10 (18.18)	45 (68.18)	66 (100.0)	
	Student	0 (0.00)	1 (1.61)	0 (0.00)	61 (98.39)	62 (100.0)	
	Housewife	6 (2.32)	10 (3.86)	39 (15.06)	204 (78.76)	259 (100.0)	
	Business	7 (3.17)	12 (5.43)	40 (18.10)	162 (73.30)	221 (100.0)	
	Day labor	1 (1.89)	0 (0.00)	5 (9.43)	47 (88.68)	53 (100.0)	
	Unemployed	0 (0.00)	5 (6.49)	1 (1.30)	71 (92.21)	77 (100.0)	
Urban	Service	20 (5.42)	32 (8.67)	71 (19.24)	246 (66.67)	369 (100.0)	$\chi^2_{(18)}$=43.95, p=0.001
	Farmer	0 (0.00)	0 (0.00)	3 (33.33)	6 (66.67)	09 (100.0)	
	Student	0 (0.00)	0 (0.00)	5 (10.87)	41 (89.13)	46 (100.0)	
	Housewife	17 (6.49)	18 (6.87)	38 (14.50)	189 (72.14)	262 (100.0)	
	Business	16 (7.02)	8 (3.51)	41 (17.98)	163 (71.49)	228 (100.0)	
	Day labor	8 (12.70)	2 (3.17)	20 (31.75)	33 (52.38)	63 (100.0)	
	Unemployed	2 (4.08)	0 (0.00)	5 (10.20)	42 (85.71)	49 (100.0)	

5.43 Association between gylcaemic status and BMI of the participants

On the basis of BMI, in the rural community, 40.0% obese, 38.10% underweight and 27.42% overweight participants had DM followed by 20.0% obese and 5.65% overweight participants had IFG while 4.84% participants had IGT and these differences were statistically significant [$\chi^2_{(9)}$=122.2 p=0.000], which are shown in table-37.

On the contrary, in the urban community, 29.81% overweight, 29.09% underweight and 16.67% obese participants had DM followed by another 16.67% obese, 12.73% underweight and 10.58% overweight participants had IFG while 25.0% obese, 9.13% overweight and 5.45% underweight participants had IGT and these differences were statistically significant [$\chi^2_{(9)}$=78.8 p=0.000], which is shown in table-37.

Table-37: Association between gylcaemic status and BMI of the participants

Community	BMI	Glycaemic status					Significance
		IFG f(%)	IGT f(%)	DM f(%)	Normal f(%)	Total f(%)	
Rural	Underweight (<18.5)	00 (0.00)	00 (0.00)	08 (38.10)	13 (61.90)	21 (100.0)	$\chi^2_{(9)}$=122.2, p=0.000
	Normal (18.5-24.99)	07 (0.93)	30 (3.99)	52 (6.91)	663 (88.16)	752 (100.0)	
	Overweight (25-29.99)	14 (5.65)	12 (4.84)	68 (27.42)	154 (62.10)	248 (100.0)	
	Obese (30-34.99)	01 (20.00)	00 (0.00)	02 (40.00)	02 (40.00)	05 (100.0)	
Urban	Underweight (<18.5)	07 (12.73)	03 (5.45)	16 (29.09)	29 (52.73)	55 (100.0)	$\chi^2_{(9)}$=78.8, p=0.000
	Normal (18.5-24.99)	32 (4.26)	35 (4.66)	103 (13.72)	581 (77.36)	751 (100.0)	
	Overweight (25-29.99)	22 (10.58)	19 (9.13)	62 (29.81)	105 (50.48)	208 (100.0)	
	Obese (30-34.99)	02 (16.67)	03 (25.00)	02 (16.67)	05 (41.67)	12 9100.0)	

5.44 Association between gylcaemic status and waist-hip ratio of the participants

According to WHR, among the rural obese participants, 32.48% had DM while 4.01% and 3.65% had IFG and IGT respectively and this difference was statistically significant [$\chi^2_{(3)}$=142.9 p=0.000], which is shown in the table-38.

On the other hand, among the urban obese participants, 41.34% had DM while 6.71% and 5.65% had IFG and IGT respectively and this difference was also statistically significant [$\chi^2_{(3)}$=153.1 p=0.000], which are portrayed in the table-38.

Table-38: Association between gylcaemic status and waist-hip ratio of the participants

Community	WHR ratio	Glycaemic status					Significance
		IFG f(%)	IGT f(%)	DM f(%)	Normal f(%)	Total f(%)	
Rural	Normal	11 (1.46)	32 (4.26)	41 (5.45)	668 (88.83)	752 (100.0)	$\chi^2_{(3)}$=142.9, p=0.000
	Obese	11 (4.01)	10 (3.65)	89 (32.48)	164 (59.85)	274 (100.0)	
Urban	Normal	44 (5.92)	44 (5.92)	66 (8.88)	589 (79.27)	743 (100.0)	$\chi^2_{(3)}$=153.1, p=0.000
	Obese	19 (6.71)	16 (5.65)	117 (41.34)	131 (46.29)	283 (100.0)	

5.45 Association between gylcaemic status and smoking habit of the participants

In respect of smoking habit, among the rural smokers, 12.50% participants had DM followed by 3.80% and 5.43% had IFG and IGT respectively while among the non-smokers, 12.71% had DM followed by 1.78% and 3.80% had IFG and IGT respectively but this difference was not statistically significant [$\chi^2_{(3)}$=4.09 p=0.252], which is shown in the table-39.

On the contrary, among the urban smokers, 21.16% had DM followed by 8.12% and 6.09% participants had IFG and IGT respectively while among the urban non-smokers, 16.15% had DM followed by 5.14% and 5.73% participants had IFG and IGT respectively and this difference was statistically significant [$\chi^2_{(3)}$=8.84 p=0.031], which are depicted in table-39.

Table-39: Association between gylcaemic status and smoking habit of the participants

Community	Smoking habit	Glycaemic status					Significance
		IFG f(%)	IGT f(%)	DM f(%)	Normal f(%)	Total f(%)	
Rural	Yes	07 (3.80)	10 (5.43)	23 (12.50)	144 (78.26)	184 (100.0)	$\chi^2_{(3)}$=4.09, p=0.252
	No	15 (1.78)	32 (3.80)	107 (12.71)	688 (81.71)	842 (100.0)	
Urban	Yes	28 (8.12)	21 (6.09)	73 (21.16)	223 (64.64)	335 (100.0)	$\chi^2_{(3)}$=8.84, p=0.031
	No	35 (5.14)	39 (5.73)	110 (16.15)	497 (72.98)	681 (100.0)	

5.46 Association between gylcaemic status and chemical exposure of the participants

Among the rural participants who had exposure to chemical agents, 11.81% had DM followed by 3.82% and 6.60% had IFG and IGT respectively while among the non-exposed participants, 13.01% had DM followed by 1.49% and 3.12% had IFG and IGT respectively and this difference was statistically significant [$\chi^2_{(3)}$=12.15 p=0.007], which is focused in the following table-40.

On the other hand, among the urban exposed participants, 18.45% had DM followed by 8.74% and 9.22% had IFG and IGT respectively while among the non-exposed participants, 17.68% had DM followed by 5.49% and 5.00% had IFG and IGT respectively and this difference was statistically significant [$\chi^2_{(3)}$=9.50 p=0.023], which are focused in table-40.

Table-40: Association between gylcaemic status and chemical exposure

Community	Chemical exposure	Glycaemic status					Significance
		IFG f(%)	IGT f(%)	DM f(%)	Normal f(%)	Total f(%)	
Rural	Yes	11 (3.82)	19 (6.60)	34 (11.81)	224 (77.78)	288 (100.0)	$\chi^2_{(3)}$=12.15, p=0.007
	No	11 (1.49)	23 (3.12)	96 (13.01)	608 (82.38)	738 (100.0)	
Urban	Yes	18 (8.74)	19 (9.22)	38 (18.45)	131 (63.59)	206 (100.0)	$\chi^2_{(3)}$=9.50, p=0.023
	No	45 (5.49)	41 (5.00)	145 (17.68)	589 (71.83)	820 (100.0)	

5.47 Association between duration and economic burden of DM by residing community

In respect of duration of DM, most (86.5%) of the rural participants with duration of 1-5 years, 78.6% with duration of 6-10 years and all the participants (100.0%) with 11-15 years duration had Tk.1,001-5,000/- treatment cost while 14.30% and 4.50 % participants with duration of 1-5 years and 6-10 years had treatment cost Tk.5,001-10,000/- but these differences were not statistically significant [$\chi^2_{(4)}$=3.07 p=0.546] as shown in the table-41.

On the contrary, in the urban community, most (81.90%) of participants with 1-5 years duration and majority (69.20% and 42.90%) of the participants with duration of 6-10 and 11-15 years had Tk.1,001-5,000/- treatment cost while 10.50% and 25.60 % participants with duration of 1-5 years and 6-10 years had treatment cost Tk.5,001-10,000/- and these differences were statistically significant [$\chi^2_{(9)}$=18.67 p=0.028], which are shown in table-41.

Table-41: Association between duration and economic burden of DM by community

Community	Duration of DM	Total treatment cost (Taka)					Significance
		500-1000 f(%)	1001-5000 f(%)	5001-10000 f(%)	10001-20000 f(%)	Total f(%)	
Rural	1-5 years	08 (9.00)	77 (86.50)	04 (4.50)	00 (0.00)	89 (100.0)	$\chi^2_{(4)}$=3.07 p=0.546
	6-10 years	01 (7.10)	11 (78.60)	02 (14.30)	00 (0.00)	14 (100.0)	
	11-15 years	00 (0.00)	05 (100.00)	00 (0.00)	00 (0.00)	05 (100.0)	
	16-20 years	00 (0.00)	00 (0.00)	00 (0.00)	00 (0.00)	0 (0.00)	
Urban	1-5 years	07 (6.70)	86 (81.90)	11 (10.50)	01 (1.00)	105 (100.0)	$\chi^2_{(9)}$=18.67 p=0.028
	6-10 years	00 (0.00)	27 (69.20)	10 (25.60)	02 (5.10)	39 (100.0)	
	11-15 years	00 (0.00)	03 (42.90)	03 (42.90)	01 (14.30)	07 (100.0)	
	16-20 years	00 (0.00)	02 (100.00)	00 (0.00)	00 (0.00)	02 (100.0)	

5.48 Association between complications and economic burden of DM by community

In respect of complications of DM, 99.71% of the rural participants having complications and 82.61% without complications had Tk.1,001-5,000/- treatment cost while 6.45% and 4.35% participants with and without complications had treatment cost Tk.5,001-10,000/- but these differences were not significant [$\chi^2_{(8)}$=2.46, p=0.293], which are shown in table-42.

On the contrary, 82.61% of the rural participants having complications and 72.22% without complications had treatment cost Tk.1,001-5,000/- while 14.81% and 16.67% participants with and without complications had treatment cost Tk.5,001-10,000/- but these differences were not also statistically significant [$\chi^2_{(3)}$=3.43, p=0.33], which are shown in table-42.

Table-42: Association between complications and economic burden of DM by residing community

Community	Complication of DM	Total treatment cost (Taka)					Significance
		500-1000 f(%)	1001-5000 f(%)	5001-10000 f(%)	10001-20000 f(%)	Total f(%)	
Rural	Yes	03(4.84)	55(88.71)	04(6.45)	00(0.00)	62(100.0)	$\chi^2_{(8)}$=2.46
	No	06(13.04)	38(82.61)	02(4.35)	00(0.00)	46(100.0)	p=0.293
Urban	Yes	02(2.47)	66(81.48)	12(14.81)	01(1.23)	81(100.0)	$\chi^2_{(3)}$=3.43
	No	05(6.94)	52(72.22)	12(16.67)	03(4.17)	72(100.0)	p=0.33

5.49 Association between complications and disability burden of DM

In respect of complications of DM, majority (45.16%) of the rural DM patients with complications had 5.10-10.00 DALY loss while most (97.66%) of the patients without complications had 2.50-5.00 DALY loss and this difference was statistically significant [$\chi^2_{(2)}$=87.71, p=0.000], which is shown in the table-43.

On the contrary, in the urban community, majority (49.38%) of the urban DM patients with complications had 5.10-10.00 DALY loss while majority (79.41%) of the patients without complications had 2.50-5.00 DALY loss and this difference was also statistically significant [$\chi^2_{(2)}$=87.09, p=0.000], which are focused in the table-43.

Table-43: Association between disability burden and complications of DM by residing community

Community	Complication of DM	Disability burden of DM				Significance
		2.50-5.00 f(%)	5.10-10.00 f(%)	10.10-15.50 f(%)	Total f(%)	
Rural	Yes	10(16.13)	28(45.16)	24(38.71)	62(100.0)	$\chi^2_{(2)}$=87.71
	No	66(97.06)	02(2.94)	00 (0.00)	68(100.0)	p=0.000
Urban	Yes	10(12.35)	40(49.38)	31(38.27)	81(100.0)	$\chi^2_{(2)}$=87.09
	No	81(79.41)	19(18.63)	02 (1.96)	102(100.0)	p=0.000

5.50 Association between complications and disability burden of DM

Regarding total disability burden of DM and its complications, majority of the patients with retinopathy (53.85%) and nephropathy (46.67%) had 10.10-15.50 DALY loss while majority of the patients with neuropathy (63.64%), diabetic foot (50.00%) and glaucoma (55.56%) had 5.10-10.00 DALY loss but these differences were not statistically significant [$\chi^2_{(8)}$=4.84, p=0.33], which are depicted in the table-44.

In the urban community, majority of the patients with retinopathy (41.18%) and nephropathy (50.00%) had 10.10-15.50 DALY loss while majority of the patients with neuropathy (78.57%) and diabetic foot (71.43%) had 5.10-10.00 DALY loss and these differences were statistically significant [$\chi^2_{(8)}$=23.78, p=0.002], which are shown in the table-44.

Table-44: Association between complications and disability burden of DM by community

Community	Types of complications of DM	Disability burden (DALY) of DM				Significance
		2.50-5.00 f(%)	5.10-10.00 f(%)	10.10-15.50 f(%)	Total f(%)	
Rural	Retinopathy	2 (15.38)	4 (30.77)	7 (53.85)	13 (100.0)	$\chi^2_{(8)}$=4.84, p=0.775
	Nephropathy	3 (20.00)	5 (33.33)	7 (46.67)	15 (100.0)	
	Neuropathy	2 (18.18)	7 (63.64)	2 (18.18)	11 (100.0)	
	Diabetic Foot	2 (14.29)	7 (50.00)	5 (35.71)	14 (100.0)	
	Glaucoma	1 (11.11)	5 (55.56)	3 (33.33)	09 (100.0)	
Urban	Retinopathy	3 (17.65)	7 (41.18)	7 (41.18)	17 (100.0)	$\chi^2_{(8)}$=23.78, p=0.002
	Nephropathy	4 (18.18)	7 (31.82)	11 (50.00)	22 (100.0)	
	Neuropathy	1 (7.14)	11 (78.57)	2 (14.29)	14 (100.0)	
	Diabetic Foot	2 (9.52)	15 (71.43)	4 (19.05)	21 (100.0)	
	Glaucoma	0 (0.00)	0 (0.00)	7 (100.00)	07 (100.0)	

5.51 Association between disability burden of DM and level of physical activity

Among the rural patients who performed physical activity, 59.82% had 2.50-5.00 and 25.00% had 5.10-10.00 DALY loss while 50.00% and 38.89% patients who didn't perform physical work had 2.50-5.00 and 5.10-10.00 DALY loss and these differences were statistically significant [$\chi^2_{(2)}$=6.24, p=0.043], which are shown in the table-45.

On the other hand, among the urban patients who performed physical work, majority (49.60%) had 2.50-5.00 and 31.20% had 5.10-10.00 DALY loss while 50.00% and 34.48% of the patients who didn't perform physical work had 2.50-5.00 and 5.10-10.00 DALY loss but these differences were not statistically significant [$\chi^2_{(2)}$=0.43, p=0.906], which are shown in the table-45.

Table-45: Association between disability burden of DM and physical work by residing community

Community	Physical work	Disability burden (DALY) of DM				Significance
		2.50-5.00 f(%)	5.10-10.00 f(%)	10.10-15.50 f(%)	Total f(%)	
Rural	Yes	67 (59.82)	28 (25.00)	17 (15.18)	112 (100.0)	$\chi^2_{(2)}$=6.24, p=0.043
	No	9 (50.00)	2 (11.11)	7 (38.89)	18 (100.0)	
Urban	Yes	62 (49.60)	39 (31.20)	24 (19.20)	125 (100.0)	$\chi^2_{(2)}$=0.43, p=0.806
	No	29 (50.00)	20 (34.48)	9 (15.52)	58 (100.0)	

5.52 Association between economic burden of DM and residing community

In respect of residing community, average direct cost was significantly higher in the urban community (Tk.2114.80±1997.64) than in the rural community (Tk.1593.00±1159.10), [$t_{(259)}$, p=0.015)], which is shown in the table-46.

On the other hand, average indirect cost was also higher (Tk.1601.10±1867.92) in the urban community than in the rural community (Tk.983.71±870.37) and this difference was statistically significant [$t_{(219)}$, p=0.003)], which is focused in the table-46.

Average treatment cost was also significantly higher (Tk.3414.80±3004.92) in the urban community than in the rural community (Tk.2465.40±1613.79), [$t_{(259)}$, p=0.003)], which is depicted in the table-46.

Table-46: Economic burden of DM by residing community of the participants

Economic burden	Community	N	Mean	Std. Deviation	t	df	P value
Direct cost	Rural	108	1593.00	1159.10	-2.44	259	0.015
	Urban	153	2114.80	1997.64			
Indirect cost	Rural	97	983.71	870.37	-3.009	219	0.003
	Urban	124	1601.10	1867.92			
Total cost	Rural	108	2465.40	1613.79	-2.992	259	0.003
	Urban	153	3414.80	3004.92			

5.52 Association between disability burden of DM and residing community

Regarding disability burden of DM, mean±SD YLD was 4.29±0.57 in the rural community while it was 4.28±0.58 in the urban community. On the other hand, mean±SD YLL was 4.38±0.38 in the rural community and 4.93±0.86 in the urban community but these differences were not statistically significant. Mean±SD DALY loss due to DM was significantly ('t',$_{(311)}$= 2.191, p=0.029) higher in the urban community (4.70±1.30) than in the rural community (4.42±0.78), which is focused in the table-47.

Regarding disability burden of complications of DM, mean±SD YLD was 5.30±1.22 in the rural community and it was equal 5.30±1.41 in the urban community. On the other hand, mean±SD DALY loss of complications was 5.38±1.36 in the rural community while it was 5.32±1.40 in the urban community and this difference was not statistically significant. In respect of total burden of DM and its complications, mean±SD DALY loss was 6.97±3.10 in the rural community 7.06±3.03 in the urban community but the difference was not statistically significant, which is depicted in the table-47.

Table-47: Disability burden of DM by residing community of the participants

Disability burden	Community	N	Mean	Std. Deviation	t	df	P value
YLD Shared by DM	Rural	130	4.29	0.57	0.164	311	0.87
	Urban	183	4.28	0.58			
YLL shared by DM	Rural	4	4.38	0.38	-1.24	18	0.231
	Urban	16	4.93	0.86			
DALY loss due to DM	Rural	130	4.42	0.78	-2.191	311	0.029
	Urban	183	4.70	1.30			
YLD Shared by complications of DM	Rural	62	5.30	1.22	0.022	141	0.983
	Urban	81	5.30	1.41			
DALY loss due to complications of DM	Rural	62	5.38	1.36	0.26	141	0.795
	Urban	81	5.32	1.40			
Total disability burden (DALY)	Rural	130	6.97	3.10	-0.244	311	0.807
	Urban	183	7.06	3.03			

6.0 Discussion

This comparative cross-sectional study was conducted to compare disability and economic burden of diabetes mellitus between urban and rural communities. The study also anticipated to determine the socio-demographic characteristics of the participants along with the prevalence and risk factors of diabetes mellitus in the communities. The study used Disability Adjusted Life Years (DALY) approach of World Health Organization to estimate the disability burden of diabetes mellitus and "Cost of Treatment" approach to estimate the economic burden of diabetes mellitus from patient perspective.

Socio-demographic and economic characteristics

Among the respondents in the rural community, male (50.88%) and female (49.12%) participants were almost equal with a sex ratio of 103.0. In the urban community, proportion of male participants (55.7%) was notably higher than that of the female (44.93%). The finding of the rural community is similar to the national scenario as depicted by Bangladesh Bureau of Statistics (BBS) where sex ratio is 100.3. On the contrary, sex ratio in the urban community revealed by this study was around 124.0, which was very higher than the country profile as revealed by BBS (100.3).[157] This discrepancy may be explained by the facts that survey conducted by BBS was countrywide while this specific study was conducted in selected urban and rural communities. Moreover, females in the urban community were involved in jobs in different organizations and as a result, they were little less available at the time data collection in comparison to rural community.

By age group, majority (70.60%) of the rural participants were in the age group 30-59 years followed by 16.00% were in the age group 20-29 years and the rest 13.40% were in the age group 60-80 years. On the other hand, in the urban community, majority (70.60%) were in the age group 30-59 years followed by 13.10% were in the age group 20-39 years and the rest 16.30% were in the age group 60-80 years. This difference in proportion of the participants by age group may be explained by the fact that adult and older participants were most engaged in their different professional or income generating activities even in the holidays. Due to engagement in different professional activities with fixed work schedule, elderly and young patients were not available in their residences at the time of data collection.

More than 95% of the participants were Muslims whereas only 3.7% were Hindu by religion in the rural community but the proportion of Hindu was slightly higher in the urban community (5.46%). These findings were not consistent with the country scenario as found by BBS where Muslims were Hindu around 89.5% and 9.5% respectively. These differences may due to the fact that this specific study was conducted in defined urban and rural communities while the survey of BBS was carried out countrywide with larger population.[157]

In the rural community, literacy rate was 81.7% and illiteracy rate was 18.32% but literacy rate (91.70%) was higher and illiteracy rate (8.30%) was lower in the urban community. However, maximum number of the rural participants had primary level education whereas maximum number of the urban participants had SSC and HSC level education. The adult literacy rate was found 58.6% by BBS[157], which was lower than the rate found by this pertinent study. This difference also may be justified by the facts that BBS conducted the survey with wider population countrywide while this study was conducted among selected population of specific rural and urban communities. On the contrary, literacy rate was higher in urban community than in the rural community because urban populations were aware about education and they had better opportunities for education in urban settings.

By occupation, there were more or less the same proportion of housewives and businessmen in the both urban and rural communities but service holders were more in urban community than in the rural community (35.96% and 28.07%). Surprisingly, monthly average monthly income of the rural community (Tk.15921±9759) was higher compared to the urban community (Tk.13661±95). This difference can be explained by the logics that the monthly family income of rural participants included income all the family members and different sources of income generations and income of more or less homogenous group of participants. On the other hand, in the urban community, diversified groups with different income categories especially lower and lower-middle groups were incorporated mostly, which cumulatively reduced average monthly income of the urban participants.

About four-fifths of the participants in the rural community were from nuclear family but most (83.33%) of the participants in the urban community were from nuclear family and the rest 16.67% was from joint family. Average number of family member was higher

(5.33±1.64) in the rural community than in the urban community (4.65±1.36). This finding differed with the finding of BBS where the average family size was found 4.5.[157] This can be explained with the realities that BBS calculated family size in country perspective while this particular study calculated family size from selective community perspective. Another aspect, family size was larger in rural community than on the urban community because the rural people may be less aware regarding family planning and contraceptive use in comparison to the urban community. Moreover, due to cultural norms, rural people still live together with dear and near ones in joint family in comparison to the urban people.

About 80% of the participants were married in the urban community but the corresponding figure in the rural community was about 76.0%. The proportions of both widow/widower and divorced participants were more in the rural community (4.8% and 2.3%) compared to the urban community (1.9% and 1.0%). This can be explained by the facts that majority of the rural participants were younger in comparison to the urban participants as a result, proportion of married people was comparatively larger in the urban community than in the rural community.

Anthropometric measurement of the participants

Average height of the participants in both rural and urban communities was 1.59 meters. Mean weight of the rural participants (62.31±11.67) was slightly higher than that of the urban participants (60.64±11.35). Based on BMI, about three-fourths of the participants in both rural and urban community were normal but the proportion of overweight was higher in the rural community (24.17%) compared to the urban community (20.27%). But obesity was higher in urban (1.17%) in comparison to rural (0.49%) community. In respect of waist circumference, more than 91.0% of rural participants had 71 to 107 cm while the corresponding figure for urban community was about 68.0%. Average waist circumference was 82.59±8.74 cm and 77.34±11.86 cm in rural and urban community respectively. Average hip circumference was 91.13±6.67 cm and 86.01±9.72 cm in rural and urban community respectively. By waist-hip ratio (WHR), central obesity was also higher among urban (27.6%) participants in comparison to the rural participants (26.7%). The study conducted by Bhowmik et. all also found significant association of WHR with diabetes mellitus in rural

community and it was revealed that WHR had significant association with diabetes mellitus in both male and female participants.[172]

On the basis of both BMI and WHR, proportion of obesity was higher in the urban community in comparison to the urban community. These differences can be supported by the facts and logics that rural participants performed more physical activities and took less fatty or fast/junk foods in comparison to the urban participants, which predisposed to the occurrence of obesity in higher proportion in the urban community. But on the basis of BMI, overweight was a little higher in the rural community than in the urban community. This diverse finding can be explained by the logics that average weight of the urban participants was slightly higher as they were more used to consume more carbohydrate foods (especially rice) in comparison to the urban participants.

Habits of the participants (Personal and Food Habit)

Food habit of the participants was more or less the same in both communities but vegetables were taken more by the rural community (97.9%) than the urban community (93.6%). Rice intake was more frequent among the rural participants as about two-thirds of them took 16-21 times per week while in the urban community about half of the participants took 10-15 times per week. In case of 'ruti' intake about two-thirds of the rural participants took 1-5 times and in urban community about two-thirds participants took 6-10 times per week. These differences in 'rice' and 'ruti' intake can be justified by the realities that rural people usually produce rice and consume it more as their traditional and cultural norms. On the contrary, rural participants are more aware about their health and take more 'ruti' and less 'rice' in comparison to the rural community.

Regarding fruits intake, most of the rural (83.32%) and majority (74.62%) of the urban participants took fruits 1-4 times per week. On the other hand, 'dal' and 'fish' intake were more frequent in the rural community than the urban community but 'egg' and 'meat' intake were more frequently in the urban community in comparison to the rural community. These discrepancies can be explained by the logics that rural people produce vegetables and local natural fruits are available in their residing community and they can get it at a minimum costs

and that's why they consume it more in comparison to the urban community where people have to purchase fruits and vegetables at a higher cost.

Tobacco consumption was slightly higher among the urban participants (52.24%) in comparison to the rural participants (46.88%). Both the mean frequency and duration of tobacco consumption were also higher among the participants of the urban community (11.56±7.20 times per day and 13.78±7.69 years) than the participants of rural community (8.87±5.84 times per day and 10.61±7.45 years). On the other side, about 18.0% rural and 34.0% urban participants had smoking habit. Average duration of smoking was 12.60±8.66 and14.86±7.24 years in the rural and urban community respectively. This scenario can be described by the facts that urban participants were exposed to more stressful environment and modern life style, which altogether imposed them to smoking habit more than the participants of the rural community.

Alcohol consumption was slightly higher among the participants of the urban community (8.87%) compared to the participants of the rural community (7.41%). In the rural community 2.92% but in the urban community 6.23% participants were current alcohol consumer. Average duration of alcohol consumption was 5.20±3.68 years and 5.14±2.90 years in the rural and urban community respectively. This disparity in alcohol consumption by community can be explained by the logics that alcohol is comparatively more available in the urban community than in the rural community. Moreover, more exposure to modern life style, peer pressure and environmental factors instigate the urban participants to consume alcohol more than the rural participants.

Regarding physical activity, 12.0% rural and 29.0% urban participants didn't perform any kind of physical activity. But 47.0% rural and 31.0% urban participants performed light physical activities (daily rapidly walking for 60-90 minutes). However, 11.0% rural and 9.0% urban participants performed heavy physical activities (daily rapidly walking for more than 90 minutes). On the other side, 21.8% rural and 17.8% urban participants performed moderate physical activity while 8.5% rural and 13.2% urban participants performed sedentary work. This diversity between urban and rural community can be explained by the realities that the urban people were engaged in professional activities like services and

business with tight schedule, which didn't permit them to perform physical activity in comparison to the rural people who were involved more in physical activity related to their professional activities with less stress and pressure with congenial work schedule.

Level of satisfaction of the participants

Unhappiness or dissatisfaction was found more among participants of rural community than that of the urban community. Such as about 15.0% rural and 9.0% urban participants were not happy about their working places, dissatisfaction about economic conditions was prevailing among 20.0% and 15.0% rural and urban participants respectively. On the contrary, 11.31% rural and 3.8% urban participants were unhappy about their family life. Regarding overall satisfaction of life, it was revealed that 60.7% rural and 60.9% urban participants were 'neither happy nor unhappy' followed by 10.8% rural and 2.5% urban participants were 'unhappy' and 26.6% rural and 34.6% urban participants were 'happy'. These differences can be explained by the realities that the rural participants had poor economic condition, poor working condition and poor family solvency in comparison to family need and all these realities made them overall less happy in comparison to the urban participants who have better life facilities.

Self medication, viral diseases and chemical exposure

The study revealed that, 35.0% rural and 18.0% urban participants had history of self medication of steroid, homeopath, diuretics and oral contraceptive pill etc. This difference may be due to the fact that rural participants were less aware of the adversities of self use of drugs and they have poor access to modern treatment and drugs; as a result they had self medication history with low cost drug available in their residing community.

The study found the history of suffering from viral diseases such as rubella, mumps, measles, hepatitis etc. and it was found among 6.0% rural and 15.0% urban participants. This finding can be explained by the logics that urban participants were exposed to overcrowded and polluted environment like air and water pollution, which made them the victims of different diseases especially viral diseases more in comparison to the rural participants.

Overall, chemical exposure was more among the rural participants (28.07%) than in the urban participants (20.08%). This difference may be explained by the facts that rural participants were more exposed to chemicals like fertilizer, pesticides and different dyes related to their occupation like cultivation, business and industrial works etc. which altogether expelled them to chemical exposure little more than the urban participants.

Family history of diabetes mellitus

In respect of family history of diabetes mellitus, about 20.47% rural and 21.15% urban participants had family history of diabetes mellitus. DM was prevalent among 32.38% rural and 36.43% urban fathers while among 24.76% rural and 23.04% urban mothers. On the other hand, 11.43% rural and 11.06% urban brothers while 10.0% rural and 5.53% urban sisters had history of DM. These findings could not be compared due to scarcity of relevant study findings in respect of urban and rural communities.

Prevalence of diabetes mellitus

The study found that about 10.53% rural and 14.91% urban participants were found previously diagnosed cases of DM. The urban prevalence of DM (Both old and new cases) found by this study was higher (17.84%) than the prevalence found by another study conducted by Sayeed MA et. all where the urban prevalence of 11.2%.[27] This difference of prevalence can be explained by the fact the study of Sayeed MA et. all was conducted long time ago and in different urban setting and that's why the prevalence differed with the findings of this particular study.

Though glucose level of most of the rural participants (85.19%), and majority of urban participants (76.02%) was <5.6 mmol/L, but the prevalence of DM was higher among the urban participants (17.84%) in comparison to the rural participants (12.67%). However another study also found the higher prevalence in urban community (8.1%) than in the rural community (2.3%) though the prevalence was much lower than the current study.[122] Among all the diabetes mellitus patients, 16.92% cases in the rural community and 16.39% cases in the urban community and overall 16.61% cases of DM were previously undiagnosed and were detected by this present study. This finding reflects that diabetes mellitus is an iceberg

diseases and it remains undetected and un-manifested to a remarkable extent within the community. For this, the present study suggests comprehensive screening program for diabetes mellitus for its early detection, treatment and disability limitation.

More than 82.0% of the rural and about 69.0% of the urban participants were suffering from DM for 1-6 years but the proportion of participants suffering from DM for 6-10 years was around two times higher in the urban community (25.49%) than in the rural community (12.96%). However, mean duration of suffering from DM was slightly higher among the rural participants (5.81±4.70 years) than the urban participants (5.27±3.62 years). This variation may be explained by the facts the participants included in this particular study were mostly previously detected cases of different duration in both the rural and urban communities and that's why average duration of DM was close in both the communities.

Risk factors related to diabetes mellitus

The study found that risk of occurrence of DM was 2.37 times higher in urban community (17.84%) than in rural community (12.67%), ($p<0.001$, OR= 2.37, 95% CI, 1.88-2.99). There was significant association between family-history of DM, waist-hip ratio (WHR), performing physical activity and the occurrence of DM. Among the participants who had family-history of DM, did not perform any physical activity and had history of suffering from viral diseases, prevalence of DM was 2-5 times higher compared to their counter groups who were not related to the mentioned conditions. However, DM was found about 13 times higher among the obese (36.98%) than the normal participants (7.16%) ($p<0.001$, OR=12.97 95% CI, 10.66-15.79). Another study conducted by Rahim et. all in rural Bangladesh found that age, body mass index, waist circumference and waist-hip ratio were higher in glucose-intolerant subjects than in normal glucose tolerant group.[173]

The study revealed that DM was 5.05 times higher among the participants who didn't perform physical work (18.23%) than the participants who did physical work (14.5%), ($p<0.001$, OR=5.05, 95% CI, 4.21-6.07). The study also found that DM was significantly higher (2.73 times) among the participants suffered (33.49%) from viral diseases than the participants, who didn't suffer (10.46%) from any viral diseases ($p<0.001$, OR=2.73, 95%

CI, 1.58-4.71). Risk of developing complications of DM was 1.24 times higher among the patients of rural community (57.41%) than among the patients of urban community (52.94%), (p=0.03, OR=1.24, 95% CI, 0.56-1.92). Risk of occurring complications was 1.44 times higher among the smokers (58.57%) than the non-smokers (53.04%) (p=0.02, OR=1.44, 95% CI, 0.69-2.18).

The study showed that the risk of developing complications was higher among the obese patients (55.81%) than the normal patients (52.81%) (p=0.08, OR=0.51, 95% CI, 0.24-1.07) but this finding was not statistically significant. However development of complications was about 7.95 times higher among the patients who were only on diet-control than the patients who were taking anti-diabetic drugs and performing physical activities and separately or together (p<0.01, OR=7.95, 95% CI, 2.06-30.72).

DM was more prevalent among the elderly (60-80 years) group (19.7% rural and 25.1% urban participants) in comparison to the younger age (20-39 years) group (3.0% rural and 17.0% urban participants) [$\chi^2_{(2)}$=50.89, p=0.000]. A hospital-based study revealed that 7.0% of the diabetic patients were from the age group of less than 25 years i.e. patients developed diabetes at very early age and 19.2% of the diabetic patients developed diabetes after 55 years.[174] Another study conducted among urban population also found that the age-specific prevalence of diabetes increased with increasing age.[27]

Both in the rural and urban community there were significant differences in occurrence of DM among the participants of different types of physical activities. In the rural community, about 21.0% of sedentary workers, 14.0% of light workers, 15.0% non-physical workers, 10.0% moderate workers and 4.0% heavy workers had DM [$\chi^2_{(4)}$=15.21, p=0.004]. On the contrary, in the urban community, 31.0% light workers, 20.0% moderate workers, 11.0% sedentary workers, 20.0% non-physical workers and 9.0% heavy workers had DM [$\chi^2_{(4)}$=11.54 p=0.02]. Similar findings were revealed by the study conducted by Sayeed MA et. all and Hussain A et. all where diabetes mellitus was significantly higher among the participants who didn't perform physical ativity.[27,122]

Gylcaemic status and socio-demographic characteristics of the participants

Regarding glycaemic status, among the rural elderly (60-80 years) participants, both DM (19.60%) and IGT (11.60%) were higher in comparison to other age groups but IFG was little higher (2.30%) among the rural adult (30-59 years) participants. This difference was statistically significant [$\chi^2_{(6)}$=87.91, p=0.000]. On the contrary, in the urban community, DM was significantly higher (25.10%) among the elderly (60-80 years) participants while both IGT (6.8%) and IFG (7.70%) were higher among adult (30-59 years) participants and these differences were statistically significant [$\chi^2_{(6)}$=35.55, p=0.000].

In the rural community, DM (15.1%), IGT (5.4%) and IFG (2.5%) all were significantly higher in the males than their counterpart females (10.1%, 2.8% and 1.8% respectively) [$\chi^2_{(3)}$=12.06 p=0.007]. But no significant difference of glycaemic status was found between male and female participants in the urban community.

Significance differences were also identified in respect of glycaemic status and the different types of occupation in both rural and urban community. DM was more prevalent among the farmers (18.18%) followed by businessmen (18.10%), housewives (15.06%) and service holders (11.46%). On the other hand, IGT was higher among farmers (10.61%) and unemployed (6.49%) while IFG was more prevalent among businessmen (3.17%) and farmers (3.03%). These differences were statistically significant. [$\chi^2_{(18)}$=50.02 p=0.000]. These differences can be explained by the facts that farmers in the context of Bangladesh are land owners and they are not use to do physical work like cultivation in real field rather they employ cultivators or workers to carry out agricultural activities on payment and thus they are acquainted less physical activity or sedentary life, which increase the risk of occurrence of diabetes mellitus. On the contrary, businessmen and service holders also use to perform poor physical activity and mostly enjoy sedentary life style, which also may increases the risk of occurrence of DM among these groups.

In the urban community, DM was more prevalent among farmers (33.3%), day laborer (31.75%), service holders (19.24%), businessmen (17.98%) and housewives (14.50%). Whereas IGT was higher among the service holders (8.67%) and housewives (6.87%) but the IFG was higher among the day laborer (12.70%) and businessmen (7.02%). These

differences were statistically significant. [$\chi^2_{(18)}$=43.95 p=0.001]. These diversified findings can be logically explained by the realities that the farmers in urban settings are very rare and they including service holders, businessmen and housewives don't perform any physical work and mostly lead sedentary life, which increase the risk of occurrence of DM and impaired glucose tolerance among these groups. One special variation was found that a large proportion of day laborer had DM in rural community and mostly in urban community. This finding was unlikely among the day laborers as they were supposed to do more physical work according to their occupation. But in this study, this group comprised diversified participants like the workers who work occasionally, carry out light work, follow simple orders of people including waste pickers, rickshaw pullers, brick breakers etc. Moreover, these groups usually suffer from malnutrition and nutritional problems which may also predispose the occurrence of DM.

There were also significant differences between glycaemic status and the BMI of the participants in both the rural [$\chi^2_{(9)}$=122.2, p=0.000] and urban community [$\chi^2_{(9)}$=78.8, p=0.000]. Glycaemic status was also associated with the variation of WHR. In the rural obese participants, 32.0% had DM while each 4.0% had IFG and IGT [$\chi^2_{(3)}$=142.9 p=0.000]. On the other hand, among the urban obese participants, DM was significantly higher (41.0%) than IFG (7.0%) and IGT (6.0%) [$\chi^2_{(3)}$=153.1 p=0.000]. These findings corresponded to the findings of the study done by Sayeed MA et. all among urban population which showed that people with positive family history of diabetes, higher family income, and lack of physical activities were independently related to IFG.[27] In addition, advancing age and obesity (general and central) were also proved to be the significant risk factors for developing DM.

Smoking habit also interfered with the glycaemic status of the participants in the urban community [$\chi^2_{(3)}$=8.84, p=0.031], but in the rural community no significant association was found between smoking and the glycaemic status [$\chi^2_{(3)}$=4.09, p=0.252]. There was significant association between chemical exposure and glycaemic status in participants of both rural [$\chi^2_{(3)}$=12.15 p=0.007] and urban [$\chi^2_{(3)}$=9.50 p=0.023] community. To compare these findings relevant study findings were very scarce in the context of Bangladesh. But it is established and evident that destruction of beta cell of pancreas on exposure to chemical agents may be responsible for the occurrence of DM.

Treatment seeking and complications of diabetes mellitus

Three principles of DM treatment such as diet control, exercise and medication were taken by the 43.0% rural and 25.0% urban participants whereas only medication was taken by about 49.0% and 60.0% participants of the respective communities. Insulin was taken by about 17.17% rural and 27.48% urban participants. About 20.37% of the rural participants took treatment from homeopathic doctors but the corresponding figure was around 3.27% for the urban participants. On the other hand, 28.70% and 16.67% rural participants took treatment from government and private hospitals respectively and these corresponding figures were 16.34% and 27.45% in the urban community. This divergence finding can be explained by the facts that rural people were less aware and economically poor as a result they sought less expensive treatment from government health facilities and homeopathic doctors while the comparatively affluent urban people sought treatment from private chamber of specialized doctors and hospitals.

Diabetes is a major source of morbidity, mortality, and economic burden to the family and society. Patients with diabetes are at risk of the development of acute metabolic complications such as diabetic ketoacidosis, hyperglycaemic hyperosmolar nonketotic coma, and hypoglycemia. They are also at risk of experiencing chronic complications such as atherosclerotic diseases, retinopathy, nephropathy, neuropathy, and foot ulceration, as well as other medical conditions unrelated to the acute or chronic complications specific to diabetes. Complication of DM was prevailing among 57.0% rural and 53.0% urban diabetic patients. The complications included nephropathy, diabetic foot, retinopathy, neuropathy, glaucoma etc. Mean duration of suffering from complications of DM was slightly higher among the urban (4.73±2.87 years) compared to the rural (4.29±2.77 years) diabetic patients. The difference between prevalence of complications of DM in the communities can be supported by the facts that rural patients were less educated and aware as a result they were not more sincere to self care and care of diabetes, which made them to more vulnerable to the complications of DM in comparison to the urban patients. Moreover, facilities for diagnosis and treatment diabetes and its complications are not available in the rural settings as result the rural participants have poor access to need based diabetic care and they suffer from uncontrolled diabetes mellitus and ultimately develop different grave complications.

Economic burden of DM of diabetes mellitus

Average treatment cost of the participants was higher in the urban community (Tk.3,415) than in the rural community (Tk.2,465). Both average direct cost and indirect cost of urban patients (Tk.2,115 and Tk.1,601) were also higher in comparison to that of rural diabetic patients (Tk.1,593 and Tk.984). All types of direct costs except cost for tips (Tk.379 in rural and Tk.341 in urban), self monitoring cost (Tk.265 in rural and Tk.235 in urban) and cost of treatment of complication (Tk.987 in rural and Tk.896 in urban) were higher among the urban participants than of the rural participants. Average hospital cost was much higher in the urban community (Tk.1,200) in comparison to that in the rural community (Tk.312). Among the different types of indirect costs, average wage loss was Tk.942 and Tk.1,265 in the rural and urban community respectively. But the average disability payment, social cost, and tax rebate, all were higher among the diabetic patients of the rural community (Tk.1,500 for each) than those of the urban community (Tk.1,214, Tk.1,104 and Tk.1,091 respectively).

Relevant findings were revealed by a study conducted by Afroz A which showed that in Bangladesh, the average annual cost of care was found US $314 (direct cost US$283 and indirect cost US$37) ranging from $23 to $1,334. Average nutrition related cost was $1.50 per person per day. This study has also identified that the average annual cost of diabetes care per patient in OPD of tertiary care facility in Bangladesh is $313.[175]

To cope up the economic burden of diabetes mellitus, about 30% rural patients and 52% urban patient compromised with any of basic family needs of sufficient food, and clothing, adequate shelter for residing, treatment of other family members, and education cost of family members etc. A study conducted in combined military hospital found that regarding sources of fund for treatment, 31.8% patients used their savings while 27.3% took loan, 20% got help from relatives and the remaining 20.9% got donation and sold wealth. Average treatment cost incurred by the patients was estimated to Tk.5,543. Average direct treatment cost was estimated to Tk.2,657 of which average drug cost was Tk.656, investigation cost was Tk.597, travel cost Tk.530, and consultation fee was Tk.244. Average indirect cost was calculated to Tk.3,081 which was only due to loss of income due to illness.[176]

The study didn't found any association of duration of suffering from DM with cost of treatment among the diabetic patients in the rural community [$\chi^2_{(4)}$=3.07, p=0.546], but in the urban community there was significant association between duration of DM and the cost of treatment as the cost of treatment increased among those who were suffering from DM for more duration [$\chi^2_{(9)}$=18.67, p=0.028].

In both the communities, treatment cost was higher among the diabetic patients having complications than those without any complication but this difference was not statistically [rural community $\chi^2_{(8)}$=2.46, p=0.293 and urban community $\chi^2_{(3)}$=3.43, p=0.33]. Average total direct cost was significantly higher (Tk.2,114.80±1997.64) in the urban community in comparison to that in the rural community (Tk.1,593.00±1,159.10), [$t_{(259)}$, p=0.015)]. On the other hand, average indirect cost was higher (Tk.1,601.10±1,867.92) in the urban community than that in the rural community (Tk.983.71±870.37) and this difference was statistically significant [$t_{(219)}$, p=0.003)].

Average treatment cost (urban Tk.3,415 and rural Tk.2,465) as well as average direct cost (urban Tk.2,115 and rural Tk.1,593) and average indirect cost (urban Tk.1,601 and rural Tk.984) was significantly higher among the diabetic patients in the urban community than those in the rural community (t test, p=<0.05).

These diversifications of costs can be explained by the realities that complications of DM required more treatment costs in comparison to the only diabetes. Moreover, average treatment cost was significantly higher in the urban community because the urban patients were more cautious about their health problems and took treatment from more expensive and standard sources of treatment. On the other hand, rural patients took treatment from less expensive sources of treatment and as result, their average treatment cost was comparatively less than that of the urban patients.

Disability burden of diabetes mellitus

It was found that average 'Years of life Lived with Disability (YLD)' was very close to each other in both the rural (4.29±0.57) and urban community (4.28±0.58 years). Average 'Years of Life Lost due to Premature Death (YLL)' was 4.38±0.38 and 4.93±0.86 years in the rural

and urban community respectively. The study found that three-fourths of the rural patients had YLL of 3.2-4.50 years, maximum (43.75%) of the urban patients had 4.6-5.5 years YLL. Average 'Disability Adjusted Life Years (DALY)' was 4.42±0.78 and 4.70±1.30 in the rural and urban community respectively. Average YLD for complications of DM was 5.30±1.22 and 5.30±1.41 years in the rural and urban community respectively. Average DALY of complications of DM was 5.38±1.36 and 55.32±1.40 in the rural and urban community respectively. Regarding total disability burden of both DM and its complications, average DALY loss was 6.97±3.10 and 7.06±3.03 years in the rural and urban community respectively. This diversification in the finding can be explained by the facts that the prevalence of DM was higher in urban community than in the rural community.

DALY was significantly [$\chi^2_{(2)}$=87.71, p=0.000] higher among the of the patients with complications of the rural community as about 45.0% of the rural DM patients with complications had DALY loss 5.10-10.00, while about 98.0% of the patients of that community without complications had DALY loss 2.50-5.00. Again in the urban community, about 49.0% of the urban diabetic patients with complications had DALY loss 5.10-10.00 but about 79% patients of that community without complications had DALY loss 2.50-5.00 and this difference was also statistically significant [$\chi^2_{(2)}$=87.09, p=0.000].

However, there was no significant association found between type of complications and disability burden (DALY) in the rural community [$\chi^2_{(8)}$=4.84, p=0.33], but in the urban community, DALY was significantly [$\chi^2_{(8)}$=23.78, p=0.002] higher (10.10-15.50) in case of diabetic patients with neuropathy (78.57%) and diabetic foot (71.43%) than DALY (5.10-10.00) of those patients with retinopathy (41.18%) and nephropathy (50.00).

A study conducted by Islam MZ on outpatient department of BIRDEM hospital to estimate and compare disability burden of Diabetes Mellitus (DM) and its complications found that older patients shared more YLD than the younger patients and the disparity was statistically significant ('t'(152)=9.53, p<0.01). More YLD was shared by the patients with long duration of the disease than the patients with short duration and this divergence was statistically significant ('t'(152)=8.71, p<0.01).[177]

In the rural community, disability burden (DALY) of the diabetic patients who performed physical work was significantly less than those who didn't perform physical work [$\chi^2_{(2)}$=6.24, p=0.043] as about 60.0% of the rural patients who performed physical work had DALY of 2.50-5.00 and 25.0% had 5.10-10.00 disability burden (DALY loss) while 50.0% and 39.0% patients who did not perform physical work had DALY loss 2.50-5.00 and 5.10-10.00 respectively. But in the urban community this association was not found significant [$\chi^2_{(2)}$=0.43, p=0.906]. This finding can be explained by the reality that the rural patients who didn't perform any physical works were suffered more from uncontrolled diabetes mellitus and complications of DM as a result they incurred more disability burden. Similar finding was revealed by the conducted by Islam MZ where disability burden was more among the patients with complications of DM.[177]

Though mean YLD of the diabetic patients was slightly higher in the rural community and YLL was higher in the urban community than those of the patients of respective counterpart community but these differences were not statistically significant ('t' test, p >0.05). On the contrary there was significant difference between DALY of diabetic patients of rural (mean 4.42±0.78) and urban community (mean 4.70±1.30) ($t_{(311)}$= 2.191, p=0.029). Mean DALY loss of the complications of DM was 5.38±1.36 in the rural community while it was 5.32±1.40 in the urban community, which was numerically different but was not significant statistically. Even when combined DALY of both DM and its complications was higher among the diabetic patients in the urban community (7.06±3.03) than in the rural community (6.97±3.10) but the difference was not statistically significant (t, p>0.05). These diversified findings can be explained by the facts that urban diabetes patients shared more years of life live disability ()YLD) and years of life lost due to premature death (YLL) of both diabetes and its complications as a result the urban patients shared more disability burden (DALY) in comparison to the rural patients. Another study conducted by Islam MZ at BIRDEM hospital of Bangladesh found very close findings as it revealed that urban diabetic patients attended the BIRDEM hospital incurred more disability burden specially the patients with complications of DM.[177]

7.1 Conclusion

Prevalence of diabetes mellitus (DM) is increasing in a rapid pace in both urban and rural communities of Bangladesh. Many cases remain undiagnosed due to lack of screening and sufficient diagnostic facilities throughout the country. Moreover, diagnosed patients suffer from grave complications of the disease due to ignorance of self care, lack of financial solvency, periodic checkup and facilities for clinical management. The disease poses long-term impacts in terms of disability and economic burden to the victims and their family, society and country. This particular study intended to explore both disability and economic burden of diabetes mellitus in urban and rural communities of Bangladesh. The study also compared pertinent background and risk factors of diabetes mellitus such as age, sex, marital status, family history, education, physical exercise, waist-hip ratio and body mass index (BMI) between urban and rural communities. Prevalence of DM, IFG and IGT were higher in urban community than in the rural community. Urban people were found more prone to develop DM as they were less likely to perform physical activities rather led sedentary life. This trend can be related to the differential occupations, working conditions and also the motivation for better living which were absent in the rural community. Males were more likely of developing diabetes than females. Complications of DM were more prevalent among the rural population in comparison to the urban population as they did not take self care, periodic checkup and proper treatment for the disease. Both economic and disability burden of the disease were comparatively higher in the urban community and among the patients with long duration and complications of the disease. Average treatment cost was higher in the urban community than in the rural community, which may be due to better and expensive treatment were taken by the urban participants while rural participants either took cheaper or inappropriate treatment for the disease. Disability burden (DALY loss) of DM and its complications was also higher in the urban community than in the rural community. As diabetes is a group of metabolic disorders due to relative insulin deficiency which can cause serious health complications and thus the study found complications like heart disease, retinopathy, nephropathy, neuropathy and diabetic foot. It is quite shocking that a remarkable proportion of people in both the communities were found unaware of occurrence of diabetes as they were detected as DM patients by this current study. The study recommends comprehensive measures for early diagnosis, self monitoring, self care and affordable cost-effective treatment facilities throughout the country to combat disability and economic burden of diabetes mellitus in both urban and rural communities of Bangladesh.

7.2 Recommendations

- Public health measures like screening program should be implemented for early diagnosis of diabetes mellitus in both urban and rural communities of the country with special emphasis to people with family history and exposed to risk factors of the disease.
- Comprehensive measures should be undertaken for the diabetic patients to raise their awareness regarding self care, self monitoring and periodic checkup for the disease with special emphasis in the rural community.
- Health facilities for diagnosis and treatment of diabetes mellitus should be available throughout the country to maintain normo-glycaemic status and to prevent grave complications of the disease among the victims especially in the rural community.
- To combat colossal disability burden of diabetes mellitus, periodic follow up of the patients, screening for complications of the disease and necessary treatment facilities should be ensured throughout the country.
- To reduce the economic burden of the disease, holistic approaches like cost-effective care and subsidized or free of cost treatment should be launched for the victims of diabetes mellitus especially for the rural poor and urban middle classes.
- Health education and promotional activities must be enhanced in the communities to make them aware regarding physical exercise, sedentary lifestyle, hazards of obesity and dietary habit to reduce the rapidly escalating prevalence of diabetes mellitus with special emphasis to the urban inhabitants.
- Measures also should be taken particularly for the service holders, businessmen and housewives for prevention of exposure to risk factors like smoking, harmful chemicals and biological agents to condense the prevalence of diabetes mellitus.
- To reduce the disability and economic burden of diabetes mellitus, prioritized attention should be paid to the elderly and obese patients as they were found worst victims of diabetes and its complications.
- Comprehensive study should be carried out to determine the magnitude of burden of diabetes mellitus in the country to formulate realistic policy for provision of cost-effective health care services to the victims of the disease.

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Annex-1: Time Framework

(October 2010 - September 2012)

Work statement	Oct 2010 - Jan 2011	Feb 2011- May 2011	June 2011- Sept 2011	Oct 2011- Jan 2012	Feb 2012- May 2012	June 2012- Sept 2012
Litterateur review						
Seminar on Methodology						
Finalization of Methodology						
Questionnaire & Checklist Formatting						
Ethical Clearance						
Pre-testing						
Finalization of Questionnaire & Checklist						
Data Collection						

(October 2012 - July 2014)

Work statement	Oct 2012 - Jan 2013	Feb-May 2013	June-Sept 2013	Oct 2013- Jan 2014	Feb-May 2014	June-July 2014
Litterateur review						
Data collection						
Data Processing & editing						
Data base development, entry and analysis						
Report Writing						
Seminar on Draft Report						
Finalization of the Report						
Examination / Defense						
Production of Final Report, Binding and Submission						

Annex-2: Consent Form in English

Dear Sir / Madam,

We have come to obtain some relevant information from you for the study entitled **"Burden of Diabetes Mellitus: Experience from Urban and Rural Communities of Bangladesh"**. The study is being conducted as a part of Doctor of Philosophy (PhD) program under the University of Dhaka. For your concern, burden of diabetes mellitus is increasing in Bangladesh in a rapid pace. Diabetes causes many fatal complications if not treated properly. The study aims to estimate disability burden of the disease in terms of its prevalence, disability adjusted life years and economic burden in terms of health care expenditure. The study finding will help in policy making for effective utilization of scarce resources of our country for prevention, early diagnosis and treatment along with rehabilitation of diabetes mellitus patients at all levels of health care delivery. The information provided by you will be dealt with high confidentiality and only be used for this research purpose. The information will be kept confidential in computer and by anonymization.

We will interview and examine you at your convenient time. It will take on an average 20-30 minutes to interview you and to estimate your blood glucose level. We will measure your blood glucose by a glucometer and it will need 2-3 drops of blood by pricking your finger, which will be done by maintaining all aseptic precautions. It will cause very mild pain at the time of finger pricking but there will be arrangement for management if any complication or problem arises. All your findings will be kept confidential and used only for this research purpose. Your blood glucose will be estimated free of cost and you will not be paid any compensation for your participation in the study. If you are diagnosed as diabetic, we will provide you free advices and will be referred to nearby diabetes hospital. Your participation will not do any personal, economic, social or professional harm to you.

Moreover, you will preserve full freedom to withdraw your consent for participation in the study at any time and at any stage of the study. Finally we will be grateful and highly obliged to you for your sincere participation and offering opportunity to measure your blood glucose and collect essential information from you.

Signature of the interviewer/doctor Signature/Thump impression of the participant
Date: Date:

Annex-3: Consent Form in Bengali

অবহিতকরণ সম্মতি পত্র

জনাব/ জনাবা,

"Burden of Diabetes Mellitus: Experience from Urban and Rural Communities of Bangladesh" শীর্ষক স্বাস্থ্য তথ্য সংক্রান্ত গবেষণার জন্য আপনার নিকট থেকে কিছু তথ্য নেয়া আমাদের খুব প্রয়োজন। আপনার অবগতির জন্য জানাচ্ছি যে, এই গবেষণায় আপনার অংশগ্রহন এবং তথ্য প্রদানের জন্য আপনি শারিরীক, মানসিক, সামাজিক এবং অর্থনৈতিকভাবে ক্ষতিগ্রস্থ হবেন না। উলেলখ্য, আপনার দেয়া তথ্যের গোপনীয়তা রক্ষা করা হবে এবং প্রদত্ত তথ্যসমূহ শুধূমাত্র এই গবেষণায় ব্যবহৃত হবে। এই গবেষণায় অংশ গ্রহণ এবং গবেষণা থেকে অব্যহতির ব্যাপারে আপনার পরিপুর্ণ স্বাধীনতা থাকবে। এই গবেষণায় আপনার অংশগ্রহণ শুধুমাত্র আপনার অবহিতকরণ সম্মতির মাধমেই সম্পন্ন হবে। আরও উল্লেখ্য, এই গবেষণায় অংশগ্রহণের জন্য আপনাকে কোন অর্থনৈতিক সুবিধা দেয়া হবেনা। আমরা মৌখিকভাবে আপনার কাছে গবেষণা সংক্রান্ত কিছু সুনির্দিষ্ট প্রশ্নের উত্তর জানতে চাইব এবং বিনামূল্যে আপনার রক্তের শর্করা পরীক্ষা করবো। রক্তের শর্করা পরীক্ষা করার সময় আপনার শারিরীক নিরাপত্তা যথাযথভাবে রক্ষা করা হবে। আপনার দেয়া তথ্যসমূহের গোপনীয়তা দৃঢ়ভাবে সংরক্ষন করা হবে এবং তা শুধুমাত্র এই গবেষণার কাজে ব্যবহার করা হবে। আপনার অংশগ্রহণ ও গবেষণা সংক্রান্ত তথ্যপ্রদান এবং সার্বিক সহযোগিতার জন্য আপনাকে আন্তরিকভাবে ধন্যবাদ। এই গবেষণার সমস্ত বিষয় অবগত হয়ে আমি স্বেচ্ছায়, স্বশরীরে এবং স্বজ্ঞানে অংশগ্রহণ এবং তথ্য প্রদান করলাম।

তথ্য পত্রে বর্ণিত তথ্যসমূহ আমি ভালভাবে শুনেছি এবং স্পষ্টভাবে বুঝেই এই গবেষণায় অংশগ্রহণ করতে সম্মতি দিয়েছি। তথ্যপত্রে যেভাবে বর্ণিত হয়েছে, আশা করি সেভাবেই গবেষণাটি পরিচালিত হবে। এই তথ্যসমূহ যিনি ব্যখ্যা করেছেন তিনি হলেন :

আমি জানি যে গবেষণার যে কোন পর্যায় থেকে কোন রকম কারণ দর্শানো ছাড়াই আমি নিজেকে প্রত্যাহার করে নিতে পারি এবং এটি আমাকে কোন ভাবেই প্রভাবিত করবে না। আমি সাক্ষাৎকারীর মাধ্যমে প্রশ্নপত্র পূরণের জন্য সম্মতি প্রদান করছি। আমি বিশ্বাস করি, গবেষণাকালিন সংগৃহীত সকল ব্যক্তিগত তথ্যাবলী গবেষকদের তত্ত্বাবধানে গোপনীয়তার সাথে সংরক্ষিত থাকবে। তথ্যপত্রে উল্লেখিত কোন বিষয় স্পষ্টভাবে বোঝার জন্য আমি পর্যাপ্ত সুযোগ পেয়েছিলাম।

অংশগ্রহনকারীর নামঃ

পিতা/স্বামীর নামঃ

ঠিকানাঃ

অংশগ্রহনকারীর স্বাক্ষর বা টিপসইঃ তারিখঃ

অংশগ্রহনকারীর নামঃ

আমি এই তথ্য পত্রটি পড়েছি যেটি গবেষণায় অংশগ্রহনকারীকে পড়ে শোনানো হয়েছে এবং আমি নিশ্চিত যে অংশগ্রহণকারীকে যা বলা হয়েছে তা সে বুঝেছে।

ব্যখ্যাকারীর নামঃ

ব্যখ্যাকারীর স্বাক্ষরঃ তারিখঃ

Annex-4: Questionnaire in English

Burden of Diabetes Mellitus: Experience from Urban & Rural Communities of Bangladesh

Questionnaire

- Place of the interview : ----------
- Code No. of the study place : |___|___|
- Date of data collection : ----------
- Name of the participant : ----------
- Address of the participant : ----------

1. ID No |___|___|___|___|

Section A: Socio-demographic Feature of the Participant

2. Sex	3. Age (yrs)	4. Education	5.Occupation	6. Religion	7. Marital Status	8. Monthly income (TK.)	9. Type of family	10. Family size

***2. Sex: 01**= Male **| 02**= Female

***4. Education: 01**= Primary **| 02=** Secondary | **03**= SSC | **04**= HSC | **05**= Graduate | **06**= Masters | **07=** Illiterate | **88**= Others

***5.Occupation: 01**= Service **| 02**= Farmer **| 03**= Student | **04**= House wife | **05**= Businessman | **06**= Day labor | **88=** Others

***6. Religion: 01**= Islam **| 02**= Hindu **| 03=** Christian **| 04=** Buddhist

***7. Marital Status**: **01**= Married **| 02**= Unmarried **| 03**= Separated **| 04**= Divorced **| 05**= Widow/Widower

*9. **Type of Family: 01**= Nuclear family **02**= Joint family

Section-B: Information Regarding Risk Factors of Diabetes Mellitus

11. Do you perform any physical activity?

    01. Yeas 02. No

12. If yes, Please mention the status of your physical activity?

    01. Heavy: Equivalent to brisk walk of >90 minutes in 24 hours

    02. Moderate: Equivalent to brisk walk of 60-90 minutes in 24 hours

    03. Mild: Equivalent to brisk walk of 30-59 minutes in 24 hours

    04. Sedentary: Equivalent to brisk walk of <30 minutes in 24 hours

13. Do you intake the following foods?

Question No.	Type of Food	Intake (01=Yes, 02=No)
13.1	Rice	
13.2	Bread	
13.3	Fish	
13.4	Egg	
13.5	Meat	
13.6	Pulse	
13.7	Vegetables	
13.8	Fruits	

14. If yes, how many time(s) do you take following foods per week (Out of 21 times)?

Question No.	Type of Food	Times per Week
14.1	Rice	
14.2	Bread	
14.3	Fish	
14.4	Egg	
14.5	Meat	
14.6	Pulse	
14.7	Vegetables	
14.8	Fruits	

15. What type of vegetables do you take more?

    01. Leafy vegetables 02. Non-leafy vegetables

    88. Others (Please specify…….)

16. Please mention your smoking status?

    01. Never smoked 02. Former smoker 03. Current smoker

    04. Occasional smoker

17. Please mention the duration of smoking (Years).

18. How many cigarettes do you smoke per day?

19. Do you take any other forms of tobacco?

    01. Jarda 02. Sada pata 03. Gul 04. Nashshi 05. Hukka

    88. Others (Please specify…….) 99. Not applicable

20. What is the duration of other forms of tobacco use (Years)?

21. What is your alcohol consumption status?

    01. Never consumed 02. Former consumer 03. Current consumer

    04. Occasional consumer

22. (If consumer), Please mention the duration of alcohol consumption (Years):

23. To what extent do you consume alcohol?

    01. Mild 02. Moderate 03. Extreme

24. Do you have exposure to any chemical(s)?

    01. Yes 02. No

25. If yes, mention the type chemical exposure

    01. Rodenticide 02. Insecticide 88. Others (Please specify…….)

26. Do you have exposure to any drug(s)?

    01. Yes 02. No

27. If yes, mention the type of drug(s)?

    01. Corticosteroid 02. Oral contraceptive 03. Diuretic

    04. Hormone Replacement Therapy (HRT) 88. Others (Please specify…….)

28. Did you suffer from any viral disease(s)?

    01. Yes 02. No

29. If yes, please mention the name of the viral disease(s)?

    01. Rubella 02. Mumps 88. Others (Please specify……)

30. Have you family history of Diabetes Mellitus?

    01. Yes 02. No

31. If yes, who (first degree relative) have/had Diabetes Mellitus?

    01. Father 02. Mother 03. Grandfather 04. Grandmother

    05. Brother 06. Sister 07. Uncle 08. Aunt

    88. Others (Please specify…….)

32. How much happy are you considering all things?

    1. Very unhappy 2. Unhappy 3. Neither happy nor unhappy.

    4. Happy 5. Very happy.

33. How much happy are you in your working environment?

    1. Very unhappy 2. Unhappy 3. Neither happy nor unhappy.

    4. Happy 5. Very happy.

34. How much happy are you with your economic solvency?

    1. Very unhappy 2. Unhappy 3. Neither happy nor unhappy.

    4. Happy 5. Very happy.

35. How much happy are you considering your family relationship?

    1. Very unhappy 2. Unhappy 3. Neither happy nor unhappy.

    4. Happy 5. Very happy.

Section-C: Information Regarding Diabetes Mellitus (Please review medical records)

36. Are you suffering from Diabetes Mellitus? 01. Yes 02. No

37. If yes, for how long have you been suffering from Diabetes Mellitus (Years)?

38. Where do you attend for health care for diabetes?

    01. Local diabetes center 02. Govt. hospital 03. Private hospital/clinic

    04. Allopathic Doctor 05. Homeopathic doctor

    88. Others (Please specify…….) 99. None

39. What type of therapy are you taking for Diabetes Mellitus?

    01. Oral drug (OHA) 02. Insulin 03. Diet control 04. Physical exercise

    05. All of the above 88. Others (Please specify…….) 9. None

40. Are you suffering from any complication of Diabetes Mellitus?

    01. Yes 02. No

41. If yes, please mention the complication(s) of Diabetes Mellitus?

01. Eye complication 02. Kidney complication 03. Neurological complication

04. Foot ulcer 05. Hart disease 88. Others (Please specify……)

42. Please mention the duration of the complication (s) (Years)

43. Do you monitor diabetes mellitus yourself? 01. Yes 02. No

Section-D: Information Regarding Economic Burden of Diabetes Mellitus

44. Please mention the following direct costs incurred for treatment of DM (Per month):

Type of Direct Cost	Cost Incurred (Tk.)
44.1 Travel cost	
44.2. Consultation Fee	
44.3. Cost of Drug	
44.4. Cost of Laboratory Investigations	
44.5. Cost of Attendant	
44.6. Hospital Cost	
44.7. Self Monitoring Cost	
44.8. Cost of Treating Complications	
44.9. Tips for Treatment	
44.10. Total Direct Cost	

45. Please mention the following indirect costs incurred for treatment of DM (Per month):

Type of In-direct Cost	Cost Incurred (Tk.)
45.1. Loss of Income due to Illness = Man days loss due to illness × Daily income of the patient	
45.2. Disability Payment	
45.3. Social Security	
45.4. Tax Rebate	
45.5. Total Indirect Cost	

46. Economic Burden in terms of total cost (Tk.) incurred by the DM patient (Total Direct Cost + Total Indirect Cost): ☐

47. What is/are the source(s) of fund for treatment of Diabetes Mellitus? ☐

01. Household income 02. Household saving 03. Govt. subsidy
04. Health Insurance 05. Loan from relative/others
06. Selling property 88. Others (Please specify…….)

48. Did the treatment cost compel you to compromise with any basic family demand? ☐

01. Yes 02. No

49. If yes, please mention the family demand compromised ☐

01. Sufficient food provision 02. Optimum clothing 03. Adequate shelter
04. Treatment of other family member 05. Education of the family member
88. Others (Please specify……)

50. Did any member of your family died from Diabetes Mellitus in last one year? ☐

01. Yes 02. No (If Yes, Please Refer to Verbal Autopsy)

---------- ----------

(Name & Signature of Interviewer) **(Name & Signature of the Participant)**

Date: |___|___|___|___|___|___| Date: |___|___|___|___|___|___|

Thanks for your participation & sincere cooperation

Annex-5: Questionnaire in Bengali

Burden of Diabetes Mellitus: Experience from Urban and Rural Communities of Bangladesh

প্রশ্নমালা

তথ্য সংগ্রহের স্থানঃ ----------

তথ্য সংগ্রহের স্থানের কোড নং | | |

তথ্য সংগ্রহের তারিখঃ | | | |

অংশ গ্রহনকারীর নামঃ ----------

অংশ গ্রহনকারীর ঠিকানাঃ ----------

১। অংশ গ্রহনকারীর আইডি নং | | | | |

সেকশন-১: অংশ গ্রহনকারীর আর্থো-সামাজিক তথ্যাবলী

২। লিঙ্গ	৩। বয়স (বৎসর)	৪। শিক্ষাগত যোগ্যতা	৫। পেশা	৬। ধর্ম	৭। বৈবাহিক অবস্হা	৮। মাসিক আয় (টাকা)	৯। পরিবারের ধরন	১০। পরিবারের সদস্য সংখ্যা

- ২। লিঙ্গঃ ০১= পুরুষ, ০২= মহিলা
- ৪। শিক্ষাগত যোগ্যতাঃ ০১= প্রাথমিক, ০২= মাধ্যমিক, ০৩= এসএসসি, ০৪= এইচএসসি, ০৫= স্নাতক, ০৬= মাষ্টার্স, ০৭= অশিক্ষিত, ৮৮= অন্যান্য-------
- ৫। পেশাঃ ০১= চাকুরী, ০২= কৃষক ০৩= ছাত্র/ছাত্রী, ০৪= গৃহিনী, ০৫= ব্যবসা, ০৬= দিনমজুর, ৮৮= অন্যান্য----
- ৬। ধর্মঃ ০১= ইসলাম, ০২= হিন্দু, ০৩= খ্রীষ্টান ০৪= বৌদ্ধ
- ৭। বৈবাহিক অবস্হাঃ ০১= বিবাহিত ০২= অবিবাহিত, ০৩= আলাদা ০৪= তালাক প্রাপ্ত//প্রাপ্তা, ০৫=বিধবা/বিপত্নীক
- ৯। পরিবারের ধরনঃ ০১। একক পরিবার ০২। যৌথ পরিবার

সেকশন-২: ডায়াবেটিস মেলিটাস এর ঝুকিপূর্ন বিষয় সংক্রান্ত তথ্যাবলী

১১। আপনি কি শারীরিক পরিশ্রম / কাজ করেন ? |

০১। হ্যা ০২। না

১২। হ্যা হলে, আপনি কী ধরনের শারীরিক পরিশ্রম / কাজ করেন ? |

০১। ভারীঃ প্রতি দিন ৯০ মিনিটের বেশী দ্রুত হাটা

০২। মাঝারিঃ প্রতি দিন ৬০-৯০ মিনিট দ্রুত হাটা

০৩। হালকাঃ প্রতি দিন ৩০-৫৯ মিনিট দ্রুত হাটা

০৪। বসে কাজঃ প্রতি দিন ৩০ মিনিটের কম দ্রুত হাটা

১৩। আপনি কি নিম্নে বর্নিত খাবার খান ?

প্রশ্ন নং	খাবারের ধরন	০১= হ্যা ০২= না
১৩-১	ভাত	
১৩-২	রুটি	
১৩-৩	মাছ	
১৩-৪	ডিম	
১৩-৫	মাংশ	
১৩-৬	ডাল	
১৩-৭	সব্জী	
১৩-৮	ফল	

১৪। উত্তর হ্যা হলে, নিম্নের কোন খাবার সপ্তাহে কতবার খান ?

প্রশ্ন নং	খাবারের ধরন	সপ্তাহে কতবার
১৪-১	ভাত	
১৪-২	রুটি	
১৪-৩	মাছ	
১৪-৪	ডিম	
১৪-৫	মাংশ	
১৪-৬	ডাল	
১৪-৭	সব্জী	
১৪-৮	ফল	

১৫। আপনি কী ধরনের সব্জী বেশী খান?

০১। পাতাযুক্ত সব্জী ০২। পাতাবিহীন সব্জী

৮৮। অন্যান্য (নির্দিষ্ট করুন----------)

১৬। অনূগ্রহ পূর্বক ধূমপান সম্পর্কিত আপনার তথ্য প্রদান করুন

০১। কখনই ধূমপান করি নাই ০২। পূর্বে ধূমপান করতাম

০৩। বর্তমানে ধূমপান করি ০৪। মাঝে মাঝে ধূমপান করি

১৭। অনূগ্রহ পূর্বক ধূমপানের মেয়াদ (বৎসর) উল্লেখ করুন

১৮। আপনি প্রতিদিন কয়টি সিগারেট খান?

১৯। আপনি কি অন্য প্রকার তামাক দ্রব্য সেবন করেন?

০১। হ্যা ০২। না

২০। অন্য প্রকার তামাক দ্রব্য সেবনর মেয়াদ (বৎসর) কত?

২১। অনূগ্রহ পূর্বক মদ্যপান সম্পর্কিত আপনার তথ্য প্রদান করুন

০১। কখনই মদ্যপান করি নাই ০২। পূর্বে মদ্যপান করতাম

০৩। বর্তমানে মদ্যপান করি ০৪। মাঝে মাঝে মদ্যপান করি

২২। উত্তর হ্যা হলে, অনূগ্রহ পূর্বক মদ্যপানের মেয়াদ (বৎসর) উল্লেখ করুন

২৩। আপনি কী মাত্রায় মদ্যপান করেন?

০১। স্বল্প মাত্রায় ২। মাঝারি মাত্রায় ০৩। অতি মাত্রায়

২৪। আপনি কি কোন প্রকার রাসায়নিক দ্রব্যের সংস্পর্শে গিয়েছেন?

০১। হ্যা ০২। না

২৫। উত্তর হ্যা হলে, অনূগ্রহ পূর্বক রাসায়নিক দ্রব্যের নাম উল্লেখ করুন

০১। ইদুরনাশক ০২। কীটনাশক ৮৮। অন্যান্য (নির্দিষ্ট করুন----------)

২৬। আপনি কি কোন প্রকার ঔষধ সেবন করেন?

০১। হ্যা ০২। না

২৭। উত্তর হ্যা হলে, অনূগ্রহ পূর্বক ঔষধের নাম উল্লেখ করুন

০১। ষ্টেরয়ড ০২। জন্ম নিয়ন্ত্রন বড়ি ০৩। মূত্রবর্ধক ০৪। হরমোন থেরাপি

৮৮। অন্যান্য (নির্দিষ্ট করুন----------)

২৮। আপনি কি ভাইরাস জনিত কোন প্রকার রোগে ভূগেছেন?

০১। হ্যা ০২। না

২৯। উত্তর হ্যা হলে, অনূগ্রহ পূর্বক ভাইরাস জনিত রোগের নাম উল্লেখ করুন

০১। রুবেলা ০২। মাম্পস ৮৮। অন্যান্য (নির্দিষ্ট করুন----------)

৩০। আপনার পারিবারে অন্য কারও কি ডায়াবেটিস মেলিটাস রোগ আছে?

০১। হ্যা ০২। না

৩১। উত্তর হ্যা হলে, আপনার পারিবারে কে/কাহারা ডায়াবেটিস মেলিটাস রোগে ভূগছেন/ভূগেছেন?

০১। বাবা ০২। মা ০৩। দাদা/নানা ০৪। দাদী/নানী ০৫। ভাই

০৬। বোন ০৭। চাচা/মামা ০৮। ফুফু/খালা ৮৮। অন্যান্য (নির্দিষ্ট করুন----------)

৩২। সার্বিক বিবেচনায় আপনি কতটুকু সুখী?

০১। খুব অসুখী ০২। অসুখী ০৩। সুখী বা অসুখী কোনটিই না

০৪। সুখী ০৫। খুব সুখী

৩৩। আপনার কর্মস্হলে আপনি কতটুকু সুখী?

০১। খুব অসুখী ০২। অসুখী ০৩। সুখী বা অসুখী কোনটিই না

০৪। সুখী ০৫। খুব সুখী

৩৪। আর্থিক অবস্হা বিবেচনায় আপনি কতটুকু সুখী?

০১। খুব অসুখী ০২। অসুখী ০৩। সুখী বা অসুখী কোনটিই না

০৪। সুখী ০৫। খুব সুখী

৩৫। পারিবারিক ভাবে আপনি কতটুকু সুখী?

০১। খুব অসুখী ০২। অসুখী ০৩। সুখী বা অসুখী কোনটিই না

০৪। সুখী ০৫। খুব সুখী

সেকশন-৩: ডায়াবেটিস মেলিটাস রোগ সংক্রান্ত তথ্যাবলী

৩৬। আপনি কি ডায়াবেটিস মেলিটাস রোগে ভূগছেন?

০১। হ্যা ০২। না

৩৭। উত্তর হ্যা হলে, কত বৎসর যাবৎ ডায়াবেটিস মেলিটাস রোগে ভূগছেন?

৩৮। আপনি কোথায় ডায়াবেটিস মেলিটাস রোগের চিকিৎসা করেন?

০১। স্হানীয় ডায়াবেটিস কন্দ্র ০২। সরকারী হাসাতাল ০২। বেসরকারী হাসাতাল/ক্লিনিক

০৪। এলোপ্যাথিক ডাক্তার ০৫। হোমিওপ্যাথিক ডাক্তার

৩৯। আপনি ডায়াবেটিস মেলিটাস রোগের জন্য কি চিকিৎসা নিচ্ছেন?

০১। ডায়াবেটিসের বড়ি ০২। ইনসুলিন ০৩। খাদ্য নিয়ন্ত্রন ০৪। ব্যায়াম

০৫। উপরের সবগুলি ০৬। কোনটিইনা ৮৮। অন্যান্য (নির্দিষ্ট করুন----------)

৪০। আপনি কি ডায়াবেটিস মেলিটাস রোগের কোন প্রকার জটিলতায় ভূগছেন?

০১। হ্যা ০২। না

৪১। উত্তর হ্যা হলে, অনূগ্রহ পূর্বক জটিলতায় নাম উল্লেখ করুন

০১। চোখের জটিলতা ০২। কিডনীর জটিলতা ০৩। স্নায়বিক জটিলতা

০৪। পায়ে ঘা ০৫। হার্টের রোগ ৮৮। অন্যান্য (নির্দিষ্ট করুন----------)

৪২। অনূগ্রহ পূর্বক ডায়াবেটিস মেলিটাস রোগের জটিলতার মেয়াদ (বৎসর) উল্লেখ করুন

৪৩। আপনি কি নীজে ডায়াবেটিস মেলিটাস রোগ পর্যবেক্ষন করেন?

০১। হ্যা ০২। না

সেকশন-৪; ডায়াবেটিস মেলিটাস রোগের আর্থিক চাপ সংক্রান্ত তথ্যাবলী

৪৪। অনূগ্রহ পূর্বক ডায়াবেটিস মেলিটাস রোগের নিম্ন বর্নিত প্রত্যক্ষ ব্যয় সমূহ উল্লেখ করুন

প্রশ্ন নং	প্রত্যক্ষ ব্যয়ের ধরন	প্রত্যক্ষ ব্যয় (টাকা)
৪৪-১	যাতায়াত ব্যয়	
৪৪-২	পরামর্শ ফি	
৪৪-৩	ঔষধের ব্যয়	
৪৪-৪	ল্যাব পরীক্ষা ব্যয়	
৪৪-৫	সহকারীর জন্য ব্যয়	
৪৪-৬	হাসপাতালে ব্যয়	
৪৪-৭	নিজ পর্যবেক্ষন ব্যয়	
৪৪-৮	জটিলতার চিকিৎসা ব্যয়	
৪৪-৯	বখশীশ বাবদ ব্যয়	
৪৪-১০	মোট প্রত্যক্ষ ব্যয়	

৪৫। অনুগ্রহ পূর্বক ডায়াবেটিস মেলিটাস রোগের নিম্ন বর্নিত পরোক্ষ ব্যয় সমূহ উল্লেখ করুন

প্রশ্ন নং	পরোক্ষ ব্যয়ের ধরন	পরোক্ষ ব্যয় (টাকা)
৪৫-১	রোগের কারনে আয়ের ক্ষতি [কর্মস্হলে মোট (দিন) অনুপস্হিতি × প্রতিদিনের আয়]	
৪৫-২	অক্ষমতা জনিত ব্যয়	
৪৫-৩	সামাজিক নিরাপত্তা জনিত ব্যয়	
৪৫-৪	আয়কর মওকুপ	
৪৪-৫	মোট পরোক্ষ ব্যয়	

৪৬। ডায়াবেটিস মেলিটাস রোগের অর্থনৈতিক চাপ (মোট প্রত্যক্ষ ব্যয় + মোট পরোক্ষ ব্যয়)

৪৭। ডায়াবেটিস মেলিটাস রোগের চিকিৎসা ব্যয়ের অর্থের উৎস কী?

০১। পারিবারিক আয় ০২। পারিবারিক সঞ্চয় ০৩। সরকারী অনুদান

০৪। স্বাস্হ্য বীমা ০৫। ঋন ০৬। সম্পদ ব্যয়

৮৮। অন্যান্য (নির্দিষ্ট করুন--------)

৪৮। রোগের চিকিৎসা ব্যয় বহনের জন্য আপনার কি পরিবারের কোন মৌলক চাহিদা ছাড় দিতে হয়েছে?

০১। হ্যা ০২। না

৪৯। উত্তর হ্যা হলে, অনুগ্রহ পূর্বক মৌলক চাহিদার নাম উল্লেখ করুন

০১। পর্যাপ্ত খাদ্য সরবরাহ ০২। পর্যাপ্ত বস্ত্র প্রদান ০৩। পর্যাপ্ত আবাসন

০৪। অন্য সদস্যের চিকিৎসা ০৫। পরিবারের সদস্যদের পড়ালেখা

৮৮। অন্যান্য (নির্দিষ্ট করুন----------)

৫০। গত এক বৎসরে আপনার পরিবারের কোন সদস্য কি ডায়াবেটিস মেলিটাস রোগে মারা গেছেন?

০১। হ্যা ০২। না

(উত্তর হ্যা হলে, অনুগ্রহ পূর্বক ভার্বাল অটোপসির জন্য রেফার করুন)

এই গবেষনায় সক্রিয় অংশগ্রহন, তথ্য প্রদান এবং সহযোগীতার জন্য আপনাকে আন্তরিক ভাবে ধন্যবাদ

তথ্য সংগ্রহকারীর নাম ও স্বাক্ষর

তারিখঃ

তথ্য প্রদানকারীর নাম ও স্বাক্ষর

তারিখঃ

Annex-6: Checklist

Burden of Diabetes Mellitus: Experience from Urban and Rural Communities of Bangladesh

Name of the Participant:---------- ID No: |___|___|___|___|

Address:----------

51. Information Regarding BMI, WHR and Obesity:

Sl. No.	Attribute	Finding
51.1	Height (Meter)	
51.2	Weight (Kg)	
51.3	BMI [Weight (kg)/Height (m^2)]	
51.4	Remark: 01= <18.50 (Underweight), 02= 18.5–24.99 (Normal Range) 03= 25.00–29.99 (Overweight), 04= 30.00–34.99 (Moderate Obese), 05= 35.00–39.99 (Severe Obese), 06= ≥40.00 (Very Severe Obese)	
51.5	Waist girth (Cm)	
51.6	Hip (Cm)	
51.7	WHR [Waist/Hip]	
51.8	Remark: Male: 01= ≤1.0 (Normal), 02= >1.0 (Obese). Female: 01= ≤0.85 (Normal), 02 = >0.85 (Obese)	

51. Information Regarding Blood Glucose:

Sl. No.	Type of Blood Glucose	Finding
52.1	Fasting Blood Glucose (mml/lt):	
	Remark: 01= <5.6 mml/l (Normal), 02= 5.6–6.0 mml/l (Impaired Fasting Glucose), 03 = ≥6.1 mml/l (Diabetes Mellitus)	
52.2	Blood Glucose 2 Hours After 75 gm Glucose Intake (mml/lt):	
	Remark: 01= <7.8 mml/l (Normal), 02= 7.8–11.0 mml/l (Impaired 2 Hours After Glucose Load), 03= ≥11.1 mml/l (Diabetes Mellitus)	
52.3	Final Remark: 01= IFG, 02= IAGL, 03= Diabetes Mellitus, 04= Normal	

53. Information Regarding Disability Burden (DALY) of DM:

Sl. No.	Attribute	Finding
53.1	Age at onset of Diabetes Mellitus	
53.2	Life Expectancy at Birth (According to BBS) 01= Male: 65.8 Years, 02 = Female: 68.1 Years	
53.3	Duration of Diabetes Mellitus	
53.4	Disability Weight	0.07
53.5	YLD Shared (To be calculated by using specific formula)	
53.6	Age (Years) at the time of death (From Verbal Autopsy)	
53.7	YLL Shared (To be calculated by using specific formula)	
53.8	DALY (YLD + YLL)	

54. Information Regarding Disability Burden (DALY) of Complications of DM

Sl. No.	Attribute	Finding
54.1	Type of Complication: 01= Retinopathy, 02= Nephropathy 03= Neuropathy, 04= Diabetic Foot, 05= Cataract, 06= Glaucoma 88= Others (Please specify…….), 99= None	
54.2	Age at onset of Complication of Diabetes Mellitus	
54.4	Duration of Complication of Diabetes Mellitus	
54.2	Life Expectancy at Birth (According to BBS) 01 = Male: 65.4 Years, 02 = Female: 67.9 Years	
54.5	Disability Weight	
54.6	YLD Shared (To be calculated by using specific formula)	
54.7	Age (Years) at the time death (From Verbal Autopsy)	
54.8	YLL Shared (To be calculated by using specific formula)	
54.9	DALY (YLD + YLL)	

55. Total Disability Burden of Diabetes Mellitus and its Complications (DALY): ☐

Signature of the Doctor/Examiner

Date: |___|___|___|___|___|___|

Signature of the Participant

Date: |___|___|___|___|___|___|

Annex-7: Verbal Autopsy Questionnaire

Burden of Diabetes Mellitus: Experience from Urban & Rural Communities of Bangladesh

(Persons aged 20 years and above)

Instructions to interviewer: Introduce yourself and explain the purpose of your visit. Ask the household head or his/her representative to speak regarding the diabetes mellitus that led to death of any his family member. If this is not possible, arrange a time to revisit the household when the respective person will be available at home. Before interviewing the person explain to him/her that participation in the interview is voluntary; she can refuse to answer any question and she can stop the interview at any time. Explain to him/her that the information provided will be used only for this specific research purposes and will be dealt with highest confidentiality. Seek his/her consent for asking questions concerning symptoms that the deceased had/showed when s/he was ill. During interview, help can also be taken from other persons present. If you could not interview in present visit, arrange a time to revisit the household when the main respondent will be at home. The main respondent must be

- ***Closely related to the deceased***
- ***Present during the illness that led to death and***
- ***Able to describe illness symptoms and medical consultations prior to death***

I. IDENTIFICATION OF THE RESPONDENT

1.1 List the names of persons present during interview and during the illness that led to death?

		Present during illness	
Name of those present in the interview	Their relationships to the deceased	Yes	No
		1	2
		1	2
		1	2
		1	2
		1	2

(Code: 1=Mother/father, 2=Spouse, 3=Sister/brother/sister-in-law, 4=Son/daughter/daughter-in-law, 5=Grand mother/father, 6=Aunt/uncle, 7=Other (specify.....)

1.2 Line # of the main respondent:		1.3 His/her relationship to the deceased:	
1.4 His/her age (in years):		1.5 His/her completed years of education: (Code: 99=NK)	

II. BACKGROUND INFORMATION ABOUT THE INTERVIEWER

2.1 Interviewer's name: _____

2.2 Date of interview (dd/mm/yy):

2.3 Date of first interview attempted:

2.4 Date arranged for second interview:

III. IDENTIFICATION & DEMOGRAPHIC DATA OF THE DECEASED

3.1 Name of deceased…… ID: PERMID

3.2 Date of Interview: (dd/mm/yy) DINT

3.3 His/her village name: | 3.4 House Name: | Code:

3.5 Date of birth (dd/mm/yy): DOB

3.6 Age at death (year): AGAD

3.7 Sex of the deceased: 1= Male | 2= Female SOD

3.8 What was the marital status of the deceased?	Never married..... 1 Married ..... 2 Separated ..... 3 Divorced ..... 4 Widowed 5

3.9 Number of years of formal education of the deceased.				Code: 99=NK 00= no education	YEDUD
3.10 Type education of deceased:			1. General	2. Religious	TEDUD
3.11 Main Occupation of deceased:	1. Farmer	2. Trader	3. Service	4. Housewife	OCCUD
	5. Other (specify): ……				

IV. BACKGROUND INFORMATION ON THE DEATH

4.1 Date of death (dd/mm/yy):							DOD

4.2 For how long (Years) was he/she ill before death?		99. NK	ILLD

4.3 Where did he/she die?	1. Hospital	2. Other health facility	3. On the way to hospital or health facility	PDD
	4. Home	5. Other (specify):……		

4.4 When did he/she die?	1. Morning	2. Noon	3. Afternoon	4. Early night	TOD
	5. Mid night	6. Late night	99. NK		

4.5. OPEN HISTORY QUESTION

4.5.1 Could you tell me about the illness that led to her/his death? Prompt: Was there anything else?

Instructions to interviewer: Allow the respondent to tell you about the disease in his or her own words. Do not prompt except for asking whether there was anything else after the respondent finishes. Keep prompting until the respondent says there was nothing else. (While recording, underline any unfamiliar terms)

_____

_____

_____

4.5.2 Summary of signs & symptoms reported by respondent:

Symptoms	Duration (Years/Months/Days)	Severity (Mild=1, Moderate=2, Severe=3)
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

4.5.3 What was the deceased person doing at the time of death?

1. Lying down	2. Sleeping	3. Walking	WDPD
4. Working	5. Talking	6. 99. NK	

4.5.4 Where or from whom did the deceased seek care? *(Record all responses)*

1 Traditional healer	1. Yes	2. No	99. NK	TRAH
2 Religious leader	1. Yes	2. No	99. NK	RELL
3 Government hospital/health centre	1. Yes	2. No	99. NK	GOVH
4 Clinic/Private hospital	1. Yes	2. No	99. NK	PVCH
5 Community-based practitioner	1. Yes	2. No	99. NK	COBP
6 Private physician or nurse	1. Yes	2. No	99. NK	PPHN
7 Pharmacy	1. Yes	2. No	99. NK	PHAR
8 Drug seller	1. Yes	2. No	99. NK	DRUS
9 Relatives or friends	1. Yes	2. No	99. NK	RELA
10 Other (specify)……..	1. Yes	2. No	99. NK	OTCAR

4.6 After respondent finishes prompt: Did you the deceases seek care anywhere else?……

4.6.1 Where or from whom was care sought first?		88. NA	99.N K	CARE_1
4.6.2 Where or from whom was care sought second?		88. NA	99.N K	CARE_2
4.6.3 Where or from whom was care sought third?		88. NA	99.N K	CARE_3

4.7 Do you know the cause(s) of his/her death?	1. Yes	2. No	RCD

4.8 If the answer is YES probe to specify the cause(s):

Cause (1)……		CAUS1
Cause (2) ……		CAUS2

4.9 Did the deceased suffer from any of the following illness?

1. Hypertension:	1. Yes	2. No	99. NK	HYP
2. Other heart diseases:	1. Yes	2. No	99. NK	OHEA
3. Diabetes Mellitus:	1. Yes	2. No	99. NK	DIAB
4. Epilepsy:	1. Yes	2. No	99. NK	EPI
5. TB:	1. Yes	2. No	99. NK	TB
6.HIV/AIDS:	1. Yes	2. No	99. NK	HIV
7. Leprosy:	1. Yes	2. No	99. NK	LEP
8. Asthma:	1. Yes	2. No	99. NK	ASTH
9. Cancer:	1. Yes	2. No	99. NK	CAN

4.9.1 If yes to cancer, please specify which type?	…….....	99. NK	CANTYP

4.10 Did the deceased suffer from any other illness?	1. Yes	2. No	99. NK	ODIS

4.11 If yes, please specify

_____

V. Injury/Accidents:

5.1 Did she sustain any injury which led to his/her death? *If the answer is 2 or 99 proceed to Q6.1*	1. Yes	2. No	99. NK	INJ

5.1.1 If yes, what kind of injury or accident? *Allow respondent to answer spontaneously*.

1. Road traffic accident (pedestrian)	2. Road traffic accident (passenger/driver)		3.Fall	4. Drowning	5. Poisoning (specify) ……..
6. Animal bite	7. Other bites or sting	8. Burn	9. Firearm	10. Sharp object- e.g. knife	11. Circumcision
12. Assault/abuse (specify):……			13. Other (specify):……		

TINJ

5.1.2 If answer to 5.1.1 is 6, please specify.	1. Dog	2. Snake	3. Other (specify) …….	99.NK	ANBI
5.1.3 Was the injury accidental or intentional?	1. Accidental		2. Intentional	99.NK	INJTY
5.1.4 Did she/he die at the site where the accident or injury occurred?	1. Yes		2. No	99.NK	DSPOT
5.1.5 How many days did she survive before she died?	1<24 hours		2.>24 hours	99. NK	INJDU
5.1.6 Did she/he receive medical care before death?	1. Yes		2. No	99.NK	MDCARE
5.2 Did she/he have an ongoing chronic illness or was sick in the month before the accident or injury?	1. Yes		2. No	99.NK	OILL
5.3 Do you think that she committed suicide?	1. Yes		2. No	99. NK	SUI

If the answer is 2 or 99 proceed to VI

5.3.1 How did she commit suicide? *Allow respondent to answer spontaneously.*

1. Hanging	2. Poisoning	3. Burns	4.Gunshot	5. Others (specify) …….	99 NK

TSU

VI: Pregnancy/Delivery (In case of female person)

6.1 Was she pregnant at the time of death?	1. Yes	2. No	99. NK	PRE
6.2 How many months was she pregnant?			99.NK	MPR

If not pregnant at time of death, please ask:

6.3 Did she deliver within 42 days (6 weeks) before death? *If the answer is 2 or 99 proceed to Q6.15*	1. Yes	2. No	99. NK	DEL
6.4 How many days before her death, did she deliver?			99.NK	EDD

6.5 Where did she deliver?	1. Hospital	2. Other health facility	3.On route to hospital or health facility	DELIV
	4. Home	5. Other (Specify:……...)	99. NK	

6.6 Who managed the delivery when the child was born?	1.Health professional (Doctor, midwife, nurse)	2. Traditional birth attendant	WMAD
	3. Relatives / 4. Mother alone	5. Other (specify……..)	

6.7 Did she have obstructed labour?	1. Yes	2. No	99. NK	OBS
6.8 How long was she in labour?	1. <24hours	2. >=24hours	99. NK	DDE
6.9 Did she have difficulty in delivering placenta?	1.Yes	2. No	99. NK	DDE
6.10 Did she have too much bleeding before the baby was born?	1. Yes	2. No	99. NK	BBEF
6.11 Did she have too much bleeding after the baby was born?	1. Yes	2. No	99. NK	BAFT

6.12 What was the mode of delivery?

	1. Vaginal delivery	2. Vacuum or forceps	3. Abdominal Operation	99. NK	MDE

6.13 Was baby born alive?	1. Alive	2. Stillborn	99. NK	BALV

6.14 If baby born alive, ask how is the baby now?	1. Died before 7 days	2. Died after 7 days		BAFT
	3. Healthy	4. Unhealthy	99. NK	

6.15 Did she have an abortion before her death?	1. Yes	2. No	99. NK	ABOR

If response is 2 or 99 skip to Q 6.20

6.16 How many days before her death, did she have an abortion?		99.NK	DABO

6.17 Did she have heavy bleeding after the abortion?	1. Yes	2. No	99. NK	BLAB
6.18 Did she have high fever after the abortion?	1. Yes	2. No	99. NK	FABO
6.19 Was the abortion induced?	1. Yes	2. No	99. NK	INAB
6.20 Did she have seizures shortly before she died?	1. Yes	2. No	99. NK	SEIZ
6.21 Did she have any previous complicated delivery?	1. Yes	2. No	99. NK	PCD
6.22 Did she have any swelling or ulcer in the breast?	1. Yes	2. No	99. NK	BTU

VII: Leading Questions to Elicit Signs & Symptoms of the Final Illness

7.1 Fever:

7.1.1 During illness that led to death did he/she have fever?	1. Yes	2. No	99. NK	FEV

(If the answer is 2 or 99 proceed to Q 7.2)

7.1.2 How many days did he/she has fever?		88 NA	99.NK	DFE

7.1.3 Was the fever:	1.Mild/moderate	2. Extremely high	88. NA	99. NK	SFE

7.1.4 Was the fever continuous or on and off?	1. Continuous	2. On & Off	88. NA	99. NK	TFE

7.1.5 Did he/she have chills/rigor	1. Yes	2.No	99. NK	RIG

7.2 Rash:

7.2.1 During illness that led to death, did he/she have rash? *If the answer is 2 or 99 proceed to Q 7.2.6)*	1. Yes	2. No	99. NK	RAS

7.2.2 Where was the rash located?	Face			
	Trunk			
	Extremities			
	All over the body			
	Other: (specify)			

7.2.3 How many days did he/she have rash?		88. NA	99. NK	DRA

7.2.4 Did the skin crack/split or peel after the rash started?	1. Yes	2. No	99. NK	SKIRAS

7.2.5 What did the rash look like?

1. Measles rash	2. Rash with clear fluid	3. Rash with pus	99. NK	TRA
4. Other (specify)....……				

7.2.6 Did he/she have red eyes?	1. Yes	2. No	99. NK	SEY

7.2.7 Did he/she have itching of skin?	1. Yes	2. No	99. NK	ITC

7.2.8 Did he/she have bleeding from the body openings? *Do not include menstruations*.	1. Yes	2. No	99. NK	BLEEO

7.2.9 Did he/she have pins and needles in feet?	1. Yes	2. No	99. NK	PNEEF

7.3 Weight Loss:

7.3.1 Had he/she lost weight recently before death?	1. Yes	2. No	99. NK	LOW

If the answer is 2 or 99 proceed to Q7.4

7.3.2 How long before death?	1. Days	2. Months	3. Years	88.NA	99. NK	DLOW

7.3.3 Was the loss of weight:	1. Mild/Moderate (a little)	2. Severe (a lot)	88. NA	99. NK	SLW

7.3.4 How did he/she look like at the end of her/his life?	1. Normal	1. Extremely thin and wasted	88. NA	99. NK	SLW

7.4 Pallor/Jaundice

7.4.1 Did he/she look pale (anaemic)?	1. Yes	2. No	99. NK	PAL
7.4.2 Did he/she have yellow discoloration of the eyes?	1. Yes	2. No	99. NK	JAU

7.5 Oedema/Swelling:

7.5.1 Did she have ulcer on any part of the body?	1. Yes	2. No	99. NK	ULC
7.5.1.1 *If yes to 7.5.1,* please specify where is the ulcer located?			99. NK	ULCL
7.5.2 Had he/she has swelling around ankle?	1. Yes	2. No	99. NK	SAA
7.5.2.1 How many days did he/she have the swelling?		88.NA	99.NK	DSAA
7.5.3 Did he/she have puffiness of the face?	1. Yes	2. No	99. NK	PUF
7.5.3.1 *If yes*, ask how many days did the swelling last		88.NA	99. NK	DPUF
7.5.4 Did he/she have swelling in the neck?	1. Yes	2. No	99. NK	SWN
7.5.4.1 *If yes*, ask how many days did the swelling last		88.NA	99. NK	DSWN
7.5.5 Did he/she have swelling in the armpit?	1. Yes	2. No	99. NK	SWA
7.5.5.1 *If yes*, ask how many days did the swelling last		88.NA	99. NK	DSWA
7.5.6 Did he/she have swelling in the groin?	1. Yes	2. No	99. NK	SWG
7.5.6.1 *If yes*, ask how many days did the swelling last?		88.NA	99. NK	DSWG
7.5.7 Did he/she have swelling of joints?	1. Yes	2. No	99. NK	SWJ
7.5.7 1 *If yes*, ask how many days did the swelling last?		88.NA	99. NK	DSWJ

7.6 Cough:

7.6.1 Did he/she have cough?	1. Yes	2. No	99. NK	COU

(If the answer is 2 or 99 proceed to Q7.6.5)

7.6.2 How many days did he/she have cough?			88.NA	99. NK	DCO
7.6.3 Was the cough productive (sputum)?	1. Yes	2. No	88. NA	99. NK	PCO
7.6.4 Did he/she cough blood?	1. Yes	2. No	88. NA	99. NK	BCO

7.6.5 Did he/she have night sweats?	1. Yes	2. No	99. NK	NCOU

7.6.6 When was the cough worse?	1.Day	2.Night	3. Same	99. NK	COUW

7.6.7 Did he/she have shortness of breathing?	1. Yes	2. No	99. NK	DIB

If the answer is 2 or 99 proceed to Q7.7

7.6.8 How many days did he/she have breathlessness?		88.NA	99.NK	DDB
7.6.9 Did he/she have noisy breathing?	1. Yes	2. No	99. NK	CHP

7.7 Chest Pain:

7.7.1 Did he/she have chest pain? *(If the answer is 2 or 99 proceed to Q7.8)*	1. Yes	2. No	99. NK	CHP

7.7.1.1 How did the pain start?	1. Suddenly	2. Gradually	99. NK	HCHP

7.7.2 Where was the pain? *(Please show where the sternum is located)*	Over the sternum	1. Yes	2. No	99. NK	PSTER
	Over the heart/in the arm	1. Yes	2. No	99. NK	PHEAR
	Ribs	1. Yes	2. No	99. NK	PRIBS
	Other (specify).....……	1. Yes	2. No	99. NK	POTHE

7.7.3 When resting, was the pain:	1. Continuous	2. On & Off	88. NA	99. NK	RPAIN

7.7.4 When in activity, was the pain:	1. Continuous	2. On & Off	88. NA	99. NK	APAIN

7.7.5 When he/she had an attack of severe pain, how long did it last?

1. <30min	2. >30min but <24hours	3. >=24 hours	88. NA	99. NK	DCP

7.7.6 Did he/she have palpitation?

1. Yes	2. No	99. NK	PALP

7.8 Diarrhoea:

7.8.1 Did he/she have diarrhoea?
If the answer is 2 or 99 proceed to Q7.9

1. Yes	2. No	99. NK	DIAR

7.8.2 How many days did he/she have diarrhoea?

	88.NA	99.NK	DDI

7.8.3 Was the diarrhoea continuous?

1. Yes	2. No	88. NA	99. NK	TDI

7.8.4 What was the consistency of stools?

2. Soft	3.Watery	99. NK	CSDIA

7.8.5 When the diarrhoea was severe, how many times did he/she pass stool in a day?

	88.NA	99. NK	FDI

7.8.6 Did he/she pass blood in the stool?

1. Yes	2. No	88. NA	99. NK	BTS

7.8.7 Did he/she have sunken eyes?

1. Yes	2. No	99. NK	SUNK

7.9 Vomiting:

7.9.1 Did he/she have vomiting?

1. Yes	2. No	99. NK	VOM

If the answer is 2 or 99 proceed to Q7.10

7.9.2 How many days did he/she have vomiting?

	88. NA	99. NK	DVO

7.9.3 When the vomiting was severe, how many times did he/she vomit in a day?

	88. NA	99. NK	FVO

7.9.4 What did the vomit look like?

1. Watery fluid	2. Yellowish fluid	3. Coffee coloured fluid	4. Blood	CVO
5. Faecal matters	6. Other (specify)…….....	88. NA	99. NK	

7.10 Abdominal pain:

7.10.1 Did he/she have abdominal pain?	1. Yes	2. No	99. NK	ABP

(If the answer is 2 or 99 proceed to Q7.10.6

7.10.2 What type of pain was it?

1. Cramp	2. Dull ache	3. Burning pain	4. Others	8. NA	99. NK	CAP

7.10.3 How many days did he/she have the pain		88.NA	99.NK	DAP

7.10.4 Where exactly was the pain?

1. Lower abdomen	2. Upper abdomen	3. All over the abdomen		SAP
4. Middle abdomen	5. Others (specify):……	88.NA	99. NK	

7.10.5 What was the severity of the pain?

1. Mild/moderate	2. Severe	88. NA	99. NK	TAP

7.11 Abdominal Distension:

7.11.1 Did he/she have distension of abdomen?	1. Yes	2. No	99. NK	ABD

If the answer is 2 or 99 proceed to Q7.12

7.11.2 How many days did he/she have abdominal distension?		88.NA	99.NK	DAD

7.11.3 Did the distension develop rapidly within days or slowly over weeks?

1. Rapid	2. Slow	88. NA	99. NK	TAD

7.12 Swallowing:

7.12.1 Did he/she have difficulty/pain on swallowing?	1. Yes	2. No	99. NK	DSW

If the answer is 2 or 99 proceed to Q7.13

7.12.2 How many days did he/she have difficulty/pain on swallowing?		88. NA	99.NK	DDS

7.13 Mass:

7.13.1 Did he/she have any mass in the abdomen?	1. Yes	2. No	99. NK	ABM

If the answer is 2 or 99 proceed to Q7.14

7.13.2 Where exactly was the mass?

Right upper abdomen			
Left upper abdomen			
Lower abdomen			
Other: (specify)			

7.13.3 How long (days) did he/she have the mass *(convert if months or years)*		88.NA	99.NK	DAM

7.14 Headache:

7.14.1 Did he/she have headache?	1. Yes	2. No	99. NK	HEA

7.15 Stiff Neck:

7.15.1 Did he/she have neck pain?	1. Yes	2. No	99. NK	STN
7.15.2 Did he/she have stiff neck?	1. Yes	2. No	99. NK	STN
7.15.3 *If yes*, for how many days?		88.NA	99.NK	DSN

7.16 Level of Consciousness/CNS:

7.15.1 Did he/she experience any change in the level of consciousness?	1. Yes	2. No	99. NK	STN

If 2 or 99 please skip to question 7.17

7.16.2 What was the level of his/her consciousness?

1. Confused	2. Unconscious	3. Other	88. NA	99. NK	TUC

7.16.3 If confused or unconscious, for how many days?		88.NA	99.NK	DUC

7.16.4 How did it start?

1. Suddenly	2. Rapidly within a day	3. Slowly over few days		FFI1
4. Others (specify):……		88. NA	99. NK	

7.17 Fits:

7.17.1 Did he/she have fits?	1. Yes	2. No	99. NK	FIT

If the answer is 2 or 99 proceed to Q7.18

7.17.2 How many days did he/she have fits		88.NA	99.NK	DFI
7.17.3 When fits were most frequent, how many did he/she have per day?		88. NA	88. NA	FFIN

7.17.4 Between fits was she	1. Awake	2. Unconscious	88. NA	99. NK	BFA

7.17.5Did he/she have difficulty in opening the mouth during fits?	1. Able to open	2. Unable to open	99. NK	LOC

7.17.6 Did he/she have stiffness of the whole body during fits?	1. Yes	2. No	99. NK	OPI

If the answer is 2 or 99 proceed to Q7.18

7.17.7 How many days did he/she have stiffness?		88.NA	99.NK	DSTIF

7.18 Paralysis:

7.18.1 Did he/she have paralysis of one side of the body?	1. Yes	2. No	99. NK	HEM

** If the answer is 2 or 99, refer to the Q. No 7.19*

7.18.2 How long did the paralysis take to develop?	1. Instantly	2. Over hours	3. Over days	HQUI
	4. Over months	5. Over years	99. NK	

7.18.3 How many days did he/she have paralysis?		88.NA	99.NK	DHE
7.19 Did he/she have paralysis of lower limbs?	1. Yes	2. No	99. NK	PAR
7.19.1 How many days did he/she have the paralysis?		88.NA	99.NK	DPA

7.20 Urine Colour:

7.20.1 Was there any change in the colour of urine?	1. Yes	2. No	99. NK		BIU
7.20.2 What was the colour of urine?	1. Dark yellow	2. Coffee like	3. Blood stained	88. NA	99. NK URC
7.20.3 How many days did he/she have the change in urine?		88.NA	99.NK		DBU

7.21 Urine Amount:

7.21.1 Was there any change in the amount of urine he/she passed daily?	1. Yes	2. No	99. NK		CQU
7.21.2 How much urine did he/she pass in a day?	1. Too much	2. Too little	3. No urine at all	88. NA	99. NK AQU
7.21.3 How many days did he/she have the change in amount of urine?		88 NA	99. NK		DQU
7.22 Did he/she have difficulty or pain in passing urine?	1. Yes	2. No	99. NK		DPU

7.22.1 What type of difficulty did he/she has?

1. Unable to pass urine	2. Continuous dribbling of urine		
3. Burning sensation while passing urine	4.Intense pain		TDP
5. Other (specify)	88. NA	99. NK	

8.1 Surgery/Operation:

8.1.1 Did he/she have any operation before death?	1. Yes	2. No	99. NK	HOP
8.1.2 How many days before death did he/she have the operation?		88. NA	99.NK	OPD

8.1.3 If yes ask for the site of operation	1. Abdomen	2. Heart	3.Head	4. Other	88. NA	99. NK	SSITE

9.0: Treatment and Records

9.1 Treatment

9.1.1 Did he/she receive any drug during the illness?	1. Yes	2.No	99. NK	TREAT
9.1.2 Did he/she receive any antibiotics during the illness?	1. Yes	2.No	99. NK	ANTIB
9.1.3. Did he/she receive any anti-tetanus vaccine during the illness?	1. Yes	2.No	99. NK	ANTIM

9.2 Health records

Source	Summary of details
Death Certificate	Cause of death:
MCH Card	
Hospital prescription forms	
Prescriptions	
Hospital discharge forms	Diagnosis:
Other hospital documents	
Laboratory/cytology results	
None	Tick here if there are no treatment records

10. Interviewer's comments and observations

_____

_____

_____

Certify correct on: | | | | | | | **By:** | | | **CCB**

1. ***Final Assessment of Cause/S of Death by Reviewers:***

_____

_____

_____

ICD-10 Code of COD:

Signature of First Reviewer: _____

Name of First Reviewer: _____Date: _____

Signature of Second Reviewer: _____

Name of Second Reviewer: _____Date: _____