

**SCHOOL OF PUBLIC HEALTH
COLLEGE OF HEALTH SCIENCES**

UNIVERSITY OF GHANA

**BARRIERS TO GLYCAEMIC CONTROL AMONG DIABETES
PATIENTS AT THE KORLE-BU TEACHING HOSPITAL**



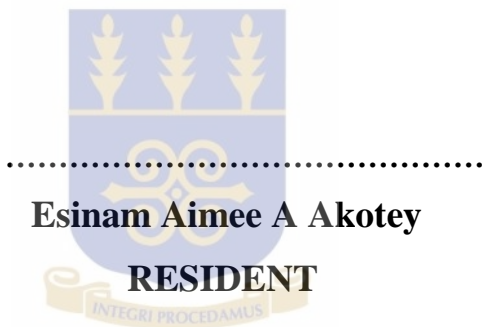
**THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY
OF GHANA IN PARTIAL FULFILMENT OF THE
REQUIREMENT FOR THE AWARD OF MASTER OF PUBLIC
HEALTH DEGREE**

JULY, 2012

DECLARATION

I, ESINAM AIMEE AKU AKOTEY hereby declare that apart from references to other people's works which have been duly cited, this dissertation is a result of my independent field research.

I further declare that this dissertation has not been submitted for the award of any degree in this institution or in another university.

AUTHOR**ACADEMIC SUPERVISOR**

.....
Dr. Pricillia Nortey
SUPERVISOR

DEDICATION

I dedicate this work to my lovely husband Lt Cdr DY Akotey for his support and encouragement throughout these years. I also dedicate this work to my children, my mother and my father for being there for me when I needed them. Thank you all and may the Almighty God bless you.

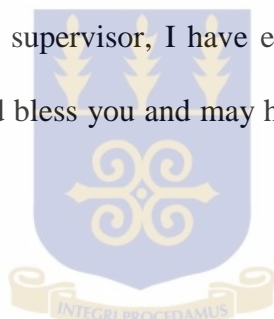


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LIST OF ABBREVIATIONS

ADA	American Diabetes Association
BGM	Blood Glucose Monitoring
BMI	Body Mass Index
DM	Diabetes Mellitus
ESRD	End-Stage Renal Disease
FBS	Fasting Blood Sugar
FPG	Fasting Plasma Glucose
GTT	Glucose Tolerance Test C
HbA _{1C}	Glycosylated Haemoglobin
IDF	International Diabetes Federation
IGT	Impaired Glucose Tolerance
KBTH	Korle-Bu Teaching Hospital
NDMRC	National Diabetes Management and Research Centre
NGT)	Normal Glucose Tolerance
RECAP-DM	Real-Life Effectiveness and Care Patterns of Diabetes Management
T2DM	Type 2 Diabetes Mellitus
WHO	World Health Organization

TERMINOLOGIES

Diabetes Mellitus is a group of metabolic diseases characterized by increase level of glucose in the blood (hyperglycemia) resulting from defect from insulin secretion, insulin action or both. (ADA 2009).

Glycosylated haemoglobin or glycaeted haemoglobin (HbA1C) is the typical levels of blood sugar (glucose) in a person with diabetes mellitus. It is a form of haemoglobin that is measured primarily to identify the average plasma glucose concentration over the previous 2–3 months in a single measure. It can be performed at any time of the day and does not require any special preparation such as fasting. The more glucose in the blood, the more haemoglobin A1C or HbA1C will be present in the blood.

Microalbuminuria occurs when the kidney leaks small amounts of albumin into the urine, this occurs when there is an abnormally high permeability for albumin in the renal glomerulus.

Proteinuria means the presence of an excess of serum protein in the urine.

Nephropathy is damage to the kidney.

End-stage renal disease (ESRD) is when the kidneys fail to filter waste products from the blood.

Fasting Plasma Glucose test/fasting blood sugar test is a carbohydrate metabolism test which measures plasma or blood glucose levels after a fast. Fasting (no food for at least 8 hours) stimulates the release of the hormone glucagon, which in turn raises plasma glucose levels.

ABSTRACT

Background: Diabetes is a condition whereby the body fails to regulate levels of glucose in the body, resulting in too much glucose being present in the body. Despite the strong consensus that good glycaemic control minimizes the risk of developing complications such as nephropathy, and cardiovascular diseases in Type 2 Diabetes Mellitus (T2DM), only few patients can obtain optimal glycaemic control.

Objective: This study was to explore factors associated with poor glycaemic control among diabetes patients at the Korle-Bu Teaching Hospital.

Design: A case control study of 230 diabetes patients consisting of 115 cases with HbA1c value ≥ 7 , and 115 controls with HbA1c value < 7 .

Method: Data was collected by trained interviewers through questionnaire interviews of a total of 230 diabetes patients older than 20 years of age, and who had an HbA1c test within the previous three months.

Univariate and multivariate logistic regression analysis were carried out to identify socio demographic factors, and to find out if there was association between lifestyle factors, knowledge about diabetes and hypertension that were likely to influence glycaemic control.

Results: Poor glycaemic control was found to be significantly associated with persons aged > 40 years (OR: 3.99) and persons who were retired from active work but still working. Women were at a higher risk of having poor glycaemic control than men (OR: 3.57). People who had poor knowledge of their fasting plasma glucose (FPG) were found to have a higher risk of poor glycaemic control (OR: 5.71). There was a significant association of poor glycaemic control and increasing number of pills to swallow daily (OR: 2.86), and persons who did not adhered to

medication regimen and missed out on some medications. Furthermore, poor glycaemic control was found to be significantly associated with persons who defaulted in follow up review visits to the physician's office (OR: 2.56), and persons who visited the physician's office for treatment every three month (OR: 4.65 95% 0.07, 0.68) with *p*-value 0.008. Hypertension was found not to be statistically associated with poor glycaemic control.

Conclusion: There is evidence suggesting that some socio demographic factors such as age and sex, knowledge about fasting plasma glucose, and lifestyle factors such as non adherence to medication regimen and follow up visit to the hospital/physicians' office were significantly associated with poor glycaemic control. Therefore a good control is essential for the future well being of all diabetes patients. Addressing these issues may help to decrease the disparities that currently exist in diabetes management.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Diabetes mellitus is a condition in which the amount of glucose (sugar) in the blood is too high because the body cannot use it properly. There are two main types of diabetes.

Type 1 diabetes develops if the body cannot produce any insulin (a hormone which helps the glucose to enter the cells where it is used as fuel by the body). Type 1 diabetes usually appears before the age of 40. It is the least common of the two main types and accounts for around 10 per cent of all people with diabetes.

Type 2 diabetes mellitus (T2DM) develops when the body can still make some insulin, but not enough, or when the insulin that is produced does not work properly. In most cases this is linked with being overweight. This type of diabetes usually appears in people over the age of 40, though in South Asian and African-Caribbean people, it often appears after the age of 25. Type 2 diabetes mellitus (T2DM) is the more common of the two main types and accounts for 85-95% of all cases of diabetes mellitus in industrialized Countries and in Low and Middle Income countries. It therefore contributes the bulk of the burden of disease. This is the type of DM that will be the focus of this study.

Other specific types of diabetes include those due to genetic disorders, infections, diseases of the exocrine pancreas, endocrinopathies, and drugs.

Globally, diabetes is the fifth most common cause of death in the world (Roglic et al., 2005), and it is associated with reduced life expectancy, significant morbidity and quality of life. Increasing number of people with type 2 diabetes is a world-wide concern. Type 2 diabetes is responsible for over 90% of the global burden of diabetes (Whiting et al., 2011). The world's prevalence of diabetes among adults (aged 20-79) was estimated to be 6.4%, affecting 285 million people in 2010 and is expected to increase to 7.7%, affecting 438 million people by 2030 (Shaw et al., 2010). The major part of the increase in the prevalence in DM according to the 2010 WHO report will occur in the developing countries.

In Africa, the prevalence of diabetes has increased significantly. The International Diabetes Federation (IDF) atlas 2006 reported an overall prevalence of diabetes at 3.1%, affecting a total population of 10.4 million people; this is a huge number despite it is of a lower prevalence than Europe 8.4%, and North America 9.2%.

In Ghana, diabetes prevalence studies in southern Ghana have recorded a trend of steady increase. Early studies in the 1960s recorded 0.2% prevalence in a population of men in Ho, a town in the Volta Region (Dodu et al., 1964). Diabetes screening conducted by the Ghana Diabetes Association in the early 1990s suggested 2-3% prevalence in urban areas in southern Ghana. In the late 1990s a prevalence rate of 6.4% for diabetes was recorded in a community in Accra (Amoah et al., 2002).

At the Korle-Bu hospital (KBTH), the percentage of medical admissions due to diabetes increased almost two-fold from 3.5 in the mid-1970s to 6.4% in the mid-1980s (Adubofuor et al., 1997). Diabetes continued to be the leading cause of admission in Korle Bu Teaching Hospital according to 2007, 2008, 2009 and 2010 annual reports. In 2010, diabetes mellitus constituted 7.9% (3,650) of the total number of medical admissions.

Glycosylated or glycaeted haemoglobin (HbA1C) which is the typical levels of blood sugar (glucose) in a person with diabetes mellitus is used as an indicator of average blood glucose concentration over the preceding 2 to 3 months. Because blood sugar levels fluctuate throughout the day and glucose records are imperfect indicators of these changes, the percentage of haemoglobin which is HbA1C is considered the best index of glycaemic control for diabetic patients in clinical settings. It is used both as an index of mean glycaemia and as a measure of risk for the development complications in diabetes.

Good glycaemic control has become an important goal of diabetes care, although a recent research suggested that the complications of type 2 diabetes may be caused by genetic factors (Tarnow et al., 2008). Poor glycaemic control is also significantly associated with the development of long term complications such as macrovascular complications of diabetes mellitus which result from many years of hyperglycaemia (Titty et al., 2010).

1.2 Problem Statement

Patients with diabetes have intensive treatment regimen designed to achieve blood glucose values as close to the non-diabetic range as possible, because good glycaemic control significantly reduces the risk of long term negative consequences of the disease. The essential

components of such treatment are education, monitoring, and pharmacological treatment with insulin or oral anti-diabetic agents, to achieve specific glycaemic goals.

Despite the strong consensus that good glycaemic control minimizes the risk of developing complications such as nephropathy, and cardiovascular diseases in T2DM, few patients can obtain optimal glycaemic control. Results from the Cost of Diabetes in Europe-Type 2 (CODE-2) study, which collected data within eight European countries, showed that only 31% of patients with T2DM had glycosylated haemoglobin A_{1C} (HbA_{1C}) < 6.5% (an optimal HbA_{1c} Value). Similarly, findings from a study conducted by the Real-Life Effectiveness and Care Patterns of Diabetes Management (RECAP-DM) in seven European countries showed that only 25.5% of a cohort of 2,023 T2DM patients who added a sulphonylurea or thiazolidinedione to their metformin monotherapy had adequate glycaemic control defined as HbA_{1C} < 6.5%. (Guisasola et al., 2008).

In their study, Guisasola et al. (2008) reported that although tools are currently available to facilitate more optimal glycaemic control and decrease the risk of long-term negative health consequences, many adolescents with diabetes do not achieve optimal glycaemic control. This literature documented decreased blood glucose monitoring frequency and deterioration in blood glucose control or haemoglobin A_{1c} (HbA_{1c}), with few adolescents achieving optimal HbA_{1c} values (< 7.5%).

In Ghana, a study by Titty et al. (2010) in Tamale Teaching Hospital reported the prevalence of good glycaemic control and poor glycaemic control to be 40% and 60% respectively among

recently diagnosed patients. Also, routine data at the National Diabetes Management and Research Centre laboratory reveals that in 2011, about 60% of diabetes patients whose HbA1c samples were analyzed could not achieve optimal values ($< 7.0\%$) as shown in appendix 1.

The above data implies that even though significant advances have been made in diagnosis and management of diabetes in recent years, persistence of inadequate metabolic control still remains and many patients do not achieve optimal glycaemic control but continue to experience complications that result in decreased length as well as quality of life.

Poor glycaemic control may be caused by both the failure of diabetes self-management by patients as well as inadequate intervention strategies by clinicians. As previous studies reported, many factors such as age, knowledge of diabetes, lifestyle and dietary habits, may affect glycaemic control. Hypertension also has a high prevalence in diabetic patients and may occur in as many as 50% of patients with non-insulin-dependent diabetes mellitus. However, much is not known about the factors that influence glycaemic control among Ghanaian diabetic patients.

1.3 Justification

The purpose of this study was to explore factors that are responsible for poor diabetes management outcomes among patients at the Korle-Bu Teaching Hospital in Accra. This will help improve the care given to diabetics in hospitals.

1.4 Main Objective

To explore factors associated with poor glycaemic control among diabetes patients at the Korle-Bu Teaching Hospital.

1.5 Specific Objectives

- i. To determine socio-demographic factors associated with glycaemic control of diabetes.
- ii. To determine the association between patients' knowledge about diabetes and glycaemic control.
- iii. To assess lifestyle factors associated with glycaemic control.
- iv. To assess the association between hypertension and glycaemic control.

CHAPTER TWO

2.0 LITERATURE REVIEW

Literature review suggests that diabetes mellitus has attained epidemic levels in both developed and developing countries, (Shaw et al., 2010). Mortality data for 2007 estimated that diabetes is responsible for 8.2% of all-cause mortality globally among people aged 20-79 years. Thus, an estimated 4 million deaths in 2010 in adults aged 20-79 years is attributed to diabetes.

In 2011, the International Diabetes Federation (IDF) estimates indicated that 8.3% of all persons aged 20-79 years have diabetes mellitus worldwide. The IDF reported, that there are 366 million persons affected globally and if the current trends continue, 552 million adults will be living with diabetes by the year 2030 (Whiting et al., 2011).

The prevalence of diabetes in people aged 20-79 has increased over the past decade. In the United States of America diabetes is diagnosed in around 5% of adults aged 20 years or over. The prevalence has doubled over the last 30 years and 34% of adults in the United States have IGT (Karve et al., 2010). The prevalence is similar in men and women, but diabetes is more common in many ethnic groups. A further 2.7% have undiagnosed diabetes on the basis of fasting glucose.

In the Arab region, the overall prevalence of DM in the Kingdom of Saudi Arabia is 23.7% among people with age between 30 and 70 years (Al-Nozha et al., 2004). The prevalence of diabetes in the United Arab Emirates, Bahrain, and Kuwait were 20.1%, 14.9% and 12.8%, respectively (International Diabetes Foundation, 2003).

Prevalence of inadequate glycaemic control among patients with type 2 diabetes mellitus (T2DM) also remains high. Literature documents that rapid socio-economic development and the consequent improvements of living standards and changes in lifestyle, as well as the negative tendency to nutrition and decrease in physical activity, have led to a dramatic increase in the prevalence of type 2 diabetes mellitus.

2.1 Socio-Demographic Factors and Glycaemic Control

Socio-demographic factors such as age, sex, ethnicity, education level, marital status, employment/retirement status and Health Insurance have been documented in Literature to be associated with the control of glycosylated haemoglobin.

Age and Sex

A longitudinal analysis of Framingham Offspring Study non diabetic subjects observed an increase in glycosylated haemoglobin A1C with aging (Pani et al., 2008). In Ghana, Amoah et al. (2002) also reported that worsening glycaemic status tended to be associated with increase in age. However, a multivariate analysis controlling for all other socio demographic, clinical and economic covariates demonstrated that adults aged ≥ 65 years were less likely to have poor glycaemic control than young and middle aged adults (Ali et al., 2012). Good glycaemic control was significantly associated with older age (Rogvi et al., 2012).

Concerning sex, Wilf-Miron et al. (2010) reported that the percentage of patients demonstrating poor glycaemic control was higher for males than females. However, Shani et al. (2008) reported that men were more likely than women to achieve well control diabetes.

Marital Status and Education

Marital status was also associated with poor glycaemic control; unmarried persons were more likely than married persons to have poor glycaemic control (Ali et al., 2012).

In addition, poor glycaemic control was common among those without a usual source of medical care compared with those who accessed clinics or doctors' offices (Ali et al., 2012).

Concerning level of education attained and glycaemic control, no significant or consistent patterns of association was found (Ali et al., 2012).

2.2 Knowledge of Diabetes and Glycaemic Control

A study by De-Graft et al. (2010) suggests that patient knowledge of major chronic diseases is poor. Late presentations at medical facilities and poor self-care have been attributed to poor medical knowledge.

Approximately 50% to 80% of people diagnosed as having diabetes lack significant knowledge and skills to manage the condition effectively (Clement S.1995). Patients' knowledge of the disease is therefore an important factor that must be explored in determining HbA1c control in diabetes. In addition to drug therapy, patient education may facilitate better glycaemic control.

A continuing interactive educational model was established for elderly patients with diabetes mellitus by (Rosario et al., 1996). Comparison between pre and post-programme demonstrated a

significant increase ($P < 0.001$) of knowledge and skills to deal with treatment requirements, and an improvement in HbA1c levels of the participants ($P < 0.02$).

Coates et al., (1995) found in young adults with diabetes that high levels of knowledge and glycosylated haemoglobin values were related when length of time with diabetes was considered. However, they did not demonstrate any relationship between knowledge and level of glycaemic control. Ozcelik et al. (2010) also concluded in their study that, in type 2 diabetic patients, the higher the knowledge and awareness the more efficient glycaemic control can be achieved.

2.3 Lifestyle Factors

Lifestyle behaviors are postulated to play a role in glycaemic control, and their effects on glycaemic control have been given increasing attention in the past decade. However, most studies in this area have focused only on the effects of diabetes-specific self-management behaviors on glycaemic control. Other studies that have demonstrated the effects of general health behaviors on haemoglobin A1c (HbA1c) levels have focused on a single lifestyle behavior, such as exercise or weight control, and adherence to prescribed medication, diet and appointment schedule and their effect on glycaemic control. Lifestyle interventions according to (Knowler et al., 2002) reduce the incidence of diabetes in persons at high risk by 58%. They concluded that lifestyle intervention was more effective than metformin. Also, in an extended follow-up of the Finnish Diabetes Prevention study, Lindstrom et al., (2004) reported that Lifestyle interventions can prevent the deterioration of impaired glucose tolerance to manifest type 2 diabetes, at least as long as the intervention continues.

Diet and Exercise

In the dietary approaches to improve glycaemic control and insulin sensitivity, weight loss and exercise have been recommended (Konzem et al., 2002). Also, the results of an analysis done by Boulé et al., (2001) showed a 0.66% reduction in glycosylated haemoglobin (HbA_{1c}) in the exercise group. They concluded that exercise improves glycaemic control in patients with diabetes.

Lindstrom et al. (2004), revealed in the extended follow-up to a Finnish Diabetes Prevention Study (in which they assessed the extent to which the originally-achieved lifestyle changes and risk reduction remain after discontinuation of active counseling), that the risk reduction was related to the success in achieving the intervention goals of weight loss, reduced intake of total saturated fat, increased intake of dietary fibre, and increased physical activity.

Adherence to Medication Regimen and Appointment Keeping

The prevalence of medication non adherence is high among patients with chronic condition like diabetes. Grant et al. (2004) showed that Clinical inertia is a critical barrier to glycaemic control in T2DM. They assessed the relationship between patients' initial medication adherence and subsequent regimen intensification among patients with persistently elevated A1C levels. Their finding was that level of medication adherence predicted subsequent medication intensification. Poor patient self-management behavior increases therapeutic clinical inertia.

Adherence to oral diabetes medications (ODMs) in patients with T2DM and the impact of ODM adherence on glycaemic control was again evaluated by Rozenfeld et al. (2008) through a

retrospective observational study. They concluded that adherent patients were more likely to achieve glycaemic control than non adherent patients.

Assessing the influence of appointment keeping and adherence to medication regimen on HbA1c, Rhee et al. (2002) performed an evaluation in 1,560 patients with T2DM. Results revealed that Keeping more appointments and taking diabetes medications as directed were associated with substantial improvements in HbA1c.

Alcohol and Smoking

Alcohol consumption is a common behavior. However, little is known about the relationship between alcohol and glycaemic control among people with diabetes. Ahmed et al. (2008) had a survey follow up study among Kaiser Permanente Northern California members to evaluate the association between alcohol consumption and glycaemic control. They reported that alcohol has an inverse relationship with glycaemic control among diabetes patients. This report supports the current clinical guidelines which prescribes moderate levels of alcohol consumption among diabetes patients. It was therefore concluded that as glycaemic control affects incidence of complications of diabetes, the lower HbA1c levels associated with moderate alcohol consumption may translate to lower risk for complications. Similarly, Ahmed et al. (2008) found that alcohol consumption was associated with lower HbA1c. They compared lifetime abstainers to consumers of 2-2.9 drinks a day and concluded that HbA1c reduced by early 0.5 which is similar to lowering of HbA1c obtained with the initiation of intensive metformin therapy.

With regard to smoking, Chaturvedi et al. (1995) examined the relationship between smoking and both glycaemic control and microvascular complications. They concluded that smoking is associated with poorer glycaemic control and an increased prevalence of microvascular complications compared with non smokers. Ex-smokers they reported can achieve glycaemic control equivalent to, and a prevalence of early complications similar to that of those who never smoked. They suggested that poorer glycaemic control can account for some of the increased risk of complications in smokers, and that quitting smoking would be effective in reducing the incidence of complications. However, Lino et al. (2004) reported glycaemic control and diastolic pressure deteriorated in type 2 diabetes patients after quitting smoking. This is contrary to previous findings.

2.4 Diabetes and Hypertension

There are many diseases that affect the management of diabetes. In this study hypertension was assessed to determine its association with glycaemic control. Hypertension has a high prevalence in diabetic patients. It is as twice as common in persons with diabetes as it is in others, and may occur in as many as 50% of patients with non–insulin-dependent diabetes mellitus (Konzem et al., 2002). Hypertension contributes to the risk of renal disease in patients with diabetes.

In general, only 25 percent of patients with hypertension have adequate control of their blood pressure. Blood pressure goals are lower, and thus more difficult to achieve in patients who also have diabetes. Elevated blood pressure is known to contribute to diabetic microvascular and macrovascular (Konzem et al., 2002).

With regard to glycaemic control being associated with hypertension, a cohort study by Iribarren et al. (2001) examined the association between glycosylated haemoglobin (HbA1c) and the risk of heart failure hospitalization and/or death in a population-based sample of adult patients with diabetes and assessed whether this association differed by patient sex, heart failure pathogenesis, and hypertension status complications. The results confirmed previous evidence that poor glycaemic control may be associated with an increased risk of heart failure among adult patients with diabetes.

Also, Basit et al. (2005) in their study concluded that there was an association of chronic complications with glycaemic control and hypertension among type 2 diabetics in Karachi, Pakistan. Again, Huang et al. (2010) documented low proportions of persons with diabetes achieving targeted levels of diabetic control, with only 1 in 4 achieving optimal glycaemic controls and 1 in 8 achieving optimal BP control. They further demonstrated that factors associated with suboptimal glycaemic control ($\text{HbA1c} \geq 7$) included younger age, higher total cholesterol levels, a lack of knowledge of diabetes diagnosis, and taking oral hypoglycaemic agents.

A study by Herman et al. (2007) sought to examine racial and ethnic differences in HbA1C in individuals with Impaired Glucose Tolerance (IGT), and found that HbA1C levels were higher among American racial and ethnic minority groups with IGT after adjustment for factors likely to affect glycaemia. They however concluded that among patients with IGT, A1C may not be valid for assessing and comparing glycaemic control across racial and ethnic groups or as an indicator of health care disparities.

CHAPTER THREE

3.0 METHOD

3.1 Study Design

The study design was a case control

Case definition

A case was a diabetes patient of 21 years and above, receiving monotherapy or combination therapy of antidiabetic drugs and or insulin for at least 6 months, has performed an HbA1c test within the previous three months and has demonstrated an HbA1c value ($\geq 7.0\%$).

Inclusion criteria:

- i. Male or female with T2DM
- ii. Patient Aged ≥ 21 years
- iii. Patient undergoing treatment with oral antidiabetic drugs and or insulin, to achieve specific glycaemic goals;
- iv. Patient having clinical records available in the hospital for more than six months.

Exclusion criteria:

- i. Pregnant and lactating women
- ii. Patient Aged < 21 years
- iii. Patient on admission
- iv. Male or female with type 1 diabetes

Definition of control:

A control was a diabetes patient of 21 years and above, receiving monotherapy or combination therapy of anti diabetes drugs and or insulin for at least 6 months, has performed an HbA1c test within the previous three months and has achieved HbA1c value ($<7.0\%$).

3.2 Study Area

The study was carried out at the National Diabetes Management and Research Centre (NDMRC) of the Korle-Bu Teaching Hospital (KBTH). KBTH is the third largest hospital in Africa. It is located in the Ablekuma South sub-metropolitan area in Accra, capital town of Ghana. Currently, KBTH has a bed capacity of 2000 beds and is the leading national referral centre in Ghana. It has 17 clinical and diagnostic departments/units. It has an average daily attendance of about 1,500 patients and about 250 admissions. KBTH is also an accredited hospital of the National Health Insurance Scheme of Ghana and this enables patients, irrespective of their socio-economic status to access care in most of the clinical and diagnostic departments. KBTH serves clients from all sub metros in the Greater Accra region, other regions in Ghana, and sometimes clients from other countries in the sub-region of West Africa. The patient population is therefore very diverse and fairly representative of the Ghanaian population.

KBTH is one of the few hospitals in Africa where there is a National Diabetes Management and Research Centre (NDMRC) with a laboratory that is well equipped to meet the daily requirements of every diabetes patient who visits the hospital or centre. From routine hospital data, 21,633 patients visited the NDMRC between January and December 2011(Appendix 1). This means an average of 92 patients attended the centre daily for diagnosis and management of

diabetes. The centre has a team of highly qualified medical doctors and nurses, a dietician, and laboratory technicians well trained in diabetes management.

3.3 Study Variables

3.3.1 Independent Variables

The effect of certain factors which may influence glycaemic control was explored in this study.

Socio Demographic Factors:

- Age
- Sex
- Marital status
- Education
- Religion
- Employment/retirement status

Knowledge about Diabetes and Glycaemic control Factors

- Family history of diabetes
- Knowledge about diabetes
- Knowledge about fasting blood sugar, and
- Knowledge about glycosylated haemoglobin
- Duration of diabetes

Lifestyle Factors:

- Visit to dietician
- Adherence to dietary recommendation
- Adherence to medication regimen

- Number of visits to the hospital
- Default in follow up review
- Large number of pills to ingest
- Miss out on some of the medication
- Reaction to medication
- Ability to buy medication
- Physical exercise
- Smoking
- Alcohol

Hypertention factors

- History of hypertension

Dependent Variable:

Outcome of glycaemic control which can be one of the following:

- Optimal/good glycaemic control which is achieving HbA1c value ($< 7.0\%$) or,
- Poor glycaemic control which is achieving HbA1c value ($\geq 7.0\%$).

3.4 Sample Size

Using STATA Version 11

Prevalence of diabetes patients who could achieve an optimal HbA1c value ($< 7.0\%$) From routine hospital data =40 %.(Appendix 2).

Estimated OR =0.2

Power =83%

Alpha =5%

P1 =0.4

P2 =0.6

Ho: $p_1 = p_2$ where p_1 is the proportion in population 1 (controls) and p_2 is the proportion in population 2 (cases).

A sample size of 230 gives a power of 83% to detect an odds ratio of 0.2 at 5 percent level of significance for 1:1 ratio for case control. Cases=115 and controls =115.

3.5 Sampling Method

HbA1c which reflected the average glucose over the preceding 2–3 months from patients' clinical records was used to select eligible cases and control and to ascertain the clinicians' management strategies and the outcome of the management for the study. Patients with HbA1c values ($\geq 7.0\%$) were classified as cases and patients with HbA1C value ($< 7.0\%$) were classified as the control group using the above inclusion and exclusion criteria.

The first cases were selected using simple random sampling and the rest were selected by systematic sampling with a sampling interval of one. For each case, a control was recruited. The controls were also selected at the National Diabetes Management and Research Centre using patients' HbA1c values from their clinical records. Also, Information was collected on various socio demographic variables, knowledge about diabetes variables, lifestyle variables and hypertension variables.

3.6 Data Collection

Standardized questionnaire was designed and used to collect information on demographic and clinical characteristics such as age, sex, marital status, occupation, retirement status, duration of diabetes, family history of diabetes, and compliance to diet recommendation. Also, information was collected on compliance to medication and appointment regimen, smoking and alcohol history, and history of hypertension. Most of the questions were closed ended.

Every morning, the study was introduced by the researcher/assistants to all patients who had already taken their blood sample for Fasting Blood Sugar (FBS) and waiting for their results to see the doctors. Patients were allowed to ask questions about the study and explanation was given to every question asked. Eligible patients were selected, taken to a consulting room and made comfortable. Each case and control was given an 'Inform Consent Form' to read and sign. The consent form was read to those who could not read and they were given an ink pad to thumbprint it. Each participant was interviewed by either the researcher or assistants who explained the contents of the questionnaire in the native language (for illiterate participants) or English (for literate participants).

This method of questionnaire administration enabled us to eliminate biases involved in self-administered questionnaires where participants will not understand some of the questions. This method of interview also eliminated incomplete filling-in of the questionnaires by participants.

3.7 Ethical Consideration

Ethical clearance was sought from the Ghana Health Service Ethical Review Board. Consent was also sought from the appropriate authorities of the Korle-bu Teaching Hospital (KBTH). Participation of subjects conformed to the required ethical guidelines regarding the use of human subjects. A written Informed Consent for participants who were literates were obtained and witnessed verbal informed consent for the illiterates were obtained from each study participant. Participants had the right to refuse to answer questions that they were not comfortable with. They also had the right to withdraw from the study at any time they did not feel comfortable to continue. However, they were assured of confidentiality with regard to all information they provide and were encouraged to fully participate. All responses obtained have been kept private and confidential, and they would be destroyed after use.

3.8 Training of Interviewers

Two day training was organized for four research assistants who could speak some of our local languages to administer the questionnaire to participants at the KBTH. The training included interpretation of questions, how to administer the questionnaire, and pre-testing of the questionnaire. This was to ensure, that the interviewers understood the questions, and gave the same interpretation to the questions. It was also to learn how to administer the questionnaire and how to examine them for inconsistencies and completeness. The objectives of the study and the study design were explained to them. They were given instructions on basic interviewing techniques and how to record responses.

3.9 Pre-Test and Review of Instruments/Tools

A questionnaire was developed to obtain the following information: socio-demographic factors of the participants; association between participants' knowledge about diabetes and glycaemic control. Information was also obtained on the lifestyle factors associated with glycaemic control and the association between hypertension and glycaemic control. The questions were both open-ended and close-ended.

The questionnaire was pre-tested at the Korle-bu polyclinic. Each research assistant was given two questionnaires for cases and two questionnaires for controls.

This was done to:

- Test respondents understanding of the questionnaire.
- Evaluate the acceptability of the questionnaire.
- Determine the willingness of respondents to answer the questions and collaborate with the study.
- Find out if the questionnaire is measuring what it is supposed to measure.
- Evaluate the accuracy in the interpretation of the questions.
- Ascertain if the research assistants understood the questions.

Correction was made and the final questionnaire prepared.

3.10 Quality Control

The following measures were put in place to ensure quality and validity of the study and findings:

- Data collection personnel with the requisite background were recruited and well trained.

- There was regular monitoring by the researcher at the data collection site to review promptly questions that research assistants presented for consistency. The appropriate corrections were made promptly on any inconsistency in responses.
- Participants were given codes to ensure each one was interviewed only once.
- Five percent of the questionnaires were re-administered to verify the reliability of the results.
- All physicians at the centre were informed about the study and were requested to prescribe HbA1c for patients who had not done this test over the last 3 months.
- All data collected were entered two times by qualified personnel in STATA version 11, and finally.
- Only research team members had access to the original data.

3.11 Data Processing and Analysis

Analysis of data took place at the Korle-Bu Teaching Hospital and at the University of Ghana. All completed questionnaire were cross-checked by the principal researcher before they were entered into the STATA software. The entered questionnaire were ticked, numbered and put into labeled envelopes.

All statistical analyses were performed using with STATA version 11. The same statistical package was used to enter the data. Frequency distribution of variables was performed for all socio demographic characteristic of patients. Univariate analysis was done for all the variables. Those that were statistically significant were put into logistic regression model. Multivariate

analysis was done using logistic regression. Confidence interval of 95% was used to test for the significance level.

3.12 Limitations of the Study

Limitation of this study included the case control designs, which recalls bias. There was information bias in this as some of the respondents found it difficult to recall some information.

Another limitation of this study was getting the controls within the time limit of the study. The six weeks for this study proved difficult to get the number of controls and gather information to do the analysis.

HbA1c was used to classify participants into case and control. This could bring biases into the classification because a case can become a control once there is an improvement in the HbA1c value.

CHAPTER FOUR

4.0 RESULTS

This chapter presents the findings and the results of the study. During this study, 115 cases and 115 controls were recruited. The study was an unmatched case control study. Age and sex were identified as some of the demographic variables to be studied and considered as risk factors for poor glycaemic control, and therefore were also explored. The results of analysis of individual variables and the results of the multiple analyses are presented in this chapter.

4.1 Demographic Characteristics:

A total of 230 diabetes patients older than 20 years of age, and who had an HbA1c test within the previous 3 months participated in the study. Of these, 115 cases had a well-controlled glycosylated haemoglobin (HbA1c) and 115 controls had a poorly controlled glycosylated haemoglobin (HbA1c).

Table 4.1 shows the baseline socio demographic characteristics of patients with type 2 diabetes. The total sample size for the study was 230 respondents, made up of 124(53.9%) females and 106 (46.1) males. Although there were more females than males in the total sample size, there were more males 64 (55.7%) in the cases group than in the control group 42 (36.52%). The mean age of the respondents was 55.25 years with a standard deviation of 12.8 and ranged from 21 to 86 years. The modal age for the case group fell within 41-60 years group which formed 78 (67.8%). Likewise, the modal age group for the control group (HbA1c <7) was aged >60 years which formed 52 (45.2%) of the total controls.

The respondents had varied level of education ranging from primary to tertiary with (10.9%) not having formal education. The proportion of cases who had never attended school was (9.6%) compared with (12.2%) in the control group. They were from varied ethnic backgrounds with more than two-third being Christians as illustrated in the Table 4.1.

Table 4.1 Socio-Demographic Characteristics of Participants in the Barriers to Glycaemic Control Among Diabetes Patients Study at KBTH (N=230). Univariate Logistic Regression

CHARACTERISTIC	CASES (n=115) Frequency (%)	CONTROL(n=115) Frequency (%)	TOTAL Frequency (%)
Sex			
Male	64 (55.7)	42 (36.5)	106 (46.1)
Female	51 (44.3)	73 (63.5)	124 (53.9)
Age			
21-40	14 (12.2)	16 (13.9)	30 (13.0)
41-60	78 (67.8)	47 (40.9)	125 (54.3)
>60	23 (20.0)	52 (45.2)	75 (32.6)
Education			
None	11 (9.6)	14 (12.2)	25 (10.9)
Primary/Elementary	26 (22.6)	35 (30.4)	61 (26.5)
JSS	12 (10.4)	7 (6.1)	19 (8.3)
Vocational/Commercial	6 (5.2)	8 (7.0)	14 (6.1)
Secondary	34 (29.6)	28 (24.3)	62 (27.0)
Tertiary	26 (22.6)	23 (20.0)	49 (21.3)
Marital Status			
Single	13 (11.3)	12 (10.4)	25 (10.9)
Married	83 (72.2)	78 (67.8)	161 (70.0)
Widowed/Separated	19 (16.5)	25 (21.8)	44 (19.1)
Religion			
Islam	11 (9.6)	12 (10.4)	23 (10.0)
Christianity	104 (90.4)	102 (88.7)	206 (89.6)
Traditional	0 (0.0)	1 (9.0)	1 (4)
Retirement Status			
Not Retired	86 (74.8)	76 (66.1)	162 (70.4)
Retired	25 (21.7)	36 (31.3)	61 (26.5)
Retired but working	4 (3.5)	3 (2.6)	7 (3.0)

Continuation of table					
Health insurance Status					
Covered	106	(92.2)	100	(87.9)	206 (89.6)
Not covered	9	(7.8)	15	(13.0)	24 (10.4)

Majority of the respondents (72.2%) of the cases were married whereas that of their control counterpart was (67.8%). A total of 162(70.4%) were not retired compared with 61(26,5%) who were retired. Also, a total of 206 (89.6%) of the respondents were registered with the national health Insurance Scheme.

4.2 Patients' Socio Demographic Characteristics and Glycaemic Control

A univariate logistic regression analysis was carried out to identify socio demographic factors that are likely to influence glycaemic control among diabetes patients. Results are shown in Table 4.2.

Age group (41-60), is statistically significant in the model. Poor glycaemic control ($HbA1c \geq 7$) was high among patients aged years 41-60 than among patients aged 21-40 years. (OR: 1.89) with p -value= 0.018. The risk, decreased with increase in age; patients aged > 60 years had the least risk of poor glycaemic control.

Sex was found to be associated with a high risk of poor glycaemic control. The risk of poor glycaemic control among men was higher than the risk among women. OR: 0.46 95% CI 0.20, 0.77 with p -value 0.04 which was statistically significant.

Poor glycaemic control showed varied association with education level attained. All the education levels attained appeared to be protective. The protective effect increased with increase in the level of education. However, the association was not statistically significant.

Also, marital status appeared to be protective with married group having the higher odds (OR: 0.98). The *p*-value of 0.96 was not statistically significant.

No statistically significant or consistent patterns of association existed between retirement status, religion, health insurance coverage and poor glycaemic control.

Table 4.2: Comparison of Socio Demographic Factors of Cases and Control in Barriers to Glycaemic Control Study at KBTH; Univariate Logistic Regression

VARIABLES	CASES (N)	CONTROL	OR (95% CI)	P-VALUE
Age				
21-40	14 (12.2)	16 (13.9)	1	
41-60	78 (67.8)	47 (40.9)	1.89 (0.84-4.23)	0.018*
> 60	23 (20.0)	52 (45.2)	0.51 (0.21-1.20)	0.124
Sex				
Male	64 (55.7)	42 (36.5)	1	
Female	51 (44.3)	73 (63.5)	0.46 (0.27-0.77)	0.04*
Education				
None	11 (9.6)	14 (12.2)	1	
Primary/JSS	26 (22.6)	35 (30.4)	0.43 (0.49-1.25)	0.123
JSS	12 (10.4)	7 (6.1)	0.61 (0.30-1.24)	0.176
Voc/Secondary	40 (34.8)	36 (31.3)	0.99 (0.30-3.20)	0.987
Tertiary	26 (22.6)	23 (20.0)	0.65 (0.31-1.40)	0.277
Marital Status				
Single	13 (11.3)	12 (10.4)	1	
Married	83 (72.2)	78 (67.8)	0.98 (0.42-2.28)	0.967
Widowed/Separated	19 (16.5)	25 (21.8)	0.70 (0.26-1.87)	0.481

Continuation of table				
Religion				
Islam	11 (9.6)	12 (10.4)	1	
Christianity	104 (90.4)	102 (88.7)	7.37 (3.11-1.75e)	1.000
Traditional	0 (0.0)	1 (9.0)	8.20 -	
Retirement Status				
Not retired	86 (74.8)	76 (66.1)	1	
Retired	25 (21.7)	36 (31.3)	1.62 (0.89-2.95)	0.109
Retired but working	4 (3.5)	3 (2.6)	0.84 (0.184-3.91)	0.833
NHIS Status				
Covered	106 (92.2)	100 (87.9)	1	
Not Covered	9 (7.8)	15 (13.0)	0.79 (0.27-3.30)	0.701

p-value from likelihood ratio test (*significant at 5% level)

4.3 Knowledge about Diabetes and Glycaemic Control

Univariate logistic regression was performed on knowledge about diabetes to determine whether this significantly influences glycaemic control among diabetes patients. The results are shown in Table 4.3.

Table 4.3: Comparison of Knowledge about Diabetes of Cases and Control in Barriers to Glycaemic Control Study at KBTH; Univariate Logistic Regression

VARIABLES	CASE	CONTROL	OR (95%CI)	P-VALUE
Knowledge of Diabetes				
Yes	92 (80.0)	90 (78.3)	1	
No	23 (20.0)	25 (21.7)	1.11 (0.58-2.09)	0.74
Knowledge about Type of Diabetes				
Yes	36 (31.3)	29 (25.7)	1	
No	79 (68.7)	84 (74.3)	0.80 (0.45-1.40)	0.439
Knowledge of FBS				
Yes	47 (40.9)	84 (73.0)	1	
No	68 (59.1)	31 (27.0)	3.92 (2.25-6.82)	0.000*
Knowledge about Glycosylated Haemoglobin				
Yes	2 (1.7)	2 (1.7)	1	
No	113 (98.3)	113 (98.3)	1 (0.13-7.22)	1.000
Family History of Diabetes				
Yes	68 (59.1)	68 (59.6)	1	
No	45 (39.1)	39 (34.2)	0.73 (0.45-1.17)	0.198
Duration/time of diagnosis				
<40 years	33	32	1	
>40 years	82	83	0.95 (0.53-0.68)	0.851

p-value from likelihood ratio test (*significant at 5% level)

Knowledge about fasting blood sugar was associated with poor glycaemic control. The risk of poor glycaemic control among cases without knowledge about their fasting blood sugar was

higher than the risk among those with knowledge about their fasting blood sugar. (OR: 3.92), p -value <0.001 which was statistically significant.

Family history of diabetes was protective. Patients with no history of parental diabetes had a lower risk poor glycaemic control (OR: 0.73). The association was not statistically significant. The risk of poor glycaemic control among patients diagnosed after 40 years of age was lower than patients diagnosed before 40 year. Diagnosis after aged 40 appeared protective, but there was no significant association found between duration and the effect of glycaemic control. Knowledge of what diabetes means, and knowledge of glycaemic control, were found not to be associated with glycaemic control.

4.4 Lifestyle Factors Associated with Glycaemic Control

Life style factors that were considered to influence glycaemic control were studied. The number of follow up visits to the hospital was found to be associated with glycaemic control. The risk of poor glycaemic control decreased with decrease in the number of visits from every three months (OR: 0.32) to every six (OR: 0.16). However, there was an increase in the risk when the number of visits to the hospital was reduced to less than two times in a year (OR: 0.49). P -value for the linear trend was 0.007 which was statistically significant (Table 4.4).

Table 4.4: Comparison of Lifestyle differences between Cases and Control in Barriers to Glycaemic Control Study at KBTH; (N=230) Univariate Logistic Regression

VARIABLES	CASE	CONTROL	OR (95%CI)	P-VALUE
Visit to the Dietician				
Yes	8 (6.8)	6 (5.2)	1	
No	107 (93.2)	109 (94.8)	1.21 (0.24-2.19)	0.758
Adherence to Dietary Recommendations				
Yes	86 (74.8)	29 (25.2)	1	
No	94 (81.7)	21 (18.3)	1.25 (0.35-1.24)	0.056*
No. of Visits to Hospital				
Every Month	21 (18.3)	9 (7.8)	1	
Every 3 Months	67 (58.3)	91 (79.1)	0.32 (1.37-7.35)	0.007*
Every 6 Months	3 (2.26)	8 (7.0)	0.16 (0.34-0.74)	0.020*
Every Year	8 (7.0)	7 (6.1)	0.49 (0.13-1.76)	0.274
Default in Follow-up Review				
No	59 (51.3)	79 (68.7)	1	
Yes	56 (48.7)	36(31.3)	2.08 (1.21-3.56)	0.007*
Large Number of Pills to Ingest				
No	78 (67.8)	91 (79.1)	1	
Yes	37 (32.2)	24 (20.9)	1.79 (0.30-1.01)	0.050*
Miss Out on Some of the Medication				
No	65(56.5)	79(68.7)	1	
Yes	50 (43.5)	36(31.3)	1.69 (0.98-2.89)	0.051*
Reaction to Medication				
No	102 (88.7)	101 (87.8)	1	
Yes	13 (11.3)	14 (12.2)	1.08 (0.48-4.63)	0.838
Ability to Buy Medication				
Yes	110 (95.7)	108 (93.9)	1	
No	5 (4.3)	7 (6.1)	1.42 (0.43-4.63)	0.555
Physical Exercise				
Yes	36 (31.3)	38 (33.0)	1	
No	79 (68.7)	77 (67.0)	0.92 (0.53-1.61)	0.778
Smoking Status				
No	113 (98.3)	114 (99.1)	1	
Yes	2 (1.7)	1 (0.9)	2.1 (0.18-22.56)	0.569
Alcohol Status				
No	82 (71.9)	93 (81.6)	1	
Yes	32 (28.1)	21 (18.4)	1.72 (0.92-3.23)	0.086

p-value from likelihood ratio test (*significant at 5% level)

Adherence to dietary recommendations was also found to be associated with poor glycaemic control. Patients who did not adhere to dietary recommendations were found to be at a higher

risk of poor glycaemic control than their counterparts who adhered to recommendations. (OR: 1.25), p -value = 0.056 which was statistically significant.

Large number of pills (more than 3 prescriptions) to swallow was also found to be associated with poor glycaemic control. The risk of poor glycaemic control among patients with large number of pills to swallow was 1.79 times higher than the risk among their counterparts who did not have large pills to swallow. P -value was 0.050 which was statistically significant.

Missing out on some of the medication was another factor that was found to be significantly associated with poor glycaemic control. The risk of poor glycaemic control among cases that missed out on some of the medications was higher (OR: 1.69) than the risk among their counterparts. P -value was 0.051 which was significant. Though the risk of poor glycaemic control among cases that reacted to medication was higher than the risk among their counterparts, the p -value was found not be statistically significant. (OR: 1.08 95% CI 0.48, 4.63).

During the univariate logistic regression analysis, ability to buy medication, and physical exercise were found not to be significantly associated with poor glycaemic control. Similarly, smoking and drinking alcohol were also not significantly associated with poor glycaemic control though individuals who smoked or drank alcohol had a higher risk of poor glycaemic control. Furthermore, there was no significant association found between visits to the dietician, and poor glycaemic control.

4.5 Hypertension and Glycaemic Control

Analysis was constructed for hypertension variables and it was found out that there was no significant association between glycaemic control and history of hypertension.

Table 4.5: Comparison of Diabetes and Hypertension of Cases and Control in Barriers to Glycaemic Control Study at KBTH; Univariate Logistic Regression

Characteristics	Cases N = 115 (%)	Controls N = 115 (%)	Or (95% Ci)	p-Value
Hypertension History				
Yes	60 (52.2)	74 (64.3)	1.65 (0.97-2.81)	0.062
No	55 (47.8)	41 (35.7)		

4.6 Socio Demographic Characteristics and Glycaemic Control

All the variables (socio demographic factors, knowledge about diabetes, lifestyle factors, and hypertension) were put into a multiple logistic regression model to determine the factors that were associated with glycaemic control. This was to assess the combined effect of all the factors, because in real life all the factors act together by interplaying with each other to result in the outcome (glycaemic control). Multiple logistic regressions show the true picture of the factors that are associated with glycaemic control (Table 4.6.).

Table 4.6: Comparison of Socio Demographic Factors of Cases and Control in Barriers to Glycaemic Control Study at KBTH; Multivariate Logistic Regression

VARIABLES	CASES (N)	CONTROL	ODDS RATIO (95% CI)	P-VALUE
Age				
21-40	14 (12.2)	16 (13.9)	1	
41-60	78 (67.8)	47 (40.9)	3.99 (1.72-12.58)	0.018*
>60	23 (20.0)	52 (45.2)	0.23 (0.06-1.41)	0.126
Sex				
Male	64 (55.7)	42 (36.5)	1	
Female	51 (44.3)	73 (63.5)	3.57 (1.44-8.82)	0.006*
Education				
None	11 (9.6)	14 (12.2)	1	
Primary/JSS	26 (22.6)	35 (30.4)	0.92 (0.20-4.76)	0.972
JSS	12 (10.4)	7 (6.1)	0.37 (0.15-1.52)	0.073
Voc/Secondary	40 (34.8)	36 (31.3)	0.32 (0.05-1.75)	0.162
Tertiary	26 (22.6)	23 (20.0)	0.55 (0.9-1.44)	0.458
Marital Status				
Single	13 (11.3)	12 (10.4)	1	
Married	83 (72.2)	78 (67.8)	1.12 (0.29-5.68)	0.870
Widowed/Separated	19 (16.5)	25 (21.8)	0.76 (0.14-4.41)	0.733
Retirement Status				
Not Retired			1	
Retired	86 (74.8)	76 (66.1)	0.29 (0.08-1.03)	0.044*
Retired but Working	25 (21.7)	36 (31.3)	0.06 (0.00-0.70)	0.030*
	4 (3.5)	3 (2.6)		
NHIS Status				
Covered	106 (92.2)	100 (87.9)	1	
Not Covered	9 (7.8)	15 (13.0)	1.00 (0.29-3.37)	0.995

P-Value from likelihood ratio test (*significant at 5% level)

The risk of poor glycaemic control showed varied association with age groups as in the univariate analysis. Age group (40-60) was found to be the one with the highest risk (OR: 3.99).

The *p*-value for the linear trend was 0.018 which was statistically significant.

The risk decreased with increase in age > 60 year (OR: 0.29). The age group (>60) appeared to be protective; however the association was not statistically significant.

Sex was also found to be significantly associated with poor glycaemic control. The risk of female cases was found to be higher than the risk of their male counterparts. (OR: 3.57 *p*-value 0.006) which is statistically significant.

Retirement status was found to have a protective effect on poor glycaemic control. The risk of poor glycaemic control among cases that were retired was lower than the risk among cases that were not retired (OR: 0.29). The risk decreased further among patients who were retired but still working, (OR: 0.06 *p*-value 0.030 95% CI 0.00-0.70) which was statistically significant.

Education had a protective effect on the risk of poor glycaemic control as in the univariate analysis. Marital status was not significantly associated with poor glycaemic control. However, widows or those separated appeared to be protective. Religion and national health insurance status of the respondents were found not to be statistically associated with poor glycaemic control in the multivariate analysis.

4.7 Knowledge about Diabetes and Glycaemic Control

Results of the association between knowledge about diabetes and glycaemic control are shown in Table 4.7. Knowledge about one's fasting blood sugar test came out to be significantly associated with poor glycaemic control as in the univariate analysis. (OR: 5.71 95% CI 2.60, 12.53) at *p*-value < 0.0001. Patients who did not have any knowledge about their fasting blood sugar had a higher risk of poor glycaemic control than their counterparts.

Knowledge about the type of diabetes and glycosylated haemoglobin and family history of diabetes were found not to be associated with the outcome of glycaemic control.

Table 4.7: Comparison of Knowledge about Diabetes of Cases and Controls in Barriers to Glycaemic Control Study at KBTH (N=230): Multivariate Logistic Regression

VARIABLES	CASES (N)	CONTROL	ODDS RATIO (95% CI)	P -VALUE
Knowledge of Diabetes				
Yes	92 (80.0)	90 (78.3)	1	
No	23 (20.0)	25 (21.7)	1.27 (0.28-1.70)	0.437
Knowledge about Type of Diabetes				
Yes	36 (31.3)	29 (25.7)	1	
No	79 (68.7)	84 (74.3)	1.00 (0.15-5.11)	0.895
Knowledge of FPG/FBS				
Yes	47 (40.9)	84 (73.0)	1	
No	68 (59.1)	31 (27.0)	5.71 (2.60-12.53)	0.000*
Knowledge about Glycaeted Haemoglobin				
Yes	2 (1.7)	2 (1.7)	1	
No	113 (98.3)	113 (98.3)	1.34 (0.83-4.12)	0.829
Family History of Diabetes				
No	45 (39.1)	39 (34.2)	1	
Yes	68 (59.1)	68 (59.6)	1.72(0.82-3.62)	0.150

p-value from likelihood ratio test (*significant at 5% level)

Lifestyle Factors

Among the lifestyle related factors, the number of visit to the hospital for treatment was found to be associated with glycaemic control.

There was an increase risk of poor glycaemic control among cases who visited the hospital every three months than their counterparts who attended the hospital every month. However, the risk of poor glycaemic control among cases who visited the hospital every six months was lower than the risk of poor glycaemic control among cases that visited the hospital every three months, but higher than those who visited every month. Furthermore, those who visited once a year had a lower risk than those who visited once every six month and every three months respectively but still higher than those who went every month.(OR: 4.65 95% 0.07, 0.68) with p -value= 0.008 which was statistically significant.

Default in follow up review was also found to be associated with poor glycaemic control. The risk of poor glycaemic control among cases that default in follow up review was higher than the risk among their counterparts who did not default in follow up visit. (OR: 2.56, 95% 1.20, 5.49) with P -value= 0.015, which was statistically significant.

Large number of pills to ingest was also found to be statistically associated with poor glycaemic control. The risk of poor glycaemic control among cases with large number of pills to swallow daily was higher than the risk of poor glycaemic control among their counterparts who did not have large number of pills to swallow. (OR: 2.86) with p -value 0.018 which means the association is statistically significant.

Table 4.8: Lifestyle Factors: Comparison of Cases and Control in Barriers to Glycaemic Control Study at KBTH; (N=230) Multivariate Logistic Regression

VARIABLES	CASES (N)	CONTROL	ODDS RATIO (95% CI)	P -VALUE
Visit to the Dietician				
Yes	107 (93.2)	109 (94.8)	1	
No	8 (6.8)	6 (5.2)	0.19 (0.36-1.09)	0.063
Adherence to Dietary Recommendations				
Yes	86 (74.8)	29 (25.2)	1	
No	94 (81.7)	21 (18.3)	2.25 (0.89-5.68)	0.085
No. of Visits to Hospital Monthly				
Every Month	21 (18.3)	9 (7.8)	1	
Every 3 Months	67 (58.3)	91 (79.1)	4.65 (0.08-0.68)	0.008*
Every 6 Months	3 (2.26)	8 (7.0)	2.31 (0.50-2.71)	0.329
once a year	8 (7.0)	7 (6.1)	2.14 (0.74-2.24)	0.304
Default in Follow-up Review				
No	59 (51.3)	79 (68.7)	1	
Yes	56 (48.7)	36 (31.3)	2.56 (1.20-5.49)	0.015*
Large Number of Pills to Ingest				
No	78 (67.8)	91 (79.1)	1	
Yes	37 (32.2)	24 (20.9)	2.86 (1.20-6.79)	0.018*
Miss Out on Some of the Medication				
No	65 (56.5)	79 (68.7)	1	
Yes	50 (43.5)	36 (31.3)	2.44 (1.14-5.23)	0.022*
Reaction to Medication				
No	102 (88.7)	101 (87.8)	1	
Yes	13 (11.3)	14 (12.2)	2.32 (0.76-7.02)	0.124
Ability to Buy Medication				
Yes	110 (95.7)	108 (93.9)	1	
No	5 (4.3)	7 (6.1)	4.63 (0.78-27.40)	0.091
Physical Exercise				
Yes	36 (31.3)	38 (33.0)	1	
No	79 (68.7)	77 (67.0)	1.73 (0.74-4.04)	0.198
Smoking Status				
No	113 (98.3)	114 (99.1)	1	
Yes	2 (1.7)	1 (0.9)	1.29 (0.39-4.29)	0.668
Alcohol Status				
No	82 (71.9)	93 (81.6)	1	
Yes	32 (28.1)	21 (18.4)	1.13 (0.43-2.94)	0.798

p-value from likelihood ratio test (*significant at 5% level)

Miss out on some of the medications/pills was also statistically associated with poor glycaemic control. The risk of poor glycaemic control among cases that missed out on some of the

medications was higher than the risk among cases that did not miss out on some of their medications. The odds of patients who missed out on some of their medications were (OR: 2.44). *P*-value for the linear trend was 0.022 which was statistically significant.

Ability to buy medication, physical exercise, smoking and alcohol were found not to be significantly associated with poor glycaemic control. Similarly, reaction to medication was also not found to be significantly associated with poor glycaemic control though it appeared that cases that reacted to medications had a higher risk of poor glycaemic control.

Diabetes and Hypertension

Sixty (52.2%) of cases had hypertension, however, there was no significant association found between hypertension and poor glycaemic control ($p = 0.51$).

Table 4.9 Comparison of Diabetes and Hypertension of Cases and Control in Barriers to Glycaemic Control Study at KBTH; Multivariate Logistic Regression

Characteristics	Cases N = 115 (%)	Controls N = 115 (%)	Or (95% CI)	P-Value
Hypertension				
Yes	60 (52.2)	74 (64.3)	1.29 (0.59-2.83)	0.518
No	55 (47.8)	41 (35.7)		

CHAPTER FIVE

5.0 DISCUSSION

The study investigated the factors that affect glycaemic control among diabetes patients at the Korle-Bu Teaching Hospital in the Greater Accra Region with emphasis on factors contributing to poor glycaemic control. Cases and controls were selected at the National Diabetes Management Centre of the Korle-Bu Teaching Hospital with HbA1c of 7 as the cutoff point.

Findings in this report supported previous studies demonstrating that socio demographic factors, knowledge about diabetes, lifestyle and hypertension were closely linked to glycaemic control and might be interconnected.

5.1 Socio Demographic Factors

Adjusted for all other demographic, lifestyle, diabetes knowledge and hypertension factors, age was found to be significantly associated with glycaemic control with age group (40-60) having the highest risk of poor glycaemic control. The risk increased with increase in age of respondents. This finding supported a study in Ghana by Amoah et al. (2002) that also reported that worsening glycaemic status tended to be associated with increase in age. These findings are not encouraging because looking at the data, more than half of the respondents (54.4%) were in the age group 40 - 60 years and substantial proportion of them did not maintain HbA1c value level <7%.

Women were found to have increase risk of poor glycaemic control than men with a *p*-value 0.006. Shani et al. (2008) reported that men were more likely than women to achieve well

control diabetes which is in support with the finding in this report. However using logistic regression, Wilf-Miron et al. (2010) in their study reported that more males demonstrated poor glycaemic control. The health seeking behavior of women might have contributed to the fact that more cases (53.9%) in this study being female.

In this study, patients who were on retirement had the lowest risk of poor glycaemic control. The risk decreased further when people were retired but still working. This supported the results of an analysis done by Boulé et al., (2001) showing a 0.66% reduction in glycosylated haemoglobin (HbA_{1c}) in the exercise group. They concluded that exercise improves glycaemic control in patients with diabetes. When people increase in age there is a decrease in their activity level resulting in poor glycaemic control. This finding is beneficial for diabetes health education.

With religion being a risk factor in glycaemic control, a study by How et al. (2011) documented that Muslim religion had a significant negative correlation with HbA_{1c} after controlling for covariates. Christians and traditionalists in that study had a *p*-value of 0.047 as compared to Muslims who had *p*-value of 0.007. However with regard to this study, religion was found not to be associated with poor glycaemic probably because majority of the respondents 206 (89.6%) were Christians.

Marital status of subjects was found not to be associated with poor glycaemic control in both univariate analysis and combined analysis using the logistic regression model. This finding is contrary to the study by Ali et al. (2012) in their evaluation of the level of glycaemic control achieved among adults in the US. They found that unmarried persons were more likely than

married persons to have poor glycaemic control. This difference could be caused by the socio cultural differences in the study areas.

Concerning education level attained and glycaemic control, no significant or consistent patterns of association was found during this study. Using a multivariate analysis, Ali et al. (2012) also found no association. This agreed with the result of this study. This finding can be due to the fact that majority of the respondents in the study had formal education. Therefore education level attained was not a risk factor of poor glycaemic control.

This study found no association between health insurance status and poor glycaemic control in univariate and combined multiple logistic regression analysis. This is however contrary to a study by Ali et al. (20012) in which poor glycaemic control was common among those without a usual source of medical care compared with those who accessed clinics or doctors' offices. Majority 206 (89.6%) of the respondents in this study were on national health insurance scheme, therefore this might have affected the result.

5.2 Knowledge about Diabetes and Glycaemic Control

Knowledge about fasting plasma glucose was strongly associated with poor glycaemic control using both univariate and multivariate regression analysis. Similarly, Rosario et al. (1996) in a continuing interactive educational model established that HbA1c levels of patients improved with increase knowledge about diabetes. This finding is beneficial for the management of diabetes patients. For patients to have skills to deal with treatment recommendations, they must improve in their knowledge about the disease.

From this study, family history was found not to be associated with poor glycaemic control. The difference could be due to the study design. Data from the National Health and Nutrition Examination Survey 1999-2004, reported that a family history of diabetes mellitus is associated with glycaemic control and increased metabolic risk among people with diabetes.

5.3 Lifestyle Factors and Glycaemic Control

Lifestyle factors such as default in follow up review, large number of pills to ingest, and miss out on some of the medication/pills were found to be associated with poor glycaemic control. This finding was similar to the findings in studies by Rozenfeld et al. (2008) and Rhee et al, (2002). Rozenfeld et al. (2008) in a retrospective observational study concluded that T2DM patients who adhered to oral diabetes medication were more likely to achieve glycaemic control than non adherent patients.

Assessing the influence of appointment keeping and adherence to medication regimen on glycaemic control, there was a significant association. Rhee et al. (2002) also reported that Keeping more appointments and taking diabetes medications as directed were associated with substantial improvements in HbA1c.

Grant et al, (2004) showed that Clinical inertia was a critical barrier to glycaemic control in T2DM. Diabetes is a chronic disease, and people diagnosed with diabetes will have to be going to hospital frequently. Patients therefore develop clinical inertia which leads to default in follow up reviews. It has also been a trend of patients to start taking medications religiously and keeping to appointment schedule only when they have a major event such as peripheral arterial disease.

There is therefore the need to encourage patients with diabetes to be regular with follow up review and adherence to medication regimen. Also, patients would be better off if the number of pills they have to swallow daily reduces.

From this study, smoking and alcohol were found to have no effect on glycaemic control among diabetes patients. Ahmed et al, (2008) had a survey follow up study among Kaiser Permanente Northern California and found that alcohol consumption was associated with lower HbA1c. This may be problematic for diabetes patients whose bodies already have difficulties to regulate blood sugar. If they consume alcohol, it will not only cause their sugar level to drop but it will also make it difficult for the body to regulate the sugar level, and this can result in hypoglycaemia. Though, the immediate effect of alcohol consumption is reduction in blood sugar level, over time, chronic drinking results in high blood sugar (Nelson et al, 2011). Even though results of this study demonstrated no significant correlation between alcohol and glycaemic control, diabetics should not be encouraged drinking alcohol since they might forget their medication regimen when they get drunk. It will be beneficial if diabetes education includes the effect of alcohol on management of the disease.

Chaturvedi et al, (1995) examined the relationship between smoking and both glycaemic control and microvascular complications, and concluded that smoking is associated with poorer glycaemic control. The finding in this study differs from the study referenced above. This can be due to the fact that Ghanaians frown on smoking and that health workers always advise patients not to smoke. There is the likelihood that patients will not admit to smoking even if they smoked

and this could underestimate the effect of smoking. Furthermore, few people smoke. In this study only 3 (2.6%) of the patients admitted to be involved in these lifestyle behavior.

Furthermore, there was no correlation between physical exercise and glycaemic control in this study. This result appeared contrary to studies of Ali et al, (2012) and Boule et al, (2001). They concluded that exercise improves glycaemic control in patients with diabetes. This finding might have been due to the fact that majority of the patients in the study were not exercising.

5.4 Hypertension and Glycaemic Control

The close association of diabetes and hypertension is a well known phenomenon. More than half of our respondents were hypertensive. However, the association of glycaemic control with hypertension was not evident in this study unlike as observed in various other studies. Basit et al, (2005) found an association between glycaemic control and hypertension.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

Barriers to glycaemic control are multi factorial. This report supported previous studies demonstrating that socio demographic, knowledge about diabetes and lifestyle exposures are linked closely to glycaemic control outcomes and might be interconnected.

The socio demographic factors identified to be associated with poor glycaemic control were age (with age group (40-60) being the highest risk), and sex with women being the highest risk. Retirement status was also associated to poor glycaemic control with persons who were retired but still working being at a lower risk.

Also, those who had knowledge about diabetes were also found to be at a lower risk of poor glycaemic control with persons who had no knowledge about their fasting plasma glucose being at a higher risk.

Lifestyle factors, also determined the level of patients glycosylated heamoglobin. Persons with large number of pills to ingest daily had higher risk of poor glycaemic control. And persons who did not adhered to medication regimen and missed out on some medications also had poor glycemic control. Furthermore, poor glycaemic control was found to be significantly high among persons who defaulted in follow up review visits to the physicians' office, and persons who visited the physician's office every 3 month for treatment. Hypertension was found not to be significantly associated with poor glycaemic control.

6.2 Recommendations

In view of the findings of this study, it is recommended that stakeholders mentioned below should do the following:

Ghana Health Service and Health Care Givers

- Care Givers should intensify education on the importance of adherence to medication regimes, follow up medical reviews, and dietary requirements for good glycaemic control.
- Education should be extended to families of diabetes patients to improve communication between patients and their families, seeking to meet their support needs and educating families so that support is more meaningful and diabetes management more attainable
- Ministry of health should import Combined Oral Medications to reduce the pill burden of the patients.
- Ministry of health should amend the National Health Insurance scheme policy to cover the Combined Oral Medications; this will make access to such medications easy for the patients.

Academia and Research Institutions

Further studies should be designed and conducted by School of Public Health, Ghana Health Service, Public Health Department, Korle-Bu, National Diabetic Management Center and other health and research institution should conduct further studies to confirm the risk factors of poor glycaemic control and the effect of the variables researched into on poor glycaemic control.

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8.0 APPENDICES

Appendix 1

Number of people who visited the NDMRC at the Hospital in the year 2011

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
1433	1547	1715	1959	1823	1959	1321	1867	1977	1735	1895	1678	20,707

Number of New cases = 926

APENDIX 2

HbA1c results for the year 2011 at the NDMC laboratory

	HbA1c value ≥ 7	HbA1c value < 7	TOTAL
MALE	155	124	279
FEMALE	411	250	661
TOTAL	566	412	940

APPENDIX 3

CONSENT FORM

BARRIERS TO GLYCAEMIC CONTROL AMONG DIABETES PATIENTS IN KORLE-BU TEACHING HOSPITAL

We are here to gather information on factors that contribute to poor management of diabetes. We also intend to assess if the presence of hypertension in diabetes patients is affecting the control of sugar in the blood. This information will help management and health care providers in the hospital to plan and provide health care that will improve diabetes management.

This study is purely an academic exercise and will involve answering questions on socio-demographic factors that are associated with glycaemic control, knowledge of diabetes and glycaemic control, lifestyle, and hypertension. The procedures involved in this study are non-invasive and will not cause any discomfort to participants. There will be no coercion to obtain response from participants, and you are at liberty to withdraw from the study at anytime. However, we encourage you to fully participate in the study since your response is important to help explore factors associated with poor glycaemic control among diabetes patients.

Your name will not be written in the final report, and your response will be kept strictly confidential and will not be shown to any other persons except those who are working on this project. The final report from this study will be disseminated.

You can stop us to ask any questions about the study during the interview.

For any clarification afterwards you can contact us on phone numbers:

Aimee Akotey 0244475719/0202612395

Consent

I, declare that the purpose, procedures as well as risks and benefits of the study have been explained to me in English /local language and I have understood.

I hereby agreed to take part in the study:

Signature of participant.....Date:.....

Interviewers Statement

I, the undersigned, have explained this consent to the subject in English/local language that he/she understands the purpose of the study, procedures to be followed, as well as the risks and benefits of the study.

The participant willingly agreed to participate in the study without any coercion.

Signature of Interviewer:..... Date:.....

Questionnaire Number.....

APPENDIX 4**QUESTIONNAIRE****A. RESPONDENT BACKGROUND**

1. Name:.....
2. Age (at last birthday):.....Not known [☐]
3. Town/Community of residence:.....
4. Sex:
 - 1 Male [☐]
 2. Female [☐]

Tel number:.....

B. SOCIO-ECONOMIC STATUS

5. Ethnic group:
 1. Akan [☐]
 2. Ewe [☐]
 3. Ga/Adangme [☐]
 4. Gonja [☐]
 5. Dagomba [☐]
 6. Other [☐] (specify).....
6. Marital status:
 - 1 Single . [☐]
 2. Married [☐]
 - 3 Separated [☐]
 4. Widow/Widower [☐]
7. Religion:
 1. Christian [☐]
 2. Moslem [☐]
 3. Traditionalist [☐]
 4. Other [☐] (specify).....
8. Educational Level:
 1. Primary/Elementary [☐]
 2. JSS [☐]
 3. SSS/Secondary [☐]
 4. Vocational / Commercial [☐]
 5. Tertiary [☐]
 6. None [☐]
9. Occupation:
 1. [☐] Managerial/professional
 - 5.[☐] Skilled worker

2. ☐ Business person 6. ☐ Unskilled worker
3. ☐ Trader/hawker 7. ☐ Housewife
4. ☐ Labourer 8. ☐ Other (specify).....

10. What is your employment Status _____

1. Full employment;
2. Part time employment
3. Unemployed

11. What is your retirement Status? _____

1. Not retired
2. Retired
3. Retired but working

12. Have you joined the National Insurance Scheme? _____ 1. Yes 2. No

If yes, what is the name of the specific scheme _____

If no, how do you finance your hospital bills? Self ☐ Remittance from others ☐

Pension benefit ☐ Other (specify)_____

C. Knowledge about Diabetes and Glycaemic Control

13. When were you first told you have diabetes? _____

(if exact date not known, Specify the year)

14. How long have you had diabetes _____years _____months

15. what is the type of diabetes were you told you have?

Type 1 ☐ Type 2 ☐ Don't know ☐

16. What is the current treatment for your diabetes? (a check from medical note or observed)_____

☐ Diet only

☐ Diet+Sulphonylurea (Glibenclamide, Tolbutamide, , Chlorpropamide)

☐ Diet+Metformin

☐ Diet+sulphonylurea+metformin

☐ Diet+insulin

☐ Other, if so specify-----

17. How long have you been on the current treatment _____years (check from medical note)

18. What treatment for diabetes were you put on when you first developed diabetes? (Use choices in 15 to answer) _____

19. Do you know what diabetes is? ☐ Yes ☐ No

If yes explain_____

20. Do you know what fasting Blood Sugar means? ☐ Yes ☐ No

If yes explain_____

21. Do you know what Glycaeted Haemoglobin means? ☐ Yes ☐ No

If yes explain_____

22. Do you know the value of your HbA1c? ☐ Yes ☐ No

If yes what is your HbA1c value?_____(from respondent not medical note)

23. Check medical note for most recent HbA1c._____

24. Do you have diabetes in your family? ☐ Yes ☐ No

d. Lifestyle and diabetes

25. Have you ever visited the dietician? ☐ Yes ☐ No

26. Are you able to observe your diet recommendation? ☐ Yes ☐ No

If yes what makes you observe it? _____

If no why _____

From question 27 – 30, indicate how you agree or disagree with the statements

27. I increase my chance of developing complications if I don't observe my diet recommendation.

Strongly agree ☐ Agree ☐ Don't know ☐ disagree ☐ Strongly disagree ☐

28. If I don't observe my diet recommendation I can have high sugar in my blood

Strongly agree ☐ Agree ☐ Don't know ☐ disagree ☐ Strongly disagree ☐

29. If I take my medicine and I don't eat on time I can have hypoglycaemia (low sugar)

Strongly agree ☐ Agree ☐ Don't know ☐ disagree ☐ Strongly disagree ☐

30. I sometimes fast to reduce the sugar level in my blood

Strongly agree ☐ Agree ☐ Don't know ☐ disagree ☐ Strongly disagree ☐

31. How often do you visit the centre for treatment?

☐ Once in a month ☐ Twice in a month ☐ Every three month

☐ Every six month ☐ other (specify) _____

32. Have you ever missed any of your visits to the hospital? ☐ Yes ☐ No

What do you do when your appointment coincides with a funeral in your home town or a celebration?

33. Do you have too many pills to swallow every day? ☐ Yes ☐ No

When was the last time you forget to take your diabetes tablets? _____

34. Do you sometimes forget to take some of your pills?

☐ Yes ☐ No ☐ Don't know

35. How often do you miss your pills in a week?.....

36. What is the reason why you sometimes do not take your pills?

37. What do you do in order not to forget to take your diabetes medicine?

38. Do you have any reaction when you take your diabetes medicine? ☐ Yes ☐ No

39. Are you able to buy all your prescribed medicines? ☐ Yes ☐ No

40. What kind of exercise do you do? _____

41. How many times do you exercise a week? _____

42. What do you do during your leisure time?

Reading ☐ Watching TV ☐ Walking ☐

Taking a drink ☐ Others (specify) ☐ _____

43. Do you smoke? ☐ Yes ☐ No

If yes, how many sticks of cigarettes do you smoke daily? _____

If no, have you ever smoked before? ☐ Yes ☐ No

44. Do you drink alcohol? ☐ Yes ☐ No

If no, have you ever taken alcohol before? ☐ Yes ☐ No

e. Hypertension

45. Do you have high blood pressure? ☐ Yes ☐ No

If yes, for how long? _____

45. What is the current treatment for your hypertension? _____

46. Diabetes And Hypertension, which one was diagnosed first?

☐ diabetes ☐ hypertension

47. Does your treatment for hypertension make it difficult for you to adhere to your current treatment for diabetes? ☐ yes ☐ no

If yes how?

48. I like the health care given in this centre.

☐ All of the time ☐ Most of the time ☐ Some of the time ☐ Hardly ever ☐ Never

49. I like the set up of this centre

Strongly Agreed ☐ Agreed ☐ Neutral ☐ Disagree ☐ Strongly Disagreed ☐

50. Overall, I am satisfied with the treatment I receive in this hospital

Very Satisfied ☐ Satisfied ☐ Somewhat Satisfied ☐ Neutral ☐

Dissatisfied ☐ Strongly Dissatisfied ☐