FACTORS ASSOCIATED WITH DIABETES PREVALENCE AND UTILISATION OF DIABETES CARE SERVICES IN MAURITIUS

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MASTERS IN PUBLIC HEALTH

BY

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ABBREVIATIONS

ANOVA	Analysis of Variance
DM	Diabetes Mellitus
GDP	Gross Domestic Product
HBM	Health Belief Model
IGT	Impaired Glucose Tolerance
NCDs	Non-Communicable Diseases
NSFD	National Service Framework for Diabetes
MDA	Mauritius Diabetes Association
MLE	Maximum Likelihood Estimation
MoU	Memorandum of Understanding
OLS	Ordinary Least Square
SES	Socio-economic Status
WHO	World Health Organization

SYNOPSIS

Diabetes is a growing problem worldwide. It is estimated that at least 171 million people have diabetes worldwide and this figure is projected to more than double by 2030. Mauritius has not been spared from diabetes. Indeed, it has one of the highest diabetes prevalence in the world. It is creating tremendous pressure not only on households but on the health care system. Health care resources are already constrained and the additional pressure exerted by the high costs of diabetes can have dire consequences on the economy, especially since the public sector bears a significant proportion of all direct health care costs.

This study was designed in order to widen the body of research and emphasize on the diabetes issue in Mauritius. It was aimed at both identifying the factors associated with diabetes prevalence and factors that influence the utilisation of diabetes care services. The study also observed whether the factors that affect the diabetes prevalence also affect its utilisation. The results of this study clearly depict the characteristics of both diabetics and non-diabetics in Mauritius in terms of their demographic, biological features as well as their socio-economic status and their lifestyle and habits.

A cross-sectional survey of 740 households was used to explore the demographic, socio-economic and lifestyle information of both male and female Mauritians aged above the age of 18 years. Three different sets of analyses were performed. Firstly, in order to evaluate the factors associated with diabetes, a logit model was used. Secondly, a binomial regression was used to identify the factors associated with utilisation. Thirdly, ANOVA tests were performed to identify a common link between prevalence and utilisation by assessing the differences between the means of two groups bearing different diabetes prevalence or utilisation. These two groups are group 1 which consists of those individuals who have diabetes and use the diabetes care services and group 2 which is made up of those diabetics who do not utilise diabetes care services

The results revealed a diabetes prevalence of 17.05%. Comparing this figure to the prevalence of diabetes in Mauritius which was 19.3% in 2004 (cited in NSFD, 2007), proves that our data is a good representation of the diabetes distribution in the Mauritian population. Only 7% of diabetics reported not to have used health services with regards to their condition.

Age was found to be positively associated with diabetes prevalence (odds ratio = 1.194), and so was gender with an odds ratio of 1.486, suggesting than males are more likely to be diabetics than females. The Chinese and European population groups are 8.858 times more like to suffer from the condition than the Creoles. However, the other ethnic groups, namely, Hindu and Muslim were not significantly associated with diabetes status. Family history was found to be a strong factor associated with diabetes (The 'parents have diabetes' variable bore an odds ratio of 5.077, and the 'parents do not have diabetes' was used as the base category). Overweight was positively associated (odds ratio = 2.140) with diabetes prevalence as well as alcohol consumption (odds ratio = 2.324). Education level attained (secondary and tertiary) was negatively associated with diabetes prevalence. Thus, those who have attained secondary and tertiary education are less likely to be diabetics than those who have only completed primary education. Physical activity was negatively associated (odds ratio = 0.615). Per-capita household expenditure was found to bear a weak positive association with diabetes status/prevalence. Place of residence also bore a positive association (odds ratio = 2.452). Smoking was not significantly associated with diabetes prevalence.

Utilisation was found to be positively associated with family history (β-coefficient = 0.499) and negatively associated with age (β-coefficient = -0.078). As people with diabetes get older, they were found to have a tendency to use less of the diabetes services. A negative association also exists between utilisation and gender (β-coefficient = -0.351), thus male diabetics utilise less of the diabetes services than female diabetics. Those diabetics whose parents have/had diabetes are more likely to utilise services than those who do not have a family history of the disease. Diabetics who smoke cigarettes utilise less than those who do not smoke (β-coefficient = -0.736). Similarly, diabetics who perform low levels of exercise utilise less of the services than those who do not perform any form of physical activity (β-coefficient = -0.412). Also, diabetics who consume low and high levels of alcohol utilise less of the services than those who do not drink while those who have medium alcohol consumption utilise more of the services. Both per-capita household expenditure and place of residence are negatively associated with utilisation (β-coefficient = -0.0001; -1.009 respectively). Those diabetics who have high incomes and who reside in urban areas are less likely to utilise the diabetes services than their counterparts who have low incomes and who reside in rural areas.

Educational level and place of residence of diabetics were found to affect their utilisation and thus are the common link between prevalence and utilisation. These factors together with others identified in this study have to be targeted by the government. If governmental priority is given to these factors, significant decrease in the overall diabetes prevalence can be achieved in a short period of time.

These results will be useful to identify the groups at risk of diabetes on which preventive measures and resources should be targeted. It will help in policy information and formulation and will serve as a basis for future works on this subject,

CHAPTER ONE
1.0 BACKGROUND

1.1 Broad Description of Diabetes

Diabetes mellitus (DM), often simply referred to as diabetes, is defined by the World Health Organization (WHO) as a chronic disease that could be inherited or caused by either inherited or acquired deficiency in the production of insulin by the pancreas (WHO, 2008a). The result is an increased in the concentration of glucose in the blood which is fatal to the body's system. Two basic forms of diabetes exist: (1) Type 1 diabetes which develops mainly in children or adolescents and (2) Type 2 diabetes, occurring most frequently in adults and accounts for approximately 90% of all diabetes cases worldwide. Type 1 diabetes is an autoimmune disease resulting in the destruction of insulin-producing beta cells of the pancreas, thus, preventing the pancreas from producing insulin. This form of diabetes can also appear later in life and requires daily administration of insulin. Type 2 diabetes is the inability of the body to respond adequately to the action of insulin that is produced by the pancreas. It is being increasingly noted in adolescents, even though it predominantly affects adults (*ibid*). It was formerly called non-insulin-dependent diabetes mellitus (NIDDM), or adult-onset diabetes. It is important to note that Impaired Glucose Tolerance (IGT) is also a condition with elevated (though not diabetic) levels of blood glucose, and it has been recognised as being a stage in the transition from normality to diabetes (International Diabetes Federation, 2005).

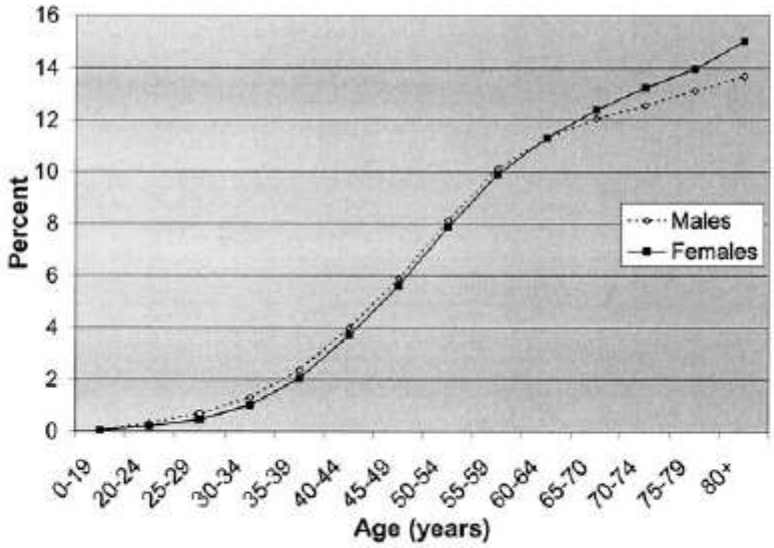
Both type 1 and type 2 diabetes lead to high blood sugar levels, a condition called hyperglycemia (International Diabetes Federation, 2009a). Diabetes predisposes sufferers to high blood pressure and high cholesterol and triglyceride levels (*ibid*). These conditions independently and together with hyperglycemia causes an increased risk for heart disease, kidney disease, and other blood vessel complications (*ibid*). Diabetes can contribute to a number of acute (short-lived) medical problems in the short run. For example, many infections are associated with diabetes (*ibid*). These infections are more dangerous in diabetics because the body's normal ability to fight infections is impaired. The health manifestations and symptoms of both type 1 and type 2 diabetes are abnormal thirst (polydipsia) and a dry mouth, frequent urination (polyuria), extreme tiredness/lack of energy, sudden weight loss, slow-healing wounds, recurrent infections and blurred vision (WHO, 2010a; International Diabetes Federation, 2009). These symptoms may occur suddenly in type 1 diabetes but they are often less marked and may be diagnosed several years after onset, once complications have already arisen, for type 2 diabetes.

Fortunately, through good control, type 2 diabetics and live a normal life and type 2 diabetes can be delayed or even prevented (NSFD, 2007). In addition, life expectancy can be increased and the risks of complications in both type 1 and type 2 diabetes can be reduced. Thus, self-management is one of the bases of effective diabetes care (*ibid*).

1.2 Diabetes: the Global Picture

1.2.1 Global Diabetes Prevalence

It is estimated that at least 171 million people have diabetes worldwide and this figure is projected to more than double by 2030 (WHO, 2008b). Figure 1 (Wild *et al*., 2004: 1049) shows the global diabetes prevalence by age and sex in the year 2000. It clearly depicts the rise of diabetes prevalence with age. It is worthwhile to note that most diabetics, between 85% and 95% depending on the population, have type 2 diabetes (cited in Detels *et al*., 2009).



Source: Wild *et al*., 2004: 1049

Figure 1: The global diabetes prevalence by sex and age in the year 2000.

Diabetes is described as an epidemic as it causes six deaths every minute with 3.2 million deaths every year (WHO, 2010d). India followed by China, the USA, Indonesia, Japan, Pakistan, Russia, Brazil, Italy and Bangladesh are the top 10 countries affected with the epidemic (WHO, 2010b). The table below (WHO, 2010b) shows the top three countries in the number of people with diabetes in year 2000 and the predicted figures for year 2030.

Table 1: The top three countries in the number of people with diabetes in year 200 and the projected figures for year 2030.

Year		2000	2030
Ranking	**Country**	**People with diabetes (millions)**	
1	India	31.7	79.4
2	China	20.8	42.3
3	United States	17.7	30.3

Source: WHO, 2010b

In Africa, diabetes is no longer a rare disease. This is what Dr Luis Sambo, the World Health Organization (WHO) Regional Director, told delegates at the seventh session of the WHO Regional Committee for Africa (WHO/AFRO, 2007). He also pointed out that recent investigations have shown a prevalence of between 1% and 2%. The prevalence of diabetes is, thus, unfortunately growing in the African region and immediate measures have to be taken by governments. More specifically in sub-Saharan Africa, the rate of death of people with diabetes is high, principally amongst those with type 1 diabetes (Alemu & Watkins, 2004). A mortality of 31% of people with type 1 diabetes has been reported in Addis Ababa, Ethiopia, with a similar rate (32%) reported from the Gondar region (Watkins & Alemu, 2003).

Fortunately, diabetes can be treated. Primary prevention includes a healthy diet and regular physical exercise for individuals at higher risk. Secondary prevention includes early detection and good treatment. The treatment of diabetes is mostly around the regulation of blood pressure and the control of blood glucose levels which can substantially slow down the progression of the disease and reduce the risk of further complications (WHO, 2008b).

1.2.2 Diabetes in Africa

Diabetes was virtually unknown in Africa, in the beginning of the 20th century (International Diabetes Federation, 2009b). A century later, in 2006, 10 million people are suffering from diabetes in the African Region and this figure is expected to double by 2025 (*ibid*). "All African countries are struggling to care for the large number of people with diabetes, especially in urban centres," said Dr Nigel Unwin from WHO's Management of Non-communicable Diseases department (WHO, 2010c). In a review of diabetes in Africa by Sobngwi and colleagues, the prevalence of diabetes ranged from 1% in rural areas to between 1% and 6% in urban areas (Sobngwi *et al.*, 2001).

One of the major challenges faced by African countries in the prevention and cover of diabetes care has been identified as the low awareness amongst the public and primary health-care practitioners (WHO, 2010c). As long as diabetes remains a low priority on national healthcare agendas, which in part reflects the low priority given by the international funding bodies, this is unlikely to change. Other obstacles to tackling the problem are a shortage of national insulin banks and the lack of diabetes specialists and centres in rural areas (*ibid*).

Many people, including children, die from lack of insulin, and sadly it is likely that many of them die even before being diagnosed, let alone treated. Not only is the price of insulin a burden on individual patients, but also on governments (International Insulin Foundation, 2010). For example, Mozambique spends approximately US$ 1.50 per person per year on medicines (*ibid*). The Mozambican government of Mozambique buys 1 vial of insulin at US$ 4.30 (on average a patient needs 13 vials a year). Thus most African governments, including the government of Mozambique, need to prioritise between providing insulin for 1 person for a year, or essential medicines for almost 40 others.

The International Diabetes Federation (IDF) African Region, the World Health Organization (WHO)-AFRO and the African Union have decided to act together and called on governments of African countries, and all partners and stakeholders in diabetes to prevent diabetes and related non-communicable diseases and to improve quality of life and reduce morbidity and premature mortality from diabetes (International Diabetes Federation, 2009b). They claimed for the provision of adequate, appropriate and affordable medications and supplies for people with diabetes; earlier detection and optimal quality care of diabetes; and the dissemination of information and education in order to improve self care.

1.2.3 Mortality and Life Expectancy Associated with Diabetes

Diabetes is strongly linked with impaired quality of life, premature mortality and major economic costs (Dawson *et al*., 2002; Gu, Cowie, Harris, 1998; Stewart, *et al*., 1989). It has been found that people with diabetes have a significantly higher mortality than people without diabetes across all age groups, mainly because diabetes is not just a disease but a risk factor for other diseases (cited in (Detels *et al*., 2009). Also, the risk of death has been found to be higher in women than men (*ibid*). This increase in mortality rates among diabetics leads to substantial reductions in life expectancy (*ibid*). Roper *et al*. (2001) showed from a North England population that both males and females with type 2 diabetes ,aged 40, lose 8 years in life expectancy and those at the age of 60 lose 4 years.

1.2.4 Economic Impact of Diabetes

Diabetes is a costly disease since it is a chronic illness with numerous severe complications associated with it and these complications are difficult to control. The three broad categories of economic costs associated with diabetes are direct health care costs (medications, devices, visits and hospitalisation), indirect health care costs (care in nursing homes and informal care by relatives) and productivity costs (loss of earnings from mortality, morbidity and disability associated with diabetes and its complications) (Economic Intelligent Unit, 2007). Although there have not been robust studies to assess the economic impact of this epidemic, it is clear that the cost of diabetes to the affected individuals and their carers, to health services and to national economies is huge (cited in Detels *et al.*, 2009). In 2007, the International Diabetes Federation (IDF) estimated that the direct annual healthcare cost of diabetes globally for people aged 20-79 was 232-422 billion US dollars (cited in Novo Nordisk, 2009). At a micro-economic level, in the US, in a family with a diabetic member, diabetes care is as high as 10% of the family's income (WHO, 2008b). This figure is 25% in India (*ibid*).

1.3 Background on Mauritius

1.3.1 Socio-Demographic/Economic Characteristics of Mauritius

Since this study has been carried out on a Mauritian population, it is important to provide an overview of the Mauritian society in terms of its social, demographic and economic characteristics.

Mauritius, a small island east of Madagascar, with a population of 1,274,189 (The World Factbook, 2008) comprising Indo-Mauritians (66%), and the general population, that is, people of mixed European and African origin (31%), as well as Sino-Mauritians (3%). Her GDP per capita (PPP) was $11, 700 in 2007, $12, 300 in 2008 and $12, 400 in 2009 (The World Factbook, 2010). Life expectancy at birth has increased from 63 to 71 years of age in the last twenty years (cited in NSFD, 2007). Statistics from the WHO report a life expectancy (in 2006) of 69 years for males and 76 for females (WHO, 2008c). Infant mortality rate has declined from 24.2 per thousand live births in 1987 to 13.2 per thousand live births in 2005 (cited in NSFD, 2007). The number of people dying between 15 and 60 years (per 1000 population) is 212 for males and 108 for females (World Health Statistics, 2008). Over the past few years, death statistics show that over 80 % of deaths are attributable to non-communicable diseases (NCDs). In 2005, 37.1 % of all deaths were attributed to cardiovascular diseases (many of which result from diabetes), 21.1 % to diabetes mellitus and 6.2 % to cancers (cited in NSFD, 2007).

1.3.2 The Mauritian Health Care System: Health Care Expenditure & Structure of the Health Care System

The public health sector in Mauritius caters for about 85% of the population and the private sector caters for the remaining 15% (cited in NSFD, 2007). In the public sector, all levels of care, that is, primary health care (PHC), curative and high-tech medical care, are free at the point of service for the entire population (*ibid*). Total expenditure on health per capita (Intl $, 2005) is $544 and total expenditure on health as a percentage of Gross Domestic Product (GDP) (2005) is 4.3% (World Health Statistics, 2008).

Public health care services in Mauritius are provided free of charge to the population (Health Research for Development in Mauritius, n.d). Mauritius is divided into five health regions, each with a catchment population of about 200,000 inhabitants (*ibid*). Each health region has its own regional referral hospital with a network of health centres, which provides primary health care service (*ibid*). The public health system on the Island, in addition to the five regional hospitals, comprises three districts, one psychiatric and five specialised hospitals (with a total of 3,699 beds). Outpatient services are also delivered in one community hospital, two mediclinics, 23 area health centres and 108 community health centres (*ibid*). The Island of Rodrigues, which a population of around 40,000 people, which is under the governance of Mauritius, has one regional hospital, two area health centres and 11 community health centres (*ibid*).

In the private sector, at the end of 1998, there were 12 nursing homes (private clinics) with a total of 471 beds, 448 medical practitioners - i.e. 45% of all doctors -, 106 dentists and 198 pharmacists (*ibid*). In Agalega, another island within the Mauritian territory, which has a population of around 300 people, there are two Health Centres that provide Primary Health Care (NSFD, 2007). Some of the major public hospitals in Mauritius are Dr. A G. Jeetoo Hospital, Queen Elizabeth Hospital, Flacq Hospital and Jawaharlal Nehru Hospital (*ibid*).

1.3.3 Disease Burden in Mauritius: Non-Communicable Diseases

NCDs have become the main issue of public health importance in Mauritius (WHO, 2004). Evidence of the share that NCDs occupy in the burden of diseases is clearly illustrated in the National Burden of Diseases study performed by the Government of Mauritius in 1994 (*ibid*). NCDs in Mauritius represent 74% of the total burden of disease in men and 76% in women and include diabetes, hypertension, cerebrovascular diseases, cancer, mental illness and substance related diseases linked to tobacco use and alcohol abuse (WHO, 2009a). Table 2 (Ministry of Health & Quality of Life, 2004) below ranks two NCDs together with diabetes over the period 1987 to 2004 and shows that as from 1998 diabetes was ranked second most prevalent NCD in Mauritius after hypertension. In 1987 and 1992, diabetes was only ranked third after Impaired Glucose Tolerance.

Table 2: Ranking of diabetes, Impaired Glucose Tolerance and hypertension over the period 1987 to 2004 in Mauritius.

Non-Communicable Diseases			
Year	**Diabetes**	**Impaired Glucose Tolerance**	**Hypertension**
1987	3rd	2nd	1st
1992	3rd	2nd	1st
1998	2nd	3rd	1st
2004	2nd	3rd	1st

Source: Ministry of Health & Quality of Life, 2004

As the table above shows, Mauritius has not been spared from the afflictions of diabetes. In fact, the Mauritian population has a very high prevalence of diabetes if compared globally and the non-communicable survey performed in 2004 shows that nearly one out of every five persons above the age of 30 years has diabetes (cited in NSFD, 2007). The prevalence of diabetes in Mauritius is discussed in more details below.

1.3.4 Diabetes in Mauritius

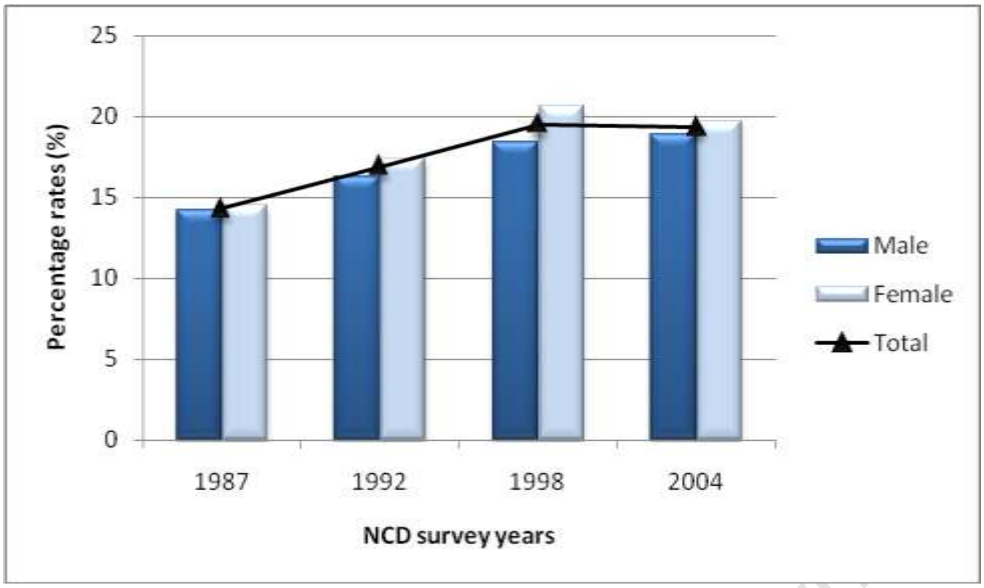
1.3.4.1 Prevalence

The Mauritian population has a high prevalence of diabetes. From 1987 to 1998, the diabetes prevalence has increased from 14.3% to 19.5% (cited in NSFD, 2007). The prevalence has slightly decreased to 19.3% in 2004 and over the past 5-10 years the prevalence of diabetes has stabilised to around 19% (Ministry of Health & Quality of Life, 2004: 8). This data was obtained from the Non-Communicable Diseases Surveys conducted in 1987, 1992, 1998 and 2004 on the Mauritian population aged 30 years and above. The sex-specific trend revealed by this survey is depicted in table 3 and figure 2 below (ibid).

Table 3: Prevalence of diabetes from 1987 to 2004 in population aged 30 years and above in Mauritius.

NCD Survey Years	1987	1992	1998	2004
Male	14.2	16.3	18.4	18.9
Female	14.5	17.4	20.6	19.7
Total	**14.3**	**16.9**	**19.5**	**19.3**

Source: Ministry of Health & Quality of Life, 2004: 8



Source: Ministry of Health & Quality of Life, 2004: 8

Figure 2: Prevalence of diabetes from 1987 to 2004 in population aged 30 and above.

The 2004 NCD survey showed that approximately one out of five Mauritian adults above the age of 30 years was found to suffer from diabetes, that is, there is roughly 120 000 diabetics in Mauritius out of a total population of 1,274,189 (cited in NSFD, 2007; World Factbook, 2008). Most diabetics in Mauritius (about 99.0%) suffer from type 2 diabetes (Ministry of Health & Quality of Life, 2009).

Most recent diabetes prevalence figures are alarming. The fourth NCD survey (2004) conducted by the Ministry of Health also reported that the number of deaths in Mauritius due to diabetes has increased by 700% in the last three years (Net News Publisher, 2009). The Mauritian Health Minister, Rajesh Jeetah, made this declaration during the signing ceremony in 2009 of a cooperation agreement with the Baker International Heart and Diabetes Institute (BIHDI) of Australia (*ibid*). He declared that 50% of those affected by diabetes are not aware of their condition. The Minister also added that some 60,000 Mauritians have already been screened for diabetes by mobile clinics of his ministry since the beginning of the year 2009 (*ibid*). Professor Paul Zimmet of the BIHDI indicated after the signing ceremony that his organisation will help the island set up a Mauritius Diabetes Institute for research, education and treatment (*ibid*). Furthermore, Zimmet indicated the imminent opening of a collaboration centre of the World Health Organization in Mauritius for the training of professionals of the African continent to deal with type 2 diabetes (*ibid*).

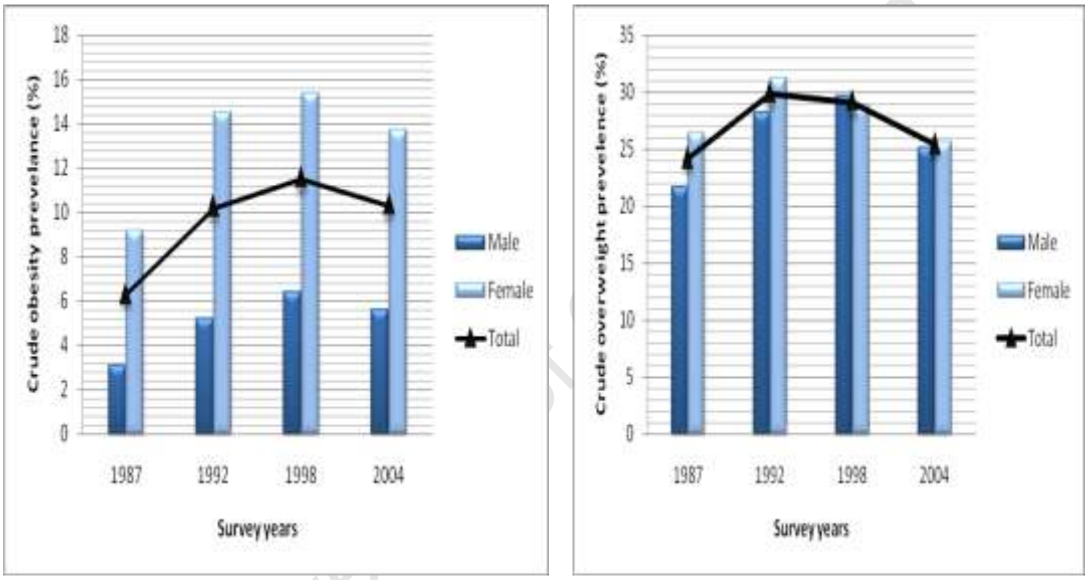
Sadly, the diabetics in Mauritius are affected by the many health complications associated with their condition. These complications are cardiovascular diseases, kidney failure, blindness, damaged nerves to limbs, amputations and secondary to peripheral vascular disease. "Every year 400 Mauritians undergo amputations, another 400 have heart surgery; 175 people's eyes are under the knife every week - all due to a disease that is easily prevented, type 2 diabetes" (Ackbarally, 2009). Other alarming facts about the diabetes epidemic in Mauritius are as follows (Ministry of Health & Quality of Life, 2007a):

- "For every newly diagnosed diabetic, one remains undiagnosed";
- "Diabetes is responsible for a high rate of health complications, costing therefore a major burden to our economy";
- "At least 50-60% of those on kidney haemodialysis are type 2 diabetics";
- "It is the most common cause of blindness in the country";
- "At least 80% of all limb amputations done in the country are from diabetes";
- "More than 50% of diabetics die of ischaemic heart disease especially coronary heart disease".

The complications associated with diabetes can be prevented through good control but the sad reality is that half of those with diabetes do not know that they have the disease and the few who are aware do not have the condition under control (Ministry of Health & Quality of Life, 2007a). For those who do know, a large proportion does not consistently take their medications or adopt healthier lifestyles (*ibid*). Health officials are concerned that the prevalence of diabetes will remain high because of a lack of awareness among the population about the seriousness of the disease (Ackbarally, 2009).

Other related figures on Mauritians' health are: 30 percent of Mauritians are hypertensive, 38 percent are either overweight or obese, 45 percent have high cholesterol, and 75 percent of men and 90 percent of women are not physically active (cited in Ackbarally, 2009). Figures 3 (a) and (b) (Ministry of Health & Quality of Life, 2004: 19) show the prevalence of obesity and overweight from 1987 to 2004 respectively in Mauritius. From the period 1998 to 2004, a decrease of around 10% in overweight and obesity has been noticed (Ministry of Health & Quality of Life, 2004). This decrease may account for the stabilisation in the diabetes prevalence over the same period and could be the result of greater awareness in the population of the health risks associated with obesity and the need to maintain normal body weight (*ibid*). The prevalence of overweight and obesity in 2004 was 35.7 % and they were both more prevalent amongst females than amongst males (*ibid*).

(a) (b)



Source: Ministry of Health & Quality of Life, 2004: 19

Figure 3: (a) Obesity prevalence in consecutive NCD surveys Mauritius and (b) Overweight prevalence in consecutive NCD surveys in Mauritius.

NB: * *"Obesity" is defined as a body mass index greater than 30 kg/m^2 and "overweight" as a body mass index greater than 25 kg/m^2 but less or equal to 30 kg/m^2.*

The prevalence of physical activity amongst Mauritians has also changed over the years. Below, in table 4 (Ministry of Health & Quality of Life, 2004: 25), it is obvious that 'Leisure Physical Activity' has continued to increase steadily in both males and females during the period 1987 to 2004 with an increase in the prevalence of moderate or heavy leisure physical activity from 11.8%(1987) to 24.5% (2004) in males and from 1.4% (1987) to 9.5% (2004) among females. Unfortunately, these figures are slow, especially in females (*ibid*). However, they are likely to increase as more and more adults adopt a healthier lifestyle where regular physical activity takes a more essential role (*ibid*).

Table 4: Prevalence (%) of leisure physical activity (moderate and heavy) in Mauritius.

Year	**1987**	**1992**	**1998**	**2004**
Male	11.8	17.3	21.2	24.5
Female	1.4	2.3	7.2	9.5

Source: Ministry of Health & Quality of Life, 2004: 25

The unhealthy changes in the lifestyle of Mauritians can be attributed to the rapid economic development during the 1990s. A more sedentary lifestyle has been adopted and it is associated with lowered physical activity; issues related to time allocation; tendency to consume more convenient foods; and preference to settle for less strenuous recreational activities (WHO, 2009a). These changes are believed to be the cause of this high diabetes prevalence in the country since diabetes is a disease that could easily be prevented through good nutrition and exercise (Ackbarally, 2009). The table below (Ministry of Economic Development and Regional Co-operation. Central Statistical Office, 1997; NCD Surveys, Ministry of Health & Quality of Life, Island of Mauritius) compares the GDP (at factor cost) growth rate of Mauritius and the diabetes prevalence in Mauritius over the period 1994 to 1997. The table clearly indicates a rapid economic growth from 1994 to 1996 with a stable rate of +5.8 in the 1997. This rapid economic development in the 1990s is accompanied by an increase in the diabetes prevalence over the same period of time. Diabetes prevalence data was only available for the years 1992 and 1998. As a result, intrapolation of prevalence data from the NCD surveys for the year 1992 (17.4%) and 1998 (20.1%) gave the prevalences for the 1994-1997 period. The 1992 and 1998 prevalences were obtained from an age-sex standardization using the 2008 population (Source: NCD Surveys, Ministry of Health & Quality of life, Island of Mauritius).

Table 5: Annual GDP growth rate of Mauritius and the diabetes prevalence in Mauritius over the period 1994 to 1997.

Year	Annual GDP Growth Rate (%)	Diabetes Prevalence
1994	+5.3	18.3
1995	+5.6	18.8
1996	+5.8	19.2
1997	+5.8	19.7

Source: Ministry of Economic Development and Regional Co-operation. Central Statistical Office, 1997; NCD Surveys, Ministry of Health & Quality of Life, Island of Mauritius

Health experts also noted that the high rate of diabetes amongst Mauritians is not caused solely by leading unhealthy lifestyles. It is believed that the Asian genetic background of the population might also play a role. Since around 80% of the Mauritian population is of Asian descent, this is quite worrisome. However, the Mauritian government has commissioned research to better understand the genetic reasons that can cause diabetes (Ackbarally, 2009). The table 6 below (Ministry of Health & Quality of Life, 2004: 9) shows the crude prevalence by ethnic groups. It indicates that the population of Asian origin (Hindu and Muslim) is more prone to diabetes. In 2004, the highest crude prevalence was amongst the Muslims (Asian origin) with 20.5% as compared to 15.8% amongst the "creoles", which had the lowest prevalence. It is worthwhile to note that crude diabetes prevalence was over 15% in all the ethnic groups that constitute the Mauritian population.

Table 6: Crude prevalence (20-74 years) by ethnic group and sex - 2004 in Mauritius.

	Hindu	Muslim	Creole	Chinese	Total
Female	21.8	20.1	16.2	18.3	**20.2**
Male	17.2	20.8	15.6	16.2	**17.7**
Both Sexes	**19.1**	**20.5**	**15.8**	**17.2**	**18.7**

Source: Ministry of Health & Quality of Life, 2004: 9

1.3.4.2 Policy Framework and Diabetes Control in Mauritius

Over time, the Mauritian Government has been conscious of the diabetes problem and has made it a priority. Numerous structures have been put in place to tackle diabetes in Mauritius in terms of diabetes prevention, diabetes management and proper diabetes care delivery.

One of these structures is the Mauritius Diabetes Association (MDA) which was founded in 1981. Its mission statement is to educate the people of Mauritius on various ways they can achieve complete control of their condition while sensitising the whole nation to diabetes, its complications and its prevention (MDA, 2009). On a regional level, the MDA conducts several diabetes control activities such as free blood glucose tests as well as education sessions (awareness and prevention), physical education sessions and counseling (*ibid*). Moreover, on a more national level, monthly programmes are broadcasted on the radio, whereby a medical doctor and a lay person from the MDA interact with the public on issues surrounding diabetes (*ibid*). Diabetes awareness sessions, talks and seminars are also part of the MDA's activities. It is interesting to note that it is as a result of the MDA's request that physical education classes have been introduced in primary schools. The MDA's current plan is to establish a network for the association in various parts of the country (*ibid*). Some of its future objectives are to hold at least three diabetic clinics and one education session each week (*ibid*). The association also envisages offering a help-line service which can operate on a 24-hour basis in order to answer questions and provide assistance in case of emergency. Another future objective of the MDA is the training of diabetic educators and nutritionists who will provide their services in diabetes care in the peripheral centres on a voluntary basis. The MDA is also considering the setting up of regional offices in the four corners of the island (*ibid*)

A more current structure is the National Service Framework for Diabetes (NSFD) included in the governmental programme in 2006 (NSFD, 2007). It has been set up with inputs from all stakeholders involved in diabetes care locally as well as from international experts involved in diabetes care. The Memorandum of Understanding (MoU) for the implementation of the NSFD was signed by the Ministry of Health and Quality of Life in Mauritius and the International Diabetes Institute (IDI) of Australia

(Government of Mauritius, 2005). This MoU was designed to assist the Ministry of Health and Quality of Life to implement the NSFD, train professionals in the management of diabetes and advise on joint collaboration for diabetes research (*ibid*). It also worked towards the establishment of a WHO Collaborating Centre for Diabetes in Mauritius which would be a reference centre for Africa (*ibid*). This MoU also supported Mauritius in the setting up of a Diabetes and Heart Institute which will be a focal point for diabetes education, care and research for Mauritius and Africa (*ibid*).

The main aim of the NSFD is to put the people suffering from diabetes first at the top of the health service (cited NSFD, 2007). Indeed, diabetes should be given such priority considering that one of five deaths in the country is caused by diabetes. The NSFD is responsible of ensuring that the strategies put in place for the prevention, treatment and care of diabetes be achieved in a ten-year time scale (*ibid*). The strategies of the NSFD aim at (1) identifying the people suffering from diabetes, but who are unaware of it, before they develop complications, (2) identifying individuals at high risk of developing diabetes, (3) undertaking a vast empowerment programme for people living with diabetes, (4) re-engineering all aspects of diabetes care such that modern and up-to-date diabetes care is delivered, (5) restoring foot care with support from a podiatry service and (6) reorganising primary, secondary and tertiary prevention services (NSFD, 2007).

As mentioned earlier, diabetes can be prevented and controlled but this is a long battle which requires political support, the right technology, both private sector and international support as well as committed skilled staff (cited in NSFD, 2007). It has to be pointed out that amongst the NCDs, diabetes is the most costly and it is the major risk factor for other NCDs (*ibid*).

Various programs and activities have also been set up by the government in Mauritius with the same aims as MDA's. In 2008, the Government put emphasis on "Diabetes and Footcare" and the slogan was "Put Feet First: Prevent Amputations" (Government of Mauritius, 2005). Furthermore, the Government sponsored a television programme creating direct interaction with the population and mounting sensitisation campaigns in Social Welfare Centres, Women Centres, Community Centres, Youth Centres, elderly clubs and other social clubs.

A future measure to fight the epidemic is the creation of a diabetics register. According to Dr. Yuva Paratian, special adviser to Prime Minister Navin Chandra Ramgoolam, a national register for diabetics will be created (Mauritius News, 2008). The register will list all patients and data on their address, the facilities at their disposal to control their disease, the availability of doctors, nurses, psychologists and the necessary infrastructure where they can do physical exercise, will be collected in the register.

Policies have been devised to tackle the problem of diabetes in Mauritius. Indeed, a United Nations General Assembly Resolution announced on 20 December 2006 the need for Member states to develop national policies for the prevention, treatment and care of diabetes (NSFD, 2007). Policies to lower the diabetes prevalence in Mauritius are numerous but studies of whether they have proven to be effective are inexistent. These policies are, firstly, the ban of the sale of aerated soft drinks in educational institutions since the beginning of the year 2008 (Devi, 2008). This strategy was designed and implemented to grapple with the problems of obesity and diabetes (*ibid*). Secondly, screening for diabetes started since 2006 and a national nutrition plan will soon be finalised (*ibid*). Other policies are the waiving of taxes on glucometres and testing strips (Government of Mauritius, 2005). In addition, changes in government nutrition policies in the 1990s and education led to greater preference for healthier types of cooking oil among the population (Dowse *et al*., 1995).

Table 7 below summarises the above information concerning the various policy frameworks that have been put in place in Mauritius overtime.

Table 7: Policy frameworks in Mauritius on diabetes overtime.

Year	Policy Frameworks
1981	Mauritius Diabetes Association founded
2006	Ban of the sale of aerated soft drinks in educational institutions
2006	National Service Framework for Diabetes (NSFD) was included in the Government's programme
2006	Screening for diabetes started
2007	(1) Government put emphasis on "Diabetes & Footcare" (2) sponsoring of a TV programme on Diabetes (3) Sensitisation campaigns in Social Welfare Centres, Social Clubs etc…

Source: Created by author

1.4 Statement of the Problem

The growing issue of diabetes is a reality in Mauritius. The adult prevalence has almost reached 20%. Just like the countries with high diabetes prevalence, Mauritius is threatened by high human, social and economic costs. According to the Health Ministry in Mauritius, the Government spends around Rs (Mauritian Rupees) 100 million[1] annually on cardiac surgery, another Rs 100 million for renal dialysis and Rs 350 million[2] on medicines for diabetes care (Mauritius News, 2008). A hundred people have their legs amputated and 5,000 receive treatment for their eyes annually because of diabetes (*ibid*). In addition, it is creating tremendous pressure not only on the health care system but on Mauritian households. Nearly every Mauritian family is confronted directly or indirectly with the suffering and costs associated with diabetes. Health care resources are already constrained and the additional pressure exerted by the high costs of diabetes can have dire consequences on the economy, especially since the public sector bears a significant proportion of all direct health care costs. Loss of income, resulting from high costs of diabetes, limits many individuals' ability to live a normal life and to perform their roles in the society to the maximum. The high medical expenses associated with diabetes care are capable of leading households into poverty and further impoverish those who are already living below

[1] $3.1 million USD
[2] $11 million USD

the poverty line. Even if public health care is free in Mauritius, other costs both direct and indirect, such as transport costs and loss of labour hours can drive households into asset depletion and indebtedness. Also, diabetes control requires specific diets which are often expensive. Thus, if this problem is not adequately and immediately addressed, the consequences will be severe.

Conscious of this alarming situation, Government has made it a priority and in fact has been visionary enough to include in its programme the formulation of a National Service Framework for Diabetes (NSFD) for Mauritius. Given the visible commitment of the Government to lower the diabetes prevalence in the country, it is surprising that there has been only little change in this figure. One reason for the apparent ineffectiveness of the diabetes control policies might be the lack of information on the determinants of diabetes in Mauritius. The current policies might be based on wrong premises. It is true that several studies have made the identification of diabetes prevalence determinants their focal point. However, these studies have not been conducted in a Mauritian setting and the use of these studies to inform policies around diabetes control might not lead to the desired impact on the diabetes prevalence in the country. Another probable reason for the prevailing high diabetes prevalence in Mauritius might be the poor implementation of the policies. The list is surely much longer, however, for the purpose of this study; we are more concerned with the most important of these reasons – information on the determinants of diabetes prevalence. In order to further facilitate the work done by the Government and other bodies to fight the diabetes epidemic, the factors associated with diabetes prevalence in Mauritius have to be identified. We believe that a poor utilisation of diabetic services in country is correlated to an increase in prevalence of the disease. Thus, determinants of diabetes utilisation also have to be identified. Type 2 diabetes instead of type 1 diabetes has been investigated in this study simply because type 1 diabetes is less common whilst type 2 diabetes accounts for 90% of all diabetes cases worldwide, and its prevalence affected by several lifestyle factors. In addition, diabetes is predominantly of type 2 in Mauritius.

1.5 Rationale & Justification

The importance of this study has already been made clear in the preceding parts of this paper. However, it shall be made more clear-cut in this section.

Our study specifically aims at identifying both the factors associated with diabetes prevalence and those that influence the utilisation of diabetes care services in the Mauritian context. The study also examined whether the factors that affect diabetes prevalence also influence its utilisation, thus, identifying the common link between the two, for example, whether poor people have greater burden of illness as well as reduced access to diabetes care services. The results of this study will clearly depict the various demographic, socio-economic and lifestyle features factors that are associated with diabetes prevalence and utilisation in Mauritius and will, without any doubt, widen the body of research and emphasise on the diabetes issue in Mauritius. Below are some justifications of this study.

A strong justification of this study is its novel contribution to the literature due to the lack of similar studies conducted in Mauritius. Indeed, only a few studies on diabetes prevalence have been conducted on the Mauritian population. One of them is Soderberg *et al*. (2005) which was aimed at describing the prevalence of different stages of glucose intolerance in the Mauritian population followed over 11 years. They reported an increase in both sexes, and in all age and ethnic groups. However, the Soderberg *et al*. (2005) study differs from our study in many ways. Firstly, they only focused on reporting an increase in diabetes prevalence and did not identify the factors associated with this increase. Secondly, the utilisation of diabetes care services was not one of their objectives. Moreover, one important gap in their study is the use of secondary data. Williams *et al*. (2003) also made use of secondary data to examine gender differences in the prevalence of various categories of glucose tolerance on the Mauritian population. Not only did Williams *et al*. (2003) examine only one associative factor of diabetes, which is gender, but also omitted to include utilisation in their study. Hence, the literature search revealed a severe lack of information on the utilisation of diabetes care services in Mauritius. Furthermore, studies focusing on both prevalence and utilisation are quasi inexistent. Thus, this study will be of major contribution to the literature as it focuses on both prevalence and utilisation, as well as the link between them. Also, our study makes use of primary data.

As mentioned in the earlier sections, diabetes is a growing issue in Mauritius. It is considered a costly disease exerting considerable pressure on both the public sector and the private sector. It is obvious that this present study will contribute towards enabling both public and private health services in Mauritius to redirect their meager resources where they are most needed, thus, avoiding unnecessary wastage. This is another strong justification of this study.

1.6 Study Aim

The overall aim of the study is to identify the factors associated with diabetes (type 2) prevalence and those associated with the utilisation the diabetes care services in Mauritius. The common link between diabetes prevalence and diabetes care utilisation will also be investigated. This study is expected to contribute to the literature with regards to diabetes.

1.7 Objectives

The following are the specific objectives of the study:

1. To identify the factors associated with the prevalence of diabetes in Mauritius.
2. To identify the factors associated with the utilisation of diabetes health care services amongst Mauritian diabetics.
3. To identify the common factors associated with diabetes prevalence and utilisation of diabetes care services.
4. To inform policies on the most appropriate ways to tackle the growing diabetes problem in Mauritius.

1.8 Gaps to be filled in the Literature

- There are only a few diabetes studies conducted in a Mauritius. Since diabetes is a growing issue in Mauritius, with a prevalence of almost 20%, amongst the adult population, it is important that more studies focus on the identification of the causes of diabetes in order to inform policies.

- Most diabetes studies have focused on either diabetes prevalence and its risk factors or the use of diabetes care services, but not both. Thus, there is a lack of knowledge on the connection between diabetes prevalence and the utilisation of diabetes care services. This study is unique in the sense that it focuses on the examination of the factors associated with the epidemic and its service utilisation as well as the association between the two.

1.9 Thesis Outline

This thesis has been organised into six chapters. Chapter one has presented the introduction of the study and is divided into different sub-sections. The introductory parts highlight the impact and burden of diabetes worldwide, together with a description of the disease. This is followed by some relevant background on Mauritius and its health care system. Then, non-communicable diseases including diabetes are described in the Mauritian context in terms of their burden and prevalence. Policy frameworks for diabetes control are presented next. The next parts are the rationale and justification section, followed by the study aim, the objectives and various gaps to be filled in the literature. A synopsis precedes the introduction.

Chapter two is the literature review which consists firstly of an introduction followed a brief review on diabetes burden and economic growth. Furthermore, this chapter reviews the literature for the risk factors of diabetes and the determinants of general utilisation of health care and the utilisation of diabetes care services. A discussion on the theories of health care utilisation is also present. A relevant concept namely, access, is also discussed in this chapter. Next, a conceptual framework depicts the structure as well as concepts and theories applied in this study. Some models and methodological issues are presented in the next section of this chapter.

Chapter three describes the methods used in the study. It elaborates on the different procedures of data collection, quality assurance of data and study as well as data management. Statistical data analysis is dealt with in this chapter which ends with the ethical considerations and the study limitations.

Chapter four presents the findings in tabular form and their interpretations. The key findings are discussed in Chapter five and Chapter six presents a summary of the research and makes policy recommendations.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

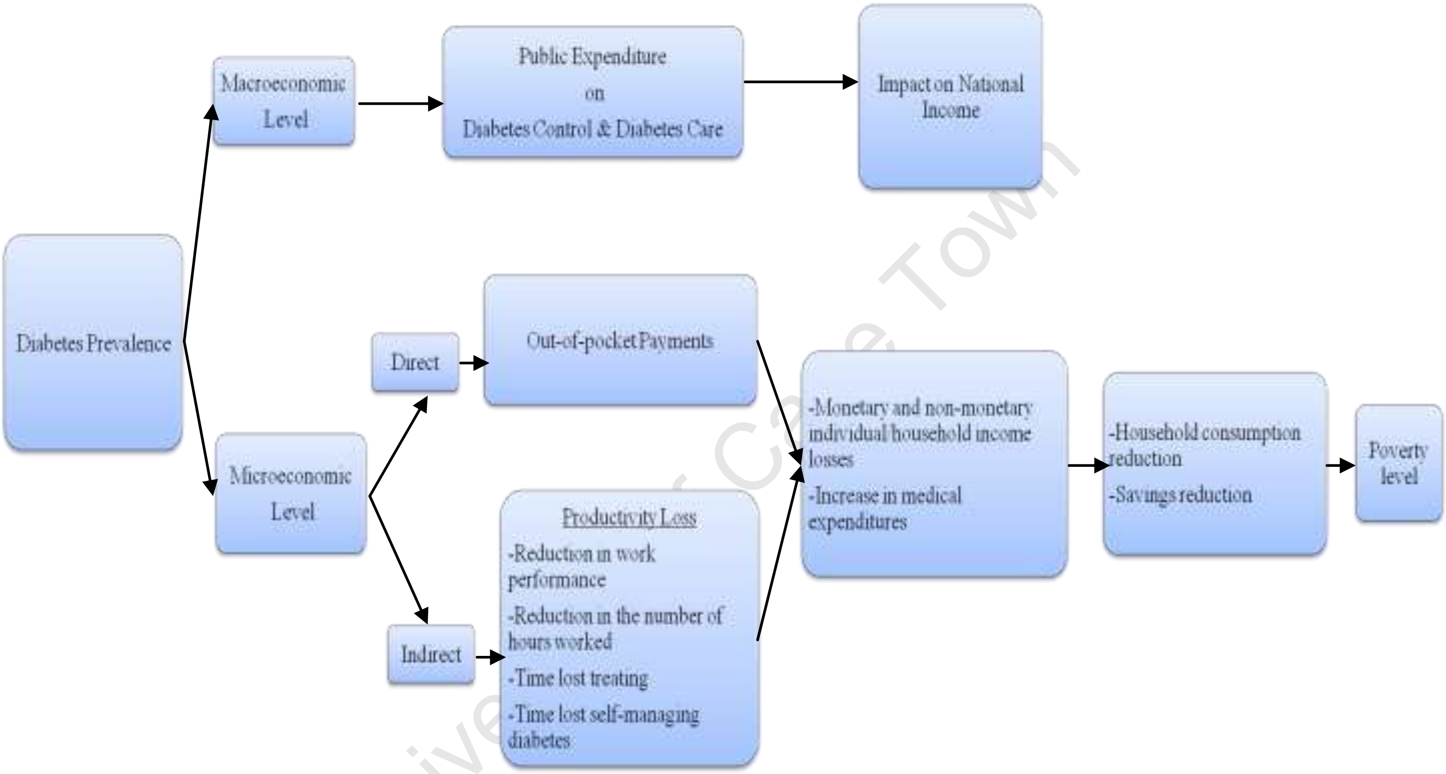
This section reviews the literature and provides a critical appraisal of writings by scholars and researchers on the various issues directly and indirectly related to the topic which deals with the factors associated with diabetes prevalence and the utilisation of diabetes care services in Mauritius.

The first section provides a discussion on the diabetes burden and its effect on economic growth. The next section reviews the literature for the factors associated with diabetes prevalence or the risks factors of diabetes. In this section, the focus will be on the risk factors of type 2 diabetes as opposed to those of type 1 diabetes. This is simply because the population group of this study is adults (above 18 years) and type 2 diabetes is more prevalent amongst adults. Various factors identified from the literature can be categorised as either un-modifiable factors or modifiable factors. Un-modifiable risk factors of diabetes are those factors that are inevitable and do not change throughout the lifetime of an individual such as ethnicity and gender. On the other hand, modifiable factors can also be termed "avoidable" factors and are those factors that can vary throughout the lifetime of an individual. In our context, they include factors such as obesity, physical activity/inactivity, smoking, diet and sedentary factors. Thus, the next section will discuss the (1) un-modifiable factors; the (2) modifiable factors as well as; (3) socio-economic determinants of diabetes like educational level and place of residence.

The following section presents the theory about health care utilisation and reviews three utilisation models that have been conceptualised by scholars. Section 2.4 reviews the empirical determinants of general health care utilisation and also narrows down the discussion to the utilisation of diabetes care services.

Sections 2.5 provides some useful information as well as a discussion on a key concept relevant to this study, namely, access, in relation to diabetes prevalence and utilisation of diabetes care services. The conceptual framework is presented next, followed by a last section on models and methodological issues.

2.1 Diabetes Burden & Economic Growth



Source: Created by author

Figure 4: Diabetes burden and economic growth framework.

The diabetes epidemic is as much an economic issue as it is a health issue (cited in Yach, Stuckler & Brownell, 2006). In fact, it is considered as one of the costliest health problems in the world (Novo Nordisk, 2009). As shown in figure 4 above, the disease burden of diabetes has multiple effects both at the macro-economic level and at the micro-economic level. The burden of diabetes on the health system (macro-economic) only reflects a fraction of the financial load the sick individuals, their families and communities (micro-economic) have to bear (cited in Yach, Stuckler & Brownell, 2006).

At the micro-economic level, both direct (out-of-pocket payments) and indirect (lost in productivity) consequences exist. Out-of-pocket payments is a form of direct health care costs which includes costs for items such as medications, devices, visits to health care professionals, both generalists and specialist as well as hospitalisation for both diabetes and its complications (Economic Intelligent Unit, 2007). Even though a large portion of medical expenses are usually borne by private and public health insurance programs for individuals with coverage, people with diabetes may still incur a considerable amount of out-of-pocket expenses (cited in Javitt & Chiang, 1995). A reason for this is that diabetics tend to use more of the medical services as compared to non-diabetics, thus, they not only are more likely to incur higher total medical expenditures but also higher out-of-pocket expenses (*ibid*). Entmacher *et al*. (1985) were able to show that the per capita out-of-pocket medical expenses for diabetic patients are much higher than for the non-diabetic population across all age groups. The authors found that the differences were especially considerable in the costs for prescribed medicine, for which diabetic individuals incurred 1.6-3.5 times more out-of-pocket expenses than the general population depending on age (see figure 4). The figure below (Javitt & Chiang, 1995: 608) shows the total and the out-of-pocket medical expenses of the diabetics versus the general population in the United States. The authors analysed data obtained from the 1987 National Medical Expenditure Survey in the United States.

Type of expense	Percent with medical expense		Average total medical expenditure ($) per person with expense		Average out-of-pocket expenditure ($) per person with expense		Cost ratio, diabetic vs. general population: Persons with expense		Cost ratio, diabetic vs. general population: All persons	
	DM	Gen. pop.	DM	Gen. pop.	DM	Gen. pop.	Total	Out-of-pocket	Total	Out-of-pocket
Physician office visit	94	71	541	311	245	167	1.7	1.5	2.3	1.9
Hospital outpatient visit	37	17	1,609	909	282	249	1.8	1.1	3.9	2.5
Emergency room visit	27	5	414	266	121	101	1.6	1.2	7.8	6.0
Prescribed medication	97	57	470	147	286	97	3.2	3.0	5.5	5.1

DM, diabetes mellitus patients; gen. pop., general population. Costs shown are costs per person for those who used any medical care; the ratio of costs for those with versus those without diabetes is shown for persons with an expense and for all persons (costs averaged over all persons, with or without an expense in the year).

Source: Javitt & Chiang, 1995: 608

Figure 5: Total and out-of-pocket medical expenses: diabetic patients versus the general population.

(Please note that the figure below presents very old data, which may not reflect the current situation)

On the other hand, an indirect consequence at the micro-economic level is the lost in productivity due to mortality, morbidity and disability associated with diabetes (Economic Intelligent Unit, 2007), which is a result of a reduction in work performance, reduction in the number of hours worked, time lost in the treatment of the diabetes by both the affected individuals and their carers and time lost in the self-management of diabetes. Thus, diabetes, like a chronic disease, can limit employment (cited in Detels *et al.*, 2009), cause premature retirement (Mete & Schultz, 2002), which may in turn have an impact on the income of people and cause a higher dependence on welfare (cited in Yach, Stuckler & Brownell, 2006).

The Pracon study performed in the United States in 1988 revealed a total amount of labour days lost by persons with diabetes due to outpatient physician visits of an estimated 1,379,103 person-days per year, which results in a cost of about $0.87 billion (Pracon Incorporated, 1988). Furthermore, a total of 873,432 work days were lost due to diabetes illness or symptoms, costing $0.55 billion. These figures correspond to the short-term morbidity only which was associated with an overall loss of $1.42 billion in productivity in 1987. As for long-term disability, the Pracon study estimated that diabetes disabled 9,319 workers with an indirect cost of $3.1 billion. Even though these results have been reported from an American study and are not generalisable, they give a good idea of the lost in productivity at micro-economic level associated with diabetes prevalence.

The consequences of both out-of pocket payments and productivity at micro-economic level are both monetary and non-monetary individual/household income losses in terms of decreased household wages, earnings and incomes (Kraut *et al*., 2001). In certain countries, where health care is not free and individuals have to pay for their own healthcare, families are forced to finance the significant costs of diabetes treatment entirely on their own (cited in Yach, Stuckler & Brownell, 2006). For example, in India, 15-25% of the household income is required in order to cover the treatment costs of diabetes (Shobhana *et al*., 2000). Moreover, in Tanzania, treatment costs amount to 20 times the per capita health expenditure or 25% of the minimum wage (Neuhann *et al*., 2002). In the United Kingdom, 7% of the type 2 diabetics aged less than 65 years lost income as a result of their condition. On average, they lost £13 800 per year and their carers lost £11 000 per year (Holmes *et al*., 2003). Thus, the diabetes burden is responsible for significant income losses and this burden is often greatest on people who can least afford it (cited in Yach, Stuckler & Brownell, 2006). This unfortunately results in impoverishment, including household reduction consumption and savings reduction, and the widening of the inequality gap (*ibid*).

Another consequence of both out-of pocket payments and productivity at micro-economic level is an increase in medical expenditures. In turn, this increase together with the income losses lead to a reduction in household consumption as well as in savings as mentioned above. Eventually, both the direct and the indirect consequences of the micro-economic level diabetes burden have an effect on poverty level of the country. Subsequently, the poverty level is naturally affected by the national income, which is directly linked to diabetes prevalence at a macro-economic level.

At macro-economic level, there is substantial evidence to show the considerable burden of diabetes on health systems and on the economy of the country as a whole.

The table below (Yach, Stuckler & Brownell, 2006: 63) shows the macro-economic burden of diabetes for some selected developed and developing countries by showing that total amount of resources that the epidemic siphons from the health systems.

Table 8: Macro-economic burden of diabetes for some selected developed and developing countries.

Country	Year of Estimate	Total Costs (percent of GDP)	Percentage of Total Indirect Costs	Reference
United States	2002	1.3	30.7	American Diabetes Association (2003)
Canada	1998	0.78	30.4	Dawson *et al*. (2002)
Mexico	2000	2.6	n/a	Barcelo *et al*. (2003)
Brazil	2000	3.8	82.5	Barcelo *et al*. (2003)
Tanzania	1992	0.5	n/a	Chale *et al*. (1992)

Source: Yach, Stuckler & Brownell, 2006: 63

The high costs on the health systems have a considerable impact on the national income, which subsequently affects the poverty level of the country. If one considers the effects of premature mortality alone, WHO estimates that (between 2005 and 2014) diabetes, heart disease and stroke (which are diabetes complications) combined, will cost $555.7 billion in lost national income in China, $303.2 billion in the Russian Federation; $336.6 billion in India; $49.2 billion in Brazil and $2.5 billion even in a very poor country like Tanzania (cited in International Diabetes Federation, 2006). As a result of these losses in national income, economic growth is naturally affected particularly due to "loss of investments in trained labour; increased taxation (in all its forms) for medical care and support of the disabled; the economic failure of family units and small businesses; withdrawals of children from education (especially girls) to care for ailing relatives; AIDS, tuberculosis, crime and other adverse consequences of destitution; and the general loss of the hope and self-reliance that ultimately drive all economic growth" (cited in International Diabetes Federation, 2006). The United Kingdom lost 0.4% of its Gross Domestic Product (GDP) to diabetes and the United States lost 1.2% (Economist Intelligence Unit, 2007). As for India, it lost 2.1% (*ibid*).

These losses due to diabetes, indeed, result in "large annual losses in economic growth that harm everyone" (cited in International Diabetes Federation, 2006).

It is a reality that diabetes threatens to slow down economic advancement globally, if nothing is done (*ibid*). Moreover, since the epidemic is growing faster in the world's developing economies than in its developed ones, it is the developing world that will bear the brunt of lost economic growth (*ibid*).

2.2 Risk Factors associated with Diabetes

2.2.1 Introduction

This section elaborates on the various risks factors of diabetes identified in the literature, which can also be referred to as the determinants of diabetes prevalence. It is important to note that the factors associated with diabetes prevalence and these associations are inexhaustible.

There exist strong genetic and environmental factors around the risk of both type 1 and type 2 diabetes and the interaction of these two types of effects causes diabetes onset (Detels *et al*., 2009). The environmental factors associated with type 2 diabetes are relatively well understood. However, environmental factors associated with type 1 diabetes are still elusive.

The main risk factors of type 1 diabetes that have been identified are firstly familial and genetic factors, whereby the lifetime risk of type 1 diabetes is approximately 6% if a first degree relative (e.g. a sibling) carries the disease and 0.4% if a first degree relative is not affected by the disease (cited in Detels *et al*., 2009). The second category of type 1 diabetes risk factors is environmental factors. The presence of these factors have been shown by the presence of rapid changes in the incidence of type 1 diabetes that are far too fast to be due to genetic factors (*ibid*).

As mentioned earlier, this study is concerned with the risk factors associated with the prevalence and onset of type 2 diabetes (more prevalent in adults) rather than type 1 diabetes since type 2 diabetes is much more prevalent in Mauritius. These risk factors have been well defined in several studies and they have been divided in two main groups namely un-modifiable and modifiable risk factors (cited in Detels *et al*., 2009; Holt & Peveler, 2009). In our study, we have added "socio-economic determinants of diabetes" as a separate category. Biological risk factors of type 2 diabetes also exist and they include raised: blood glucose and the presence of several cardiovascular risk factors (cited in Detels *et al*., 2009). However, these risk factors will not be evaluated in this study.

The following sections will review the un-modifiable and the modifiable risk factors of type 2 diabetes as well as the socio-economic determinants of diabetes. Let us now remind the reader what we mean by modifiable and un-modifiable risk factors of diabetes. Un-modifiable risk factors of diabetes are those factors that are inevitable. These factors do not change throughout the lifetime of an individual and cannot be controlled by that individual. Some examples are ethnicity and gender. On the other hand, modifiable factors can also be termed "avoidable" factors, and are those factors that can vary throughout the lifetime of an individual and examples are lifestyle factors, such as diet and smoking habits. These factors can be controlled by the individual.

2.2.2 Un-modifiable Risk Factors of Diabetes

2.2.2.1 Age & Sex

It has been shown that the risk of type 2 diabetes increases sharply with age (Figure 1) (Wild et al., 2004). The global prevalence of type 2 diabetes was slightly higher in females in year 2000 as compared to males as from the age 65-70 years (Figure 1) (Wild et al., 2004). However, in most United Kingdom studies, the prevalence of diagnosed diabetes has been found to be slightly higher in males, whilst that of where glucose is measured, no difference in prevalence was noted between the two sexes (cited in Detels *et al*., 2009). In Mauritius, a slightly higher diabetes prevalence has been reported amongst men (22.0%) as compared to women (21.8%) (Williams *et al*., 2003). In fact, within the age group 20 - 59, diabetes is more prevalent among males than females (WHO, 2009a). However, this pattern is reversed for age group over 60, with higher prevalence rates among females (*ibid*).

2.2.2.2 Family History

Another influential factor of diabetes is the genetics factor or the family history of diabetics, which has been recognised to be a very important risk factor for this disease (Bishop, Zimmerman & Roesler, 1998; Nakanishi *et al.*, 2003; The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus, 2003). Family medical history represents valuable genomic information since it comprises of interactions between environmental, behavioural, and genetic factors.

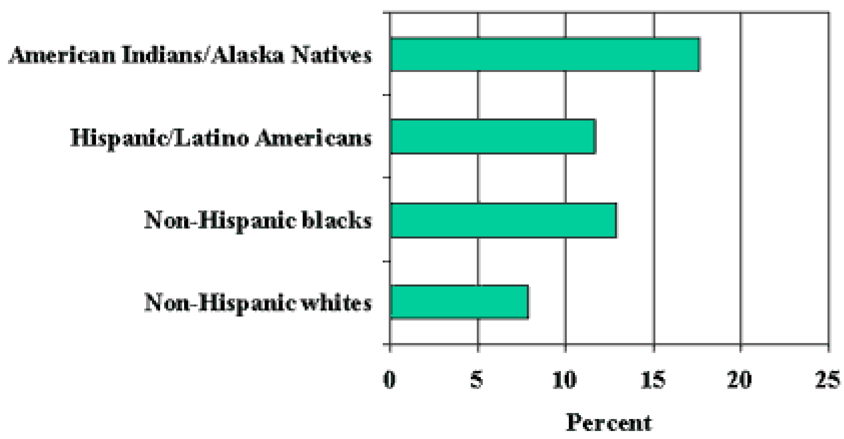
As early as 1946, Joslin *et al.*, (1946) mentioned that "hereditary is the basis of diabetes". Also, the presence of familial clustering of type 2 diabetes, suggesting its genetic influences has been known for several years (Zimmet, 1992). Indeed, genetics is believed to play a role in the occurrence of diabetes which is indicated by the fact that it occurs multiple times in a family. The sad reality is that individuals having a family history of diabetes can have two to six times the risk of type 2 diabetes compared to those with no family history of the disease (Bishop, Zimmerman & Roesler, 1998). Thus, certain individuals are predisposed to develop the disease than others.

Numerous studies have shown that type 1 diabetes is strongly genetically linked and associated with a chromosome (Atkinson *et al.*, 1993; Cox *et al.*, 2001; Herr *et al.*, 2000). However, the genetic basis of type 1 & 2 diabetes has not been totally unravelled, although some promising susceptibility genes for type 2 diabetes have been identified (Altshuler *et al.*, 2000; Gloyn *et al.*, 2003; McIntyre & Walker, 2002; Weedon *et al.*, 2003). Over 20 regions in the human genome are associated with type 1 diabetes, but most of them only make a minor contribution to the overall susceptibility to type 1 diabetes (Davies *et al*, 1994; Concannon *et al.*, 1998).

2.2.2.3 Ethnicity

Similarly, ethnicity plays a role in diabetes occurrence. In fact, it has been observed that the prevalence and the degree of changes in the prevalence of diabetes differ among different ethnic groups (Sloan, 1963). However, the reasons for these differences, whether they be due to differences in environment (including behaviours) or differences in genetic susceptibility, are not clearly known (Oldroyd *et al*., 2005).

Interestingly, in certain multiethnic populations some ethnic groups do have a much higher prevalence of diabetes than the same ethnic group living in the country of origin. For example, African Americans have a diabetes prevalence of at least 12 times higher than that observed in Native African Black people (12% and 1%, respectively) (Rotimi *et al*., 1999). These observations suggest that certain ethnic groups have a higher predisposition of developing type 2 diabetes compared with others, when exposed to similar adverse environmental conditions. This susceptibility can be explained through genetic factors (Carulli *et al*., 2005). Epidemiological studies have shown that the prevalence of diabetes is significantly higher in ethnic minorities such as the Hispanics and Asians as compared to the ethnic group of European descent (Caucasians) even when exposed to similar environmental condition (Hanis *et al*., 1983; Ramachandran *et al*., 1992; Simmons, Williams, & Powell, 1992; Stern *et al*., 1984). Figure 6 (CDC, 2005) depicts the difference in diabetes prevalence amongst American Indians/Alaska natives, Hispanic/Latino Americans, Non-Hispanic Blacks and Non-Hispanic whites. It reveals a higher prevalence in ethnic minorities.



Source: CDC, 2005

Figure 6: Age-adjusted total prevalence of diabetes in people aged 20 years or older, by race/ethnicity-United States, 2002.

Epidemiological data from India and other countries where Indians have migrated clearly show the excessive predisposition of this ethnic group to develop diabetes. Ramachandran *et al*. (1992) showed that Asian Indians living in rural India have only 2 - 3% prevalence of diabetes. However, the prevalence increases to about a fourfold for those living in urban areas or migrated to developed countries (Dowse *et al*., 1990; McKeigue, Miller, & Marmot, 1989).

In Mauritius, as mentioned in the earlier section, the Indian population (Hindu and Muslim) is more prone to diabetes (Ministry of Health & Quality of Life, 2004). This information is depicted in table 6.

2.2.3 Modifiable Risk Factors of Diabetes

2.2.3.1 Obesity

Today, more than 1.1 billion adults are overweight worldwide and 312 million of them are obese. Obesity is also a serious problem amongst children with 155 million children being either overweight or obese worldwide (Hossain, Kawar & El Nahas, 2007). The International Obesity Task Force and the World Health Organization have thus revised the definition of obesity (*ibid*). They adjusted for ethnic differences and, as a result, this broader definition now captures a higher prevalence of obesity of 1.7 billion individuals worldwide (*ibid*). The increase in the prevalence of obesity is in turn increasing the prevalence of type 2 diabetes as these two are closely linked (*ibid*). This relationship is continuous, very strong, and is apparent below conventional cut points for overweight (Hartemink *et al*., 2006; Vazquez *et al*., 2007). There is a substantial amount of evidence that suggests that it is the distribution of body fat that is particularly crucial in determining the risk of type 2 diabetes (and indeed cardiovascular disease), with greatest risk associated with abdominal obesity (Despres, 2001). It is now clear that the growing challenge of cardiovascular diseases and diabetes in particular, is linked to the prevalence of overweight and obesity (Carey *et al*., 1997; Colditz *et al*., 1990; Haslam & James, 2005; Hu *et al*., 2001).

2.2.3.2 Physical Activity

Similarly, lack of physical activity or exercise has been cited as a key factor in the management of diabetes as well as a possible risk factor of diabetes. However, it is not until this last decade that the importance of exercise and fitness has been backed up with high-quality evidence. Physical activity and the risk of diabetes have been shown to adopt a dose-response relationship (Manson *et al*., 1991; Manson *et al*., 1992). There is now good evidence that physical activity reduces the risk of type 2 diabetes independent of obesity level. A 30-50% reduction in the risk of developing type 2 diabetes has been associated with regular moderate or vigorous activity (Jeon *et al*., 2007). Moreover, similar benefits have been shown from energy expenditure from walking and vigorous activity with respect to a reduction in the risk of diabetes (Hu *et al*., 1999).

In light of the two key factors, obesity and exercise, being considered to be highly influential, further research was recommended by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) on the lifestyle changes related to them. The NIDDK conference on behavioural science research in diabetes identifies four key topics related to obesity and physical activity. These topics are namely (1) the environmental factors associated with obesity, eating and physical activity, (2) the adoption and maintenance of healthy eating, physical activity and weight, (3) the etiology of eating and physical activity and (4) multiple behaviour changes (Wing *et al*., 2001).

2.2.3.3 Smoking

Smoking is considered as a lifestyle behaviour and has been identified as a risk factor of diabetes (Hu *et al*., 2001; Kawakami *et al*, 1997; Rimm, Manson & Stampfer, 1993, Rimm *et al*., 1995). Cigarette smoking not only increases the risk of developing diabetes but increases the risk of mortality in individuals with diabetes (Klein *et al*., 1989; Moy, Laporte & Dorman, 1990; Manson, Colditz, & Stampfer, 1991; Stamler *et al*., 1993; Uusitupa *et al*., 1993).

2.2.3.4 Diet

Evidence that the composition of the diet, over and above its calorific value, has an effect on the risk of type 2 diabetes exists. Diets low in fibre and high in saturated fat have been associated with increased risk (Parillo & Riccardi, 2004). Similarly, some intervention studies support the evidence that a high-fibre-low-saturated-fat diet can help in the prevention of type 2 diabetes (Lindstrom *et al*., 2006). Also, high-glycaemic index foods have been associated with an increased in the risk of type 2 diabetes (Hodge *et al*., 2004). There is also evidence that moderate alcohol intake (Parillo & Riccardi, 2004; Wannamethee *et al*., 2003) and coffee consumption (Salazar-Martinez *et al*., 2004; Smith *et al*., 2006) can reduce the risk of type 2 diabetes.

Jiang *et al*. (2002) focused on a particular foodstuff as being an important dietary complement for diabetics and managed to show its benefits. The proposed hypothesis was that nuts are high in unsaturated, both polyunsaturated and monounsaturated, fat as well as other nutrients which can improve glucose and insulin homeostasis. Indeed, they used a sample of 83 818 women and showed an inverse relationship between nut consumption and the risk of diabetes. These findings are in line with others found in the literature suggesting that a higher intake of monounsaturated and polyunsaturated fat improves insulin sensitivity (Heine *et al*., 1989; Houtsmuller *et al*., 1980; Parillo *et al*., 1992; Vessby *et al*., 2001).

Thus, diet is also an important factor in diabetes prevention and treatment. In the case of treatment, for most of the past century, in most developing countries, the reduction of carbohydrates was the basis of the dietary prescription for diabetics. However, these same diets were subsequently high in fat. However, in the mid 1970s, these diets changed to a reduction in the intake of total and saturated fat and an increased uptake in polysaccharides (Mann, 1980). This was because coronary health disease (CHD) accounted for most of the deaths in type 2 diabetes. Thus, diabetics are now generally thought to need a diet with reduced saturated fat intake. However, discrepancies still exist in the nutritional recommendations from North America and Europe (The Diabetes and Nutrition Study Group (DNSG) of the European

Association for the Study of Diabetes (EASD), 1999; American Diabetes Association, 2002).

2.2.3.5 Sedentary Factors

Still in the context of risk factors of diabetes, an interesting study examined the relationship between various sedentary behaviours, especially prolonged television watching and the risk of obesity as well as type 2 diabetes (Hu *et al*., 2003). This prospective cohort study was conducted among female nurses from 1992 to 1998. The results showed that independent of exercise levels, sedentary behaviours, especially television watching, were significantly associated with a high risk of obesity and type 2 diabetes.

2.2.4 Socio-Economic Determinants of Diabetes

As discussed in the previous section, individuals of lower socio-economic position, as measured by individual or household income, education level, employment, occupation, or living in an underprivileged area, are associated with poorer health status. Also, their physical or emotional health is poor (Olivera, Muhalde & Gagliardino, 1991; Robinson, Stevens & Protopapa, 1993; Robinson *et al*., 1990) and they have higher rates of mortality or higher rates of fatal and nonfatal cardiovascular disease (Cabrera, 2001; Chaturvedi *et al*., 1998; Dorman *et al*., 1985; Matsushima *et al*., 1996; Nielsson, Johansson & Sundqvist, 1998; Robinson, Lloyd, & Stevens, 1995; Ware *et al*., 1996). Thus, cardiovascular diseases and their risk factors, including diabetes have been linked to socio-economic status.

Significant socio-economic inequalities have been shown to be present for many major chronic illnesses with diabetes having the largest inequality gap (Glover, Hetzel & Tennant, 2004). Diabetes seems to be one of the chronic illnesses mostly affected by socio-economic status. Diabetes has been reported to be twice as prevalent in low-income populations as compared to wealthy populations (Robbins *et al*., 2001; Stelmach *et al*., 2005).

Other studies that have focused on the association of diabetes with socio-economic status have obtained similar results. Brancati *et al*., (1996) performed a comparable study and found the highest prevalence of diabetes in individuals of low socio-economic status and the lowest prevalence in individuals of high socio-economic status. A more recent study performed in 2007 found that socio-economic disadvantage contributes to the high prevalence of diabetes in Filipino-American women (Langenberg *et al*., 2007). However, certain studies have reported a higher prevalence of several folds in urban areas as compared to rural areas (Wild *et al*., 2004).

Other studies differentiated between type 1 and type 2 diabetes. Evans *et al*. (2002) found that the prevalence of type 2 diabetes, and not type 1 diabetes, varies by deprivation, another measure of socio-economic status. His study showed the presence of a positive relationship between deprivation and type 2 diabetes. Similarly, Connolly *et al*. (2000) showed a relationship between deprivation and risk of diabetes. They also confirmed an inverse relationship between the two, and suggested that the factors responsible for causing diabetes are more common in deprived areas.

It is worthwhile to point out the presence of contrasting results about the relationship between socio-economic status and diabetes prevalence. It has been noted that in most developed countries, the prevalence is inversely related to socio-economic position, with the highest prevalence in those of lowest socio-economic position (Larranga *et al*., 2005; Whitford *et al*., 2003; Evans *et al*., 2000; Connolly *et al*., 2000; Kumari *et al*., 2004). However, the reverse is true in developing countries where the most affluent sections of the society having the higher prevalence (Xu *et al*., 2006; Abu Sayeed *et al*., 1997; Herman *et al*., 1995). Thus, these conflicting results suggest that the association between diabetes prevalence and socio-economic status depends on the income level or development level of the country in question. It is, however, expected that further economic development will even out the socio-economic pattern of type 2 diabetes in all countries, with the poorest populations having the highest prevalence (cited in Detels, *et al*., 2009).

2.3 Health Care Utilisation

The utilisation of health care services can be viewed as a type of individual behaviour in response to ill-health (Andersen & Newman, 1973). Andersen & Newman (1973) have demonstrated that health care utilisation can be characterised by type, purpose and unit of analysis. The different types of health services are, for example, hospitals, physicians and nursing homes, whereas the different purposes are firstly primary care, then secondary care, tertiary care and custodial care. Custodial care refers to provision for the personal needs of the patient but with no effort to treat his/her underlying illness conditions. The last characteristic of utilisation is the unit of analysis which can be contact, volume or episodic care (Andersen & Newman, 1973). Issues of social justice are relevant in determining utilisation of services but they have not been explored and investigated in this study. It could be interesting to elaborate on this subject further in a future study.

2.3.1 Theories

Different models have been conceptualised to study patient use of health care services. These models tend to explain how human beings utilise health care. They are conceptual and simply provide a framework for research. These frameworks are detailed and most of them consist of a set of factors that have been identified as those that mostly affect health care behaviour. Most of the studies which focus on health care utilisation and use these frameworks are driven by the fact that access to these health care services are hindered or limited by certain factors and even though every citizen has the right to access health care, often this is not the case. Though there are many health care utilisation models, the ones that will be discussed in this study are the Attachment Model, the Health Belief Model and the Andersen Behavioural Model.

2.3.1.1 The Attachment Model

The attachment theory was first developed by John Bowlby who proposed that individuals internalise their previous experiences with their caregivers, thus forming enduring cognitive schemas of relationships that influence whether they perceive themselves as worthy of care (model of self) and whether others can be trusted to provide care (model of other) (Bowlby, 1973). These cognitive schemas have been described as "internal working models" that influence the types of interactions individuals have with others and their interpretations of these interactions throughout life (Bowlby, 1973).

2.3.1.2 The Health Belief Model (HBM)

The Health Belief Model (HBM) is another framework that tries to explain, predict and influence behaviour. It was initially developed in the 1950s by a group of social psychologists at the U.S. Public Health Service with the intention to explain the widespread failure of people to participate in programs to prevent or to detect disease. (Hochbaum, 1958; Rosenstock, 1960, 1966, 1974). The model was later extended and was applied to people's responses to symptoms (Kirscht, 1974) and to their behaviour in response to diagnosed illness, particularly compliance with medical regimens (Becker, 1974). For more than three decades, the model has been one of the most influential and widely used psychosocial approaches to explaining health-related behaviour.

In general, the HBM model says that individuals will take action to "ward off, to screen for, or to control ill-health conditions if they regard themselves as susceptible to the condition" (Rosentock, Strecher, & Becker, 1994). Action will be taken if the individuals believe the health condition to have potentially serious consequences; if they believe that a particular action will reduce either their "susceptibility to or the severity of the condition; and if they believe that the anticipated barriers to (or costs of) taking action are outweighed by its benefits" (Rosentock, Strecher, & Becker, 1994). Some components of the model are "perceived susceptibility", "perceived severity", "perceived benefits", "perceived barriers" and "Cues to action" (*ibid*). Janz and Becker (1984) have reviewed the work on the health belief model and have concluded that out of all the components of the model, "perceived barriers" was the most powerful predicator of behaviour. However, "perceived susceptibility" and "perceived benefits" were important and that overall "perceived severity" was the least powerful predicator.

2.3.1.3 The Behavioural Model (The Andersen Model)

According to Andersen's (1968) model an individual's willingness to consult is affected by health attitudes, knowledge about health care as well as the social and cultural definitions of health and illness that have been learned (Aday and Andersen, 1975; McKinley 1972). His model is called the behavioural model and was first developed in the late 1960s with an intention to help in the understanding of why families use health services (Andersen, 1968). It is the most frequently used framework for analysing patient utilisation of health care services. It is also used to measure the equitable access to health care and to assist in developing new policies so as to promote access. Andersen (1968) has categorised the factors influencing health service utilisation into three categories. These factors are: (1) predisposing factors (demographic, social structural, and attitudinal-belief variables); (2) enabling factors (family resources and characteristics of the community); and (3) illness level (perceived and evaluated illness) (Figure 1) (Andersen & Newman, 2005).

Utilisation of health care services is affected by many factors that cause different groups of individuals bearing different characteristics to have different health seeking behaviour and thus, have different utilisation of health care services. Certain determinants of health care utilisation are age, gender, ethnicity, income and socio-economic status amongst others. Some of these determinants are discussed in more details below. Figure 7 (Andersen & Newman, 2005: 107) below depicts the individual determinants of health service utilisation identified by Andersen & Newman (2005).

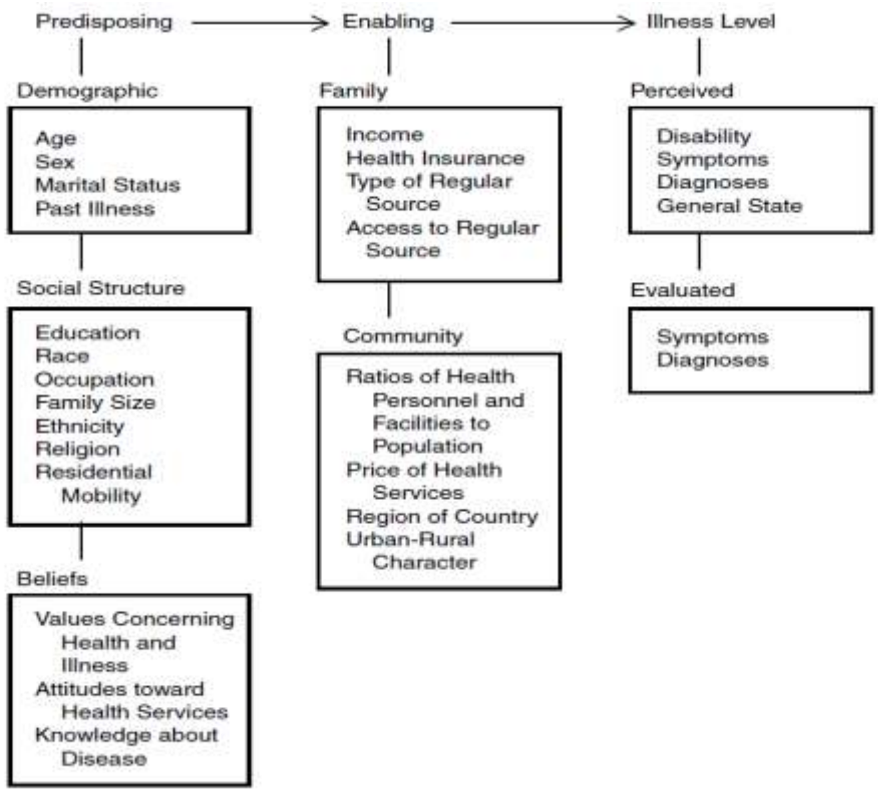
As mentioned earlier, Andersen (1968) categorised the factors influencing health service utilisation into (1) predisposing factors; (2) enabling factors and (3) illness level (see figure 7). Each component will now be examined in more detail. The predisposing factors can be demographic, social structural or attitudinal-belief (Andersen & Newman, 2005). They are characteristics of an individual which exist before the onset of the illness and which give the individual a propensity towards use of health services compared to others. Those individuals with certain characteristics are more likely to use health services, even though those characteristics are not directly responsible for health service use. These characteristics are demographic, socio-structural, and attitudinal-belief variables (*ibid*).

Demographic and social structural characteristics are linked to the attitudes or beliefs about medical care, physicians, and disease. This third subcomponent of the predisposing conditions is what an individual thinks about health and this may ultimately influence health and illness behaviour.

The second component is the enabling component and consists of factors related to family and the community. This component suggests that some means must be available for an individual to use health services, even if he is predisposed to do so (*ibid*). An enabling condition is defined as one which permits a family to satisfy a need regarding health service utilisation. These enabling conditions make health service resources available to the individual and can be measured by family resources such as income, level of health insurance coverage or other source of third-party payment. They can also be in the form of enabling characteristics of the community, for example, the amount of health facilities and personnel in a community. The latter can greatly affect individuals' use of health services.

The last component of the model is the illness level. "Assuming the presence of predisposing and enabling conditions, the individual or his family must perceive illness or the probability of its occurrence for the use of health services to take place" (Andersen & Newman, 2005: 109). Illness level represents the most immediate cause of health service use. Attempts to get at the actual illness problem that the individual is experiencing and the clinically judged severity is performed through evaluated illness measures (*ibid*).

The next section focuses on the empirical determinants of health care utilisation and the utilisation of diabetes care services.



Source**:** Andersen & Newman, 2005: 107

Figure 7: Individual determinants of health service utilisation identified by Andersen & Newman, 2005: 107.

2.3.2 Empirical Determinants of General Health Care Utilisation & Utilisation of Diabetes Care Services

2.3.2.1 Introduction

Unlike the previous section which examined the theories and models on health care utilisation, this section provides some empirical evidence of certain important determinants of health care utilisation present in the literature. The first part of this section reviews empirical determinants of general health care utilisation, while the second part narrows the discussion down to the empirical determinants of the utilisation of diabetes services. Gender is the first determinant under discussion followed by ethnicity, health care costs/methods of payment and finally socio-economic status.

2.3.2.2 Gender

Gender differences exist in the utilisation of services. Bertakis *et al*. (2000) found a strong association between gender and utilisation. They monitored the use of health care services and associated changes of U.S adult patients assigned to a university medical centre. The result showed that women have significantly higher medical care service utilisation than men. They have higher mean number of visits to their primary health care clinic and diagnostic services than men. However, the study also reported that women have lower self-reported health, lower education and income than men. Numerous other studies, prior to the one conducted by Bertakis *et al*. (2000) reported the same results (Hibbard & Pope, 1983; Mechanic & Greenley, 1982; Verbrugge & Wingard, 1987; Waldron, 1983). Different explanations have been offered for the gender differences in health care utilisation. For instance, some suggest that the differences may be associated with reproductive biology and other conditions that are specific to gender (Mustard *et al*., 1998; Gijsbers van Wijk *et al*., 1992; Waldron, 1983). On the other hand, others associate the differences with the higher rates of morbidity in women (Hibbard & Pope, 1983; Mechanic & Greenley, 1982; Verbrugge & Wingard, 1987; Waldron, 1983). Also health care utilisation differences was explained by the differential in health perceptions and reporting of symptoms and illness (*ibid*) or with a higher likelihood that women seek medical care for prevention and illness (Hibbard & Pope, 1983; Mechanic & Greenley, 1982; Vanbrugh & Wingard, 1987).

2.3.2.3 Ethnicity

Ethnicity has also been shown to influence the utilisation of health care services. Early studies on ethnic differences in health behaviour and utilisation showed that lower socio-economic and ethnic minority groups were less likely to utilise health services (Suchman, 1964). In addition, minority race or ethnicity has been associated with lower likelihood of having a regular source of care, fewer physician visits, and lower total health-care expenditures (Centers for Disease Control and Prevention, 1995; Fiscella, Franks & Clancy, 1998).

2.3.2.4 Socio-economic Status

Similarly, socio-economic status is an important determinant of health care utilisation and most utilisation studies include some measure of socio-economic status to account for differences in use (Bice, Eichhorn & Fox, 1972). The relationship between socio-economic status and health care utilisation may differ by the type of health service under study and by unit of analysis and setting. Several studies have investigated effects of social class on the utilisation of health services in western European countries (Balarajan, Yuen & Machin, 1987; Bongers, van den Bos & Mackenbach, 1997; Fernanderz de la Hoz & leon, 1996; Piperno & Di Orio, 1990). Other studies carried out in other settings are Gotsadze *et al*. (2005), Dunlop, Coyte & McIsaac (2000) and many others.

Gotsadze *et al*. (2005) found that the main reason for not seeking care was a lack of money to pay for treatment. They compare eight ethnic groups and also found a difference between their health care utilisation behaviour. They also found a lower usage of services in those of lower education, with fewer household assets and a shortage of money. The study provided evidence showing that poorest households are less likely to seek care than more affluent households. Another similar study with was performed in Canada, showed that those people with lower incomes and fewer years of schooling visit specialists at a lower rate than those with moderate or high incomes and higher levels of education attained despite the existence of universal health care (Dunlop, Coyte & McIsaac, 2000). Various reasons and interpretations exist to justify the fact that individuals with a low socio-economic status use less health services. One of them is that lower class individuals are less likely than others to recognise that various symptoms may require treatment and that, given similar symptoms, their differences in beliefs about whether care is needed and should be sought contribute to lesser use of services within the lower class (Koos, 1954). Another explanation for the relationship between socio-economic status and utilisation is that lower class persons are more likely to adopt values, attitudes, and beliefs that are incompatible with efficient use of health, that is, these individuals have some predisposing factors that cause them to under-utilise health care (Bice, Eichhorn & Fox, 1972). Such a statement cannot be tested empirically since those predisposing factors can include a multitude and unlimited number of dimensions. These predisposing factors are similar to those put forward by Andersen (1968) in his model.

2.3.2.5 Utilisation of Diabetes Care Services

The utilisation of diabetes health care services and chronic illness care services in general, are also influenced by similar factors. The assessment of these factors is important in promoting equity. This section puts health care utilisation into context and discusses the empirical factors affecting use of diabetes health care services found in the literature.

Low utilisation of care services among diabetics is quite a significant issue. It has been widely shown that a considerable proportion of diabetics are not seen at all in hospitals, diabetes clinics, especially if they require insulin treatment (Yudkin *et al*., 1980; Williams *et al*., 1990; Burrows *et al*., 1987). This is an important issue since it is known that long term complications can be greatly reduced by early and effective treatment of hyperglycaemia, hypertension, and early diabetic eye disease (UK Prospective Diabetes Study, 1998a; UK Prospective Diabetes Study, 1998b). These conditions are usually non-symptomatic and regular clinical review to detect them is crucial. Thus, individuals diagnosed with diabetes who have low utilisation rates and reduced access are at a great disadvantage. Identifying the factors giving rise to a low/reduced utilisation of diabetes care services is crucial.

There is considerable evidence that shows that affluence and deprivation are major factors that influence utilisation of diabetes care services. In studies performed on diabetic clinic populations, socio-economic factors have been shown to be significantly related to morbidity (Kelly *et al*., 1993; Connolly *et al*., 1996). It was also shown that deprivation is related to poorer diabetic control and less insulin use (Chaturvedi *et al*., 1996; Kelly *et al*., 1994). However, these studies may be biased in the sense that their study cohorts are not representative as they only include diabetics visiting clinics.

Goyder, McNally & Botha (2000) studied subjects registered for study practices who were diagnosed with diabetes before 1990. They found that the main predicators of a hospital clinic attendance were younger age, a longer duration of diabetes and the treatment with insulin. According to their findings, young people and those who have had diabetes for a longer duration as well as those treated with insulin are more likely to use more of the diabetes services. On the other hand, the use of general practice which includes family practice, family medicine or primary care for patients with non-emergency medical problems, is associated with older age and lower co-morbidity. Ownership of a house and access to a car were associated with a higher probability of attending a hospital clinic. However, living in a deprived area was associated with the opposite (Goyder, McNally & Botha, 2000). In other words, Goyder, McNally & Botha (2000) have shown the association between socio-economic status and the use of health services.

Rabi *et al*. (2006) also assessed the correlation of socio-economic status and utilisation of diabetes care services. They found that those in the lowest income quintiles had the highest rates of diabetes and a higher rate of referral to the regional Diabetes Education Centre (DEC). However, after they accounted for diabetes prevalence, they observed equal proportions referred to the DEC across all income quintiles.

Pagan & Puig (2005) evaluated the association between health insurance coverage and the use of conventional health care services, complementary and alternative medicine (CAM) and self-medication. They used a nationally representative sample of Mexican adults with diabetes and showed that health insurance coverage is positively correlated with the utilisation of conventional services but negatively associated with CAM and self-medication. Thus, the availability of financial protection, like insurance coverage can be a solution to the problem of access of diabetics to proper care and finally lead to reduction in equity problem.

2.4 A Relevant Concept: Access

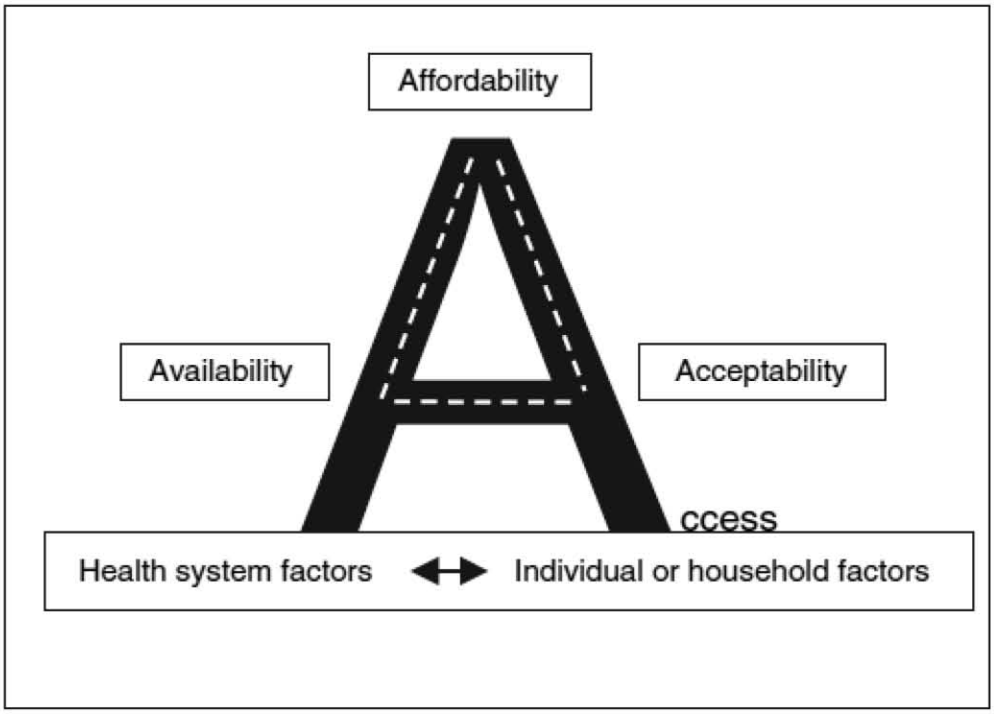
The following section discusses an important concept relevant to this study namely access. This concept will be introduced theoretically, defined and discussed.

There has been widespread debate about the concept of health care access since the early 1970s (Aday & Andersen, 1975; Penchansky, 1977; Penchansky & Thomas, 1981; Aday & Andersen, 1981; Andersen, 1995; Gulliford *et al*., 2002; Gulliford & Morgan, 2003; Oliver & Mossialos, 2005). There remains considerable confusion and only little consensus on how access should be defined. Moreover, there has been no attempt to identify a common concept that may be applicable in different settings, particularly in a low-income and middle-income context (McIntyre & Mooney, 2007). Without greater clarity and comprehension of the concept of access, it is impossible to pursue accessible health systems actively (*ibid*). Therefore, if the access concept is not well understood, comprehensive evidence on what should be done to promote equitable health systems cannot be gathered (*ibid*).

However, most of the literature agrees that access is not the same as health service use or health care utilisation (Penchansky, 1977; Mooney, 1983; Oliver & Mossialos, 2005). These two terms are not synonymous even though utilization has been, in certain cases, used as a proxy for access. Access to services does not necessarily translate into "for various acceptable reasons (for example, varying individual preferences), those in equal need and with equal opportunities to access health care may not make equal use of those opportunities" (Oliver & Mossialos, 2004: 655). It is true that the differences in access between individuals can explain the differences in the use of health care services. However, the differences in use may occur even with similar access to services. In this case, personal preferences have lead individuals to make different choices in relation to exercising their empowerment to use (or access to) a particular service (McIntyre, Thiebe & Birch, 2007).

Access has been described as the opportunity to use health services (McIntyre & Mooney, 2007). This definition tends to reflect an understanding that there is a set of circumstances that allows for the use of appropriate health services (*ibid*). At the same time, however, the definition of access should also include the notion of empowerment to make well-informed decisions about health service use (*ibid*). Individuals and communities have to be in a position to choose when to use which health service is appropriate in a given context or time (*ibid*). Thus, access can also be defined as the freedom to use health services (Thiede, 2005). Others have also defined access as a concept which represents the degree of "fit" between the clients and the system and they have clearly pointed out that access is related to but is, however, not identical with the enabling variables in the Anderson model of the determinants of use which was described in the earlier sections.

Access can be represented by three dimensions namely, availability (sometimes referred to as physical access), affordability (often referred to as financial access) and acceptability (sometimes referred to as cultural access). Those dimensions are those that appear most frequently in the literature (Penchansky, 1977; Gulliford & Morgan, 2003). Figure 8 (McIntyre & Mooney, 2007:107) depicts the access framework. Availability is concerned with the question of whether or not the appropriate health services are available in the right place and at the time that they are needed. The affordability dimension deals with the 'degree of fit' between the cost of utilising health care services and individuals' ability to pay. On the other hand, acceptability refers to the nature of service provision and how it is perceived by individuals and communities (McIntyre & Mooney, 2007).



Source: McIntyre & Mooney, 2007:107

Figure 8: The access framework.

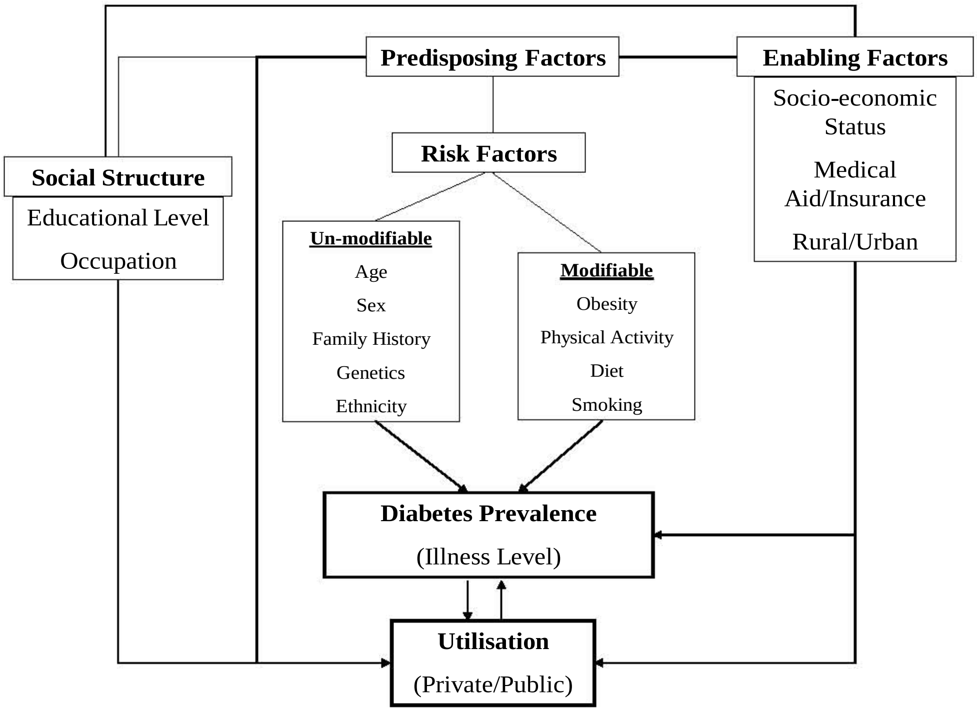
Now that access has been defined, let the discussion now converge on the problem of access to diabetes care services. Access to diabetes care services is a worldwide problem that requires attention. Considerable documentation exists on the fact that a sizeable proportion of individuals with a diagnosis of diabetes are not seen at all in hospital diabetes clinics, particularly if they do not require treatment with insulin (Burrows *et al*., 1987; Williams *et al*., 1990; Yudkin *et al*., 1980). However, some of these individuals regularly go on consultation in primary care, often in clinics run by practice nurses or general practitioners. Unfortunately, a significant percentage is not routinely reviewed at all (Goyder *et al*., 1998). This group of patients includes some who will, in the future, be present with complications who might have benefited from earlier intervention. It is worthwhile pointing out those patients who have been diagnosed with diabetes who do not access diabetes services are difficult to identify and have not been studied nearly as extensively as those who do attend diabetes clinics and diabetes programmes in public facilities.

Access to proper diabetes care in Mauritius has improved over the last few years and a lot of effort has been done to promote access (NSFD, 2007). It is very encouraging to note that physical access to facilities for monitoring blood sugar measurement is improving at the level of primary healthcare facilities (WHO, 2010e). However, it appears that neither the diabetes patients nor the providers of diabetes care have been satisfied: The hospitals and clinics in Mauritius are over-crowded and their set-up is not appropriate to deliver optimal care and attention to the patients. Moreover, there is an urgent need to provide the hospitals and clinics of Mauritius with the appropriate equipment as well as trained and qualified personnel to cater for the diabetics so as to prevent the progression of the epidemic (*ibid*).

The next section presents the conceptual framework which depicts the structure as well as concepts and theories applied in this study.

2.5 Conceptual Framework

In the previous section, the literature was reviewed and this gave us insight on the various factors that are associated with diabetes. This section presents the conceptual framework which depicts the structure of the idea of this study as well as all the concepts and theories and how they fit together. It gathers information from the literature, both theoretical and empirical and links the research question, the concepts and the literature. It is a crucial step in enhancing clarity of the work being carried out.



Source: Created by author, modified from Andersen, 1968

Figure 9: Conceptual framework.

Figure 9 is the conceptual framework schematic of this study. It is a modified version of the Andersen (1968) HBM model and depicts the three components of the model. These components are (1) the predisposing factors, (2) the enabling factors and (3) the illness level. The predisposing factors, as mentioned in section 2.3, are those characteristics of an individual which exist before the onset of the illness and which give the individual a propensity towards use of health services compared to others. Here, these factors translate into risk factors to diabetes and have been divided into un-modifiable (that can be not be controlled by an individual) and modifiable (that can be controlled and changed by an individual) factors. These factors are believed to directly affect an individual's diabetes status and thus are associated to diabetes prevalence. These factors, in turn, affect an individual's utilisation of diabetes care services. Social structure in the form of educational level attained and occupation are other predisposing factors other than modifiable and un-modifiable factors and they also affect diabetes prevalence and utilisation of diabetes care services in the same manner. Enabling factors are those factors that permit an individual to satisfy a need regarding health service utilisation and they are both directly and indirectly associated to the predisposing factors. This study will only consider three aspects of these enabling factors namely socio-economic status, possession of medical aid (insurance) and place of residence (rural/urban). However, these enabling conditions can also be in the form of enabling characteristics of the community, for example, the amount of health facilities and personnel in a community. They not only affect an individual's illness level (diabetes prevalence) but also facilitate his/her utilisation of services.

2.6 Analytic Models & Methodological Issues

2.6.1 Introduction

This section reviews the literature on the various models and methodological issues related to the topic. The first portion discusses some models that are commonly used in the analysis of health care data whilst the second portion shines more light on relevant methodological approaches found in the literature. The last portion discusses certain econometric issues that can be encountered in health care studies.

2.6.2 Common Models to Analyse Health Care Data

2.6.2.1 Ordinary Least Square Model

The Ordinary Least Square (OLS) regression model is the standard estimation method for fitting the classical linear regression model (Jones, 2006). This method is based on finding the parameter values that minimise the sum of squared errors and follows the various assumptions of the Linear Regression Model (LRM) described below (Jones, 2006).

The classical linear regression assumes that the relationship between y (dependent variable) and the x (independent variable) is a linear function with ε as the random error term (Jones, 2006). The relationship between the two types of variables, x and y, can be expressed as the following regression function: $y = x\beta + \varepsilon$.

The classical linear regression model assumes that (*ibid*):

- the error term has a mean of zero;
- the variance, σ^2, of the error term is the same across all the observations (homoscedasticity);
- values of the error term are independent across observations (serial independence);
- values of the error term are independent of the values of the *x* variables (exogeneity).

It is possible to obtain a reasonable approximation for binary choice models using the OLS regression but only so long as the function F(x) is approximately linear over the range of sample observations (Jones, 2006)[3]. However, one of the major drawbacks of the method is that, since a straight line is used, predicted values of the regression function can lie outside the range 0 to 1 (*ibid*). Thus, the OLS can lead to "logical inconsistencies, with predicted probabilities outside the logical range zero to one" (*ibid*). In order to avoid this problem, "S" curve models can be used. Examples of "S" curves are the logit and probit models which are estimated by the method of maximum likelihood estimation (MLE) (*ibid*).

2.6.2.2 The Logit and Probit Models

Logit and probit models are binary response models (BRM). They are preferred over the conventional OLS regression when dependent variables are binary (Jones, 2006). This is because using OLS for binary dependent variables violates several assumptions of the LRM. Logit and probit models are typically estimated using the standard maximum likelihood procedure.

The logit model tests the statistical significance for the coefficients using the z-statistic. It also tests the null hypothesis that all slope coefficients are simultaneously equal to zero using the Likelihood Ratio (LR) statistic. Furthermore, in a logit model,

[3] $E(y \mid x) = 0.P(y=0|x) + 1.P(y=1|x) = P(y=1 \mid x) = F(x)$ where y is the binary outcome and x is the set of explanatory variables (Jones, 2006). This equation can be shorthanded to $F(x) = x\beta$ (Jones, 2006).

the predicted values of the regression function can lie outside the range 0 to 1 (Jones, 2006).

There exists little or no difference between the logit and the probit model. The probit model assumes that the error term has a standard normal distribution. Alternatively, the logit model assumes that the error term has a standard logistic distribution (Jones, 2006). The probability functions for both the probit and logit models have the characteristic "S" shape and they are similar in appearance (*ibid*). However, the logit model gives more weight to the tails of the distribution (*ibid*) and has the advantage of providing results that are easily interpreted.

2.6.3 Methodological Approaches

This section presents a methodological review of three types of studies namely, studies to identify (1) the determinants of health and particularly diabetes or diabetes prevalence; (2) the factors influencing utilisation of health services and diabetes care services; and (3) both determinants of diabetes prevalence and utilisation of its health services. At this point it is important to define prevalence which is the measure of the frequency of a disease or condition at a particular point in time (cited in Roe & Doll, 2000).

2.6.3.1 Studies on Determinants of Health and Diabetes Prevalence

In most cases when social scientists and epidemiologists try to determine factors that affect health, they compare two variables, namely, a measure of health (or ill health) and a factor believed to have an influence on health. Such factors could be gender or age. An example of a measure of health (or ill health) is mortality or morbidity. Similarly, in order to assess the factors influencing diabetes or diabetes prevalence, a measure of diabetes and a factor that could account for the differences in diabetes status will be compared. The study design, data collection techniques, and type of statistical analysis employed will depend on the context and setting of the study, the objectives of the study and the nature of the dependent variable. Below is a presentation of several studies conducted to examine the influence of a number of independent variables on health or a specific disease prevalence. Their context, setting and especially their methodologies, including the statistical analysis, have been described and compared.

In an empirical study trying to examine the relative importance of a range of social determinants of health in predicting four health outcomes of interest, Wilson *et al*. (2009) conducted a telephone survey and selected 11 social determinants of health (SDOH) out of the 12 SDOH identified by the Public Health Agency of Canada. They used four different measures of health namely self-assessed health, chronic conditions (respondents were asked about the presence or absence of 13 chronic conditions including cancer, asthma, diabetes and arthritis), emotional distress (measured using a 20-item version of the General Health Questionnaire) and Body Mass Index (body mass index of more than 25 kg/m^2 is regarded as overweight). All the dependent variables were dichotomized and in the statistical analysis, due to the binary/dichotomous nature (0, 1) of the dependent variables, a series of logistic regression models were done in order to examine the relative contribution of the 11 categories of the SDOH with respect to the four health outcomes. Four models were thus used, one for each measure of health and the results were as follows. Age and income were both significantly associated with the health outcome of interest in all models. Coping skills and neighbourhood are also significant determinants for all health measures except for BMI. Smoking status was also significant in three models (BMI, chronic conditions, and emotional distress.

A methodologically similar study investigating the ethnic variation in health and the determinants of health among Latinos was conducted by Zsembik & Fennell in 2005. They also used self-assessed health as one of their health outcomes. Other health outcomes used were the number of chronic medical conditions and the number of physical functioning impairments. Education, income and insurance coverage were the independent variables categorised as the socioeconomic determinants of health. Another category of determinants was the cultural determinants category which included independent variables such as nativity and the language in which the interview was conducted. The last category was the health risk category with contained independent variables such as activity level, smoking and drinking history and weight. Three ordinal logit models were estimated for each of the three categories. The results clearly showed that Mexicans have health advantages, whereas Puerto Ricans experience health disparities. They also found that Cubans and Dominicans reveal a mix of health disparities and advantages, depending on the health outcome. Some more detailed results of the study are presented below. The higher educated Latinos and insured Latinos reported poorer health than the less educated and uninsured ones. But, however, higher income Latinos reported better health than lower income Latinos. Among the Latino sub-groups, the association between socio-economic status (SES) and health outcomes vary greatly. For example, in the Mexican population, poorer health is amongst the high SES Mexicans and the opposite is true amongst Puerto Ricans.

The above two papers are similar to our study except that they do not focus on a specific disease problem. They were aimed at identifying the determinants of health in general. Their review gave a clear idea of the possible methodologies that can be employed in such studies. Now, the discussion will focus on studies aimed at identifying the determinants of diabetes prevalence in particular which is the core interest of this study.

Brancati and others (1996) studied the factors associated with diabetes mellitus through a cross-sectional study. Their aims were to identify factors associated with diabetes mellitus and to determine whether racial differences in these factors, especially socio-economic status, explain the high prevalence of diabetes among African-Americans. Participants comprised of 975 white and 418 African-American adults, aged 35 to 54 years and complete socio-demographic, clinical, and laboratory data were obtained from them. The dependent variable was the presence or absence of diabetes and the independent variables were classified into "two categories according to their presumed role in the natural history of diabetes mellitus: (a) risk factors for the development of diabetes mellitus, including race, gender, overweight, central adiposity, socio-economic status, and cigarette smoking; and (b) concomitant features of the diabetic state, including high blood pressure, hypercholesterolemia, hyperuricemia, and renal dysfunction as measured by SUN" (Brancati *et al.*, 1996: 68). For risk factors, univariate associations were estimated using odds ratios (ORs) and multivariate associations were estimated using multiple logistic regression. The analysis of the concomitant features was restricted to those who had diabetes only. Race was used as one of the independent variable and the concomitants features were used as distinct dependent variables. Univariate associations were determined using Student's *t* test for continuous variables and Fisher's exact test for categorical variables. The results showed that diabetes was twice as prevalent among African-Americans (10.3%) as compared to whites (4.6%; odds ratio (OR) = 2.38; 95% confidence interval (95% CI) even after adjustments for racial differences in age, socioeconomic status, weight, and central adiposity. African-American individuals of low socio-economic status had greater diabetes prevalence (OR = 4.09) than their high socioeconomic status counterparts (OR = 1.90). The main outcome of the study was that African-American race seems to be a strong, independent risk factor for diabetes, especially among individuals of low socio-economic status. Thus, Brancati *et al*. (1996) were able to show an association between race and diabetes prevalence and a negative relationship between socio-economic status and diabetes prevalence.

On the other hand, Rimm, Manson & Stampfer (1993) carried out a longitudinal study, starting in 1976, with diabetes-free, cardiovascular disease-free and cancer-free subjects and collected exposure information (smoking) and disease status progressively for 12 years using a self-administered questionnaire to examine the association between smoking and the incidence of non-insulin-dependent diabetes mellitus (type 2 diabetes) amongst 114 247 female nurses. "Relative risks were calculated as the rate of disease among the exposed (total number of cases among smokers or past smokers divided by the total person-time of exposure) divided by the rate of disease among the non-exposed (total number of cases among non-smokers divided by the total non-smoking person-time)" (Rimm, Manson & Stampfer, 1993: 212). Risks were calculated using the Mantel-Haenszel summary statistic and 95% confidence intervals were also calculated and, where applicable, Mantel extension tests were performed for trend across increasing dosage levels among current smokers. Furthermore, Cox proportional hazard models were used to control simultaneity problem. They found that current smokers had an increased risk of diabetes. A significant dose-response trend for higher risk among heavier smokers was observed. A relative risk of diabetes of 1.42 was found among women who smoked 25 or more cigarettes per day as compared to non-smokes. Thus, a strong association was found between cigarette smoking and diabetes.

Another diabetes determinants study was performed by Hu *et al*. (2001) who examined the combined effect of diet, lifestyle on the risk of type 2 diabetes in women. 84,941 female nurses free from cardiovascular disease, diabetes and cancer were followed up for a period of 16 years and information about their diet and lifestyle was updated periodically. A low-risk group was defined as per the following combination of five variables: a body mass of less than 25; a diet high in cereal fiber and polyunsaturated fat and low in trans fat and glycemic load; engagement in moderate-to-vigorous physical activity for at least half an hour per day; no current smoking; and the consumption of an average of at least half a drink of an alcoholic beverage per day. Relative risks were calculated by dividing the incidence of diabetes among women in the low-risk group by the incidence among the remaining women. They also calculated the population attributable risk and conducted analyses stratified according to the presence or absence of a family history of diabetes and according to the body-mass index. 3300 new cases of type 2 diabetes during the 16 years follow-up were identified. Overweight or obesity was found to be the single most important predictor of diabetes. Other results are as follows: lack of exercise, a poor diet, current smoking, and abstinence from alcohol use were all associated with a significantly increased risk of diabetes. They also found that, as compared with the rest of the cohort, women in the low-risk group had a relative risk of diabetes of 0.09. In addition, a total of 91% of the cases of diabetes in this cohort could be attributed to habit behaviours that did not conform to the low-risk pattern.

2.6.3.2 Studies on Determinants of Health Care Utilisation

The methodologies of several relevant utilisation papers are presented below. Health care utilisation can be defined as the extent to which a group of individuals uses a specific service in a specified period of time. Utilisation is very often measured as the number of services provided to a patient (Diehr *et al*., 1999). An example could be the number of X-rays a patient has undergone over the past year. In certain cases, a measure of cost can be assigned to the various services under interest so that resource intensity can be summed over all provided services (*ibid*). However, another simple measure of utilisation is the number of visits a patient has had over a specified period of time (counts of visits). Other common utilisation measures are admissions, inpatient days and laboratory procedures (Diehr *et al*., 1999).

Goyder, McNally & Botha (2000) attempted to establish the factors that predict attendance at a hospital clinic and for diabetes review in general practice. Initially, a historical cohort of diabetics from general practice records was identified. Then, service contacts and other clinical, social and demographic information from general practice and from postal questionnaires were collected. The dependent variables used were (1) "having attended a hospital diabetes clinic at least once between 1990 and 1995"; and (2) "having had a routine diabetes review in general practice at least once between 1990 and 1995". The independent variables were (1) demographic variables (age, sex, ethnicity), (2) clinical variables (duration of diabetes, type of treatment, co-morbidity), and (3) socioeconomic variables (postcode, access to a car, house ownership, occupation). The individual variables associated with service use were identified using Mann-Whitney U tests for continuous variables. Chi-square (χ^2) tests were used for categorical variables. Clinical explanatory variables were also simultaneously entered into a logistic regression model and individual socio-economic variables were separately added to this model in order to determine whether they were still associated with service use outcomes after adjusting for clinical differences. Their results showed that younger age, longer duration of diabetes, and treatment with insulin were the main predictors of attending a hospital clinic. Access to a car, home ownership and a non-manual occupation were all found to be associated with an increased likelihood of attending a hospital clinic. However, living in a less deprived area was not found to be associated with the latter. On the other hand, older age, less co-morbidity, and being white were identified as the main predictors of attending for review in general practice. Additionally, living in a more deprived area and a reduced chance of review in general practice were found to be related but individual socio-economic indicators were not related to the latter.

Lee, Liu & Sales (2006) performed a cross-sectional study on three ethnic groups with diabetes namely non-Hispanic Whites, non-Hispanics African Americans and Hispanics adults. Their aim was to determine racial and ethnic differences in diabetes care use and costs. Health care use included ambulatory care visits and prescription drug fills (all prescribed medications purchased in 2000) and physician and non-physician visits were included in ambulatory care visits. Total health care costs include payments for care for ambulatory care visits, hospital inpatient stays with zero-night admission, emergency department visits, dental care, home health care, and other care including vision aids, medical supplies and equipment, and prescription medications. Dependent variables were categorised as (1) diabetes care (management, complication and treatment which were all binary variables), (2) health care use (ambulatory care visits and prescription fills), and (3) health care costs (total health care costs, ambulatory costs and prescription drug costs). Independent variables included race, age, elderly (binary variable: 1 = 65 years or older; 0 = otherwise), sex, education and marital status. The STATA 7 software was used for the bivariate and multivariate methods. In order to compare racial and ethnic differences in individual characteristics, Chi-squared tests were used. In addition, logistic regression was used to examine differences in diabetes care among the three ethnic groups. Count data methods were used for multivariate analyses of utilisation measures which are count variables and negative binomial regression models were used to analyse health care use outcomes. Binomial regression models were used because utilisation data do not satisfy the assumptions for ordinary least squares regression, which include normality, homoscedasticity, and independence of error terms. Their results showed that most of the outcomes in diabetes care management, treatment, and complications were not significantly different among race groups. Hispanics were more likely to have eye problems than whites after adjusting for socio-economic and demographic characteristics. In addition, African Americans and Hispanics had lower total health care costs, lower ambulatory care costs, and lower prescription drug costs than whites. As for health care utilisation, most of the diabetes care measures were not significantly different among the three ethnic groups. They found that African Americans were less likely to have ambulatory care and prescription fills than Whites. Their results showed major differences among groups in the proportion of individuals with a high school education or more. They suggested that these differences in education may possibly affect awareness of health-care seeking behaviours for preventive care and this may result in differences in health care utilisation amongst different races and ethnicities.

2.6.3.3 Studies on Both Health/Diabetes Prevalence and Utilisation of Diabetes Health Care Services

Only a few novel studies have attempted to interlink both diabetes prevalence and utilisation of diabetes services in their objectives (Gulliford, Sedgwick & Pearce, 2003; Rabi *et al*., 2006). Prevalence and utilisation have several common factors and it is crucial to examine the link between them. Income is an example of a common factor that influences both prevalence and utilisation. It has been reported that diabetes may be up to two times more prevalent in low income populations compared to wealthy populations (Robbins *et al*., 2001 & Stelmach *et al*., 2005). Additionally, low income is associated with an increased rate of hospitalisation for acute diabetes related complications in patients with diabetes (cited in Rabi *et al*., 2006).

Gulliford, Sedgwick & Pearce (2003) focused on specific diabetes risk factors, the main one being cigarette smoking which is considered to be associated with increased risk of cardiovascular mortality and microvascular complications. They carried out a cross-sectional survey of people registered with diabetes mellitus at 29 general practices in inner London. They tabulated current smoking by gender, age group, ethnicity and social variables. They identified variables associated with current smoking by fitting a logistic regression model with robust variance estimates. Multiple linear regression analyses were used in order to evaluate the differences in SF-36 scores according to smoking habit after adjusting for age, sex, duration of diabetes, whether English was the first language, social class, education, car ownership, and housing tenure. Also, and most importantly, logistic regression analyses were performed so as to evaluate the differences in health care utilisation according to smoking habit, after adjusting for age, sex, ethnic group, duration of diabetes, type of diabetes, the eight SF-36 scores and the eight items of self-reported morbidity. They observed a weak negative association of smoking and duration of diabetes and no association between smoking and type 2 diabetes. However, when they compare the diabetes risk factors and those that influence utilisation, it was found that cigarette smoking can be regarded as one common link between diabetes prevalence and utilisation. This is so since their results showed that both smokers and ex-smokers were less likely to report attending a diabetes nurse in the last twelve months. Thus, from their study, it is clear that "people with diabetes who smoke can be regarded as a vulnerable group who need more intensive support and treatment" (Gulliford, Sedgwick & Pearce, 2003). Unlike our study, Gulliford, Sedgwick & Pearce (2003) did not examine a number of diabetes risk factors but only focused on smoking. And indeed, the latter was found to be related to both prevalence and utilisation.

Rabi *et al*. (2006) are also one of the few who assessed both diabetes prevalence determinants and determinants of diabetes care services utilisation. They assessed the correlation between socio-economic status and both diabetes prevalence and utilisation of diabetes care services. This study is very similar to our study in several ways, the first one being the fact that both prevalence and utilisation are under study. The second similarity is that they also try to link diabetes prevalence to the utilisation of diabetes services. As mentioned earlier, linking prevalence and utilisation is crucial. The factors common to both prevalence and utilisation are the ones that the most attention has to be given to. For instance, if income is found to be associated with both diabetes prevalence and utilisation, this might mean that the poor are those who are more prone to develop diabetes and those who are less able to utilise diabetes care services. This group of individuals is doubly disadvantaged and is the one which has to be primarily targeted. They used data on referral for diabetes care, diabetes prevalence and median household income obtained from a regional Diabetes Education Centre (DEC) database, the Canadian National Diabetes Surveillance System (NDSS) and the 2001 Canadian Census respectively. Their sample consisted of 4,247 patients and all sampled patients included were from a single health region within the province of Alberta, Canada. Using the merged data sources mentioned above, they determined the following proportions: (1) The population rate of diabetes per dissemination area (DA - small geographic area covered by a single census data collector and containing around 400-700 inhabitants) which is equal to the number of diabetes cases per DA/DA population; (2) the population rate of DEC referral (referral count per DA/DA population) and; (3) the proportion with diabetes referred to the DEC (referral count per DA/diabetes cases per DA). In order to determine whether diabetes prevalence or population rates of referral differed across income quintiles, χ^2 analyses were used. In addition, Poisson regression was used to determine the relationship between neighbourhood income, education level, and age with diabetes prevalence and referral to the DEC, controlling for education level and age. Statistical analyses were performed in STATA 8. DA was used as the unit of analysis. The results showed that those in the lowest income quintiles had the highest rates of diabetes and a higher rate of referral to the regional Diabetes Education Centre (DEC). However, after they accounted for diabetes prevalence, they observed equal proportions referred to the DEC across all income quintiles. Some limitations of this study are: (1) the cross-sectional nature of the study, (2) the findings might not be generalisable, while applicable to the health region and period under study, it may not be indicative of how services are utilised elsewhere, (3) the association of low income with diabetes is one of their findings; however, it cannot be said that it was indeed the lowest income individuals in these neighbourhoods that were the most likely to have diabetes or to be referred. It is very possible that within low income groups, those with higher earnings were the ones who accessed care and (4) previous studies have called into question the validity of using neighbourhood income as a surrogate for individual level income (Demissie *et al*., 2000; Geronimus, Bound & Neidert, 1996; Sin, Svenson & Mann, 2001). However, there is emerging evidence that neighbourhood-level income can be used as an independent socio-economic status construct that can be a valid predictor of health outcomes, over and above any effect relating to individual income.

2.6.4 Summary of Empirical Analysis in Literature

This section presents a table summarising various studies whose methodologies have been found to be of relevance to this study. It is clear that in most studies concerning health determinants, logit models are preferred over other models as long as the dependent variable/measure of health is dichotomous/binary (Brancati *et al*., 1996; Hu *et al*., 2001; Wilson *et al*., 2009; Zsembik & Fennell, 2005). Several other examples of similar studies identifying health determinants which also employed logit models to examine the influence of a group of explanatory variables on health outcomes exist (Denton, Prus & Walters, 2004; Dunn & Dyck, 2000; Pevalin & Robson, 2007). Utilisation studies also have a preference to use logit models. Two of the utilisation studies presented above which dealt with the analysis of utilisation data used logit models (Goyder, McNally & Botha, 2000; Gulliford, Sedgwick & Pearce, 2003).

Lee, Liu & Sales (2006) used count data model to analyse the utilisation data, Rabi *et al*. (2006) used Poisson regression model whilst Halls, Summers & Obenchain (2003) used propensity score matching.

Table 9: Studies whose methodologies have been reviewed.

	Author	Title of Study	Aim	Methodologies	Dependent Variables	Main Results
Health/Disease Determinants study	Wilson *et al*. (2009)	Health in Hamilton neighbourhoods: Exploring the determinants of health at the local level	To examine relative importance of a range of social determinants of health in predicting four health outcomes of interest using data from a neighbourhood level cross-sectional health survey conducted in Hamilton, Ontario	Logit model	Self-assessed health, Chronic conditions, Emotional distress, Body Mass Index	+ve income with health status +ve exercise with health status +ve utilisation with health status +ve smoking, length of residence in neighbourhood with chronic conditions +ve education with BMI
	Zsembik & Fennell (2005)	Ethnic variation in health and the determinants of health among Latinos	To document and explain ethnic variation in health among Latino adults in the United States	Ordinal logit model	Number of chronic medical conditions, Number of physical functioning impairments & Self-rated health	-worse health is associated with higher levels of socioeconomic status (SES) AND acculturation among Mexicans, but with lower levels of SES and acculturation among Latinos whose origins are from Caribbean islands
	Brancati *et al*. (1996)	Diabetes Mellitus, Race, and Socioeconomic Status. A Population-Based Study	To identify factors associated with diabetes mellitus and to determine whether racial differences in these factors, especially socioeconomic status, explain the high prevalence of diabetes among African-Americans	Odds Ratio & Logit model	Presence or absence of diabetes	Diabetes more prevalent among African-Americans than Whites +ve obesity, central adiposity & SES with diabetes prevalence
	Rimm, Manson & Stampfer (1993)	Cigarette smoking and the risk of diabetes in women	To evaluate the association between cigarette smoking and the risk of diabetes, especially in women	Mantel-Haenszel summary statistic & Hazard model	Presence or absence of diabetes	+ve smoking with risk of diabetes

	Author	Title of Study	Aim	Methodologies	Dependent Variables	Main Results
	Hu *et al*. (2001)	Diet , Lifestyle, and the Risk of Type 2 Diabetes Mellitus in Women	To determine the combined effects of individual dietary and lifestyle factors in relation to type 2 diabetes	Logit model	Presence or absence of diabetes	+ve overweight/obesity, -ve exercise, -ve smoking, -ve alcohol use with diabetes prevalence Poor diet associated with increased risk of diabetes
Utilisation Study	Goyder, McNally & Botha (2000)	Inequalities in access to diabetes care: evidence from a historical cohort study	To establish which factors predict attendance at a hospital diabetes clinic and for diabetes review in general practice	Mann-Whitney U test, Chi-square test & Logit model	"Having attended a hospital diabetes clinic at least once between 1990 and 1995" & "Having had a routine diabetes review in general practice at least once between 1990 and 1995"	-ve age, -ve duration of diabetes, +SES with utilisation
	Lee, Liu & Sales (2006)	Racial and Ethnic Differences in Diabetes Care and Health Care Use and Costs	To examine racial and ethnic differences in diabetes care and health care use and costs for adults with diabetes using a nationally representative sample of the U.S. non-institutionalized civilian population.	Chi-square test, Count data model, Logit model	Diabetes care, Health care use & Health care costs	- Hispanics were more likely to have eye problems than whites - African Americans and Hispanics had lower total health care costs, lower ambulatory care costs, and lower prescription drug costs than whites
	Halls, Summers & Obenchain (2003)	Cost and Utilization Comparisons Among Propensity Score-Matched Insulin and Regular Insulin Users	To compare cost and utilisation among users of insulin lispro and regular (human) insulin	Propensity score-matched method	Physician office visit, Outpatient hospital visit, Inpatient hospitalisation, Emergency room visit, Pharmacy and Laboratory/radiology test	-Lispro subjects had type 1 diabetes more often and a history of insulin use, had fewer comorbidities, visited endocrinologists more often than family practice physicians, had lower total costs than regular insulin users. After matching on propensity score, they had more visits and pharmacy prescriptions but fewer inpatient hospital visits

	Author	Title of Study	Aim	Methodologies	Dependent Variables	Main Results
Both of the above	Gulliford, Sedgwick & Pearce (2003)	Cigarette smoking, health status, socio-economic status and access	To evaluate cigarette smoking in people with diabetes mellitus in a socio economically deprived area	Linear regression model & Logit model	Current smoking & Health care utilisation	-ve smoking with SES, health status & with utilisation
	Rabi *et al.* (2006)	Association of socio-economic status with diabetes prevalence and utilisation of diabetes care services	To determine whether income is associated with referral to a diabetes centre within a universal health care system	Chi-squared & Poisson regression model	Diabetes prevalence & Population rates of referral for diabetes care	-ve income with both diabetes prevalence & utilisation

Source: Created by author

2.6.6 Concluding Comments

We have, in this chapter, reviewed the literature for methodologies related to the subject. This review has allowed us to gain more insight on the various possible techniques that can be applied to our study. It is clear from this methodological review that there exists a number of appropriate models and analytical techniques that are applicable to our data. However, from all the information gathered, the preferred methodology for our study is as follows:

This study looks at three aspects of diabetes in Mauritius. The first aspect is prevalence whereby the factors associated with prevalence will be identified. A logit model is preferred over other binary response models for reasons highlighted in section 2.7.2. The second aspect under investigation is utilisation. Utilisation, being a count variable, is modelled using a negative binomial as opposed to the Poisson regression model as it is more flexible (see section 2.7.6.3 for more information about the negative binomial model). The last aspect to be looked at is a combination of the first two aspects. In order to identify the common links between prevalence and utilisation, ANOVA (Analysis of Variance) is used as means to assess the differences in means/proportions between two groups. Group 1 consists of those individuals who have diabetes and use the diabetes care services, whilst group 2 consists of those diabetics who do not utilise diabetes care services.

CHAPTER THREE
RESEARCH DESIGN, METHODOLOGY & ANALYSIS

3.1 Introduction

This section outlines the methodology used throughout this study. The first part discusses the study setting and its design. The second part explicitly unravels the data collection process. This section is followed by a brief discussion on the quality assurance of the study. The next section discusses data management. The statistical analysis section comes next and it is followed by the ethics and ethical considerations section and the limitations section.

3.2 Study Setting & Design

This study was carried out in Mauritius and was in the form of a household survey. A cross-sectional study design was employed, whereby the demographic, socio-economic and lifestyle information of both males and females was collected. Only individuals over the age 18 years were asked to participate in the study. This is because it is the age of majority in Mauritius and the participation of younger individuals would require the parents' permission. Moreover, adults are more equipped to answer questions, especially those concerning diabetes status and health care utilisation.

3.3 Data Collection Techniques

Data was collected by the author within the period of February 2009 to April 2009 (3 months) over all the nine districts of Mauritius.

3.3.1 Sample Size Determination

Sample sizes vary depending on the purpose and scope of the survey as well as on the size of the population in the country being surveyed. Large sample sizes around

10,000 are frequently encountered and correspond to a sampling fraction of 1:500 in a population of 5 million households or a population of 25 million people (Deaton, 1997). Our study is also a national survey, performed on all the nine districts, however, our population size is much smaller (1.3 million). Thus, we set the ratio as 1:400, taking budget and time constraints into consideration. With a population of 1.3 million living in about 280,000 households, we included approximately 700 households in the sample. The number of households to be interviewed from each district corresponded with the actual proportion of the population of the district to the entire population of Mauritius. This information is provided in the table 10 below. The table also shows the number of households that have actually been interviewed by interviewers from each district as well as the number of individuals interviewed in each district.

Table 10: Number of observations from each district.

	Name of District	Number of HHs in Each District*	Minimum Number of HHS to be Interviewed	Number of HHS Actually Interviewed	Number of Individuals Actually Interviewed
1	Port-Louis	32, 753	79	85	109
2	Pamplemousses	29, 886	72	74	155
3	Riviere du Rempart	24,442	60	65	125
4	Flacq	30,713	75	83	179
5	Grand Port	26,676	64	70	132
6	Savanne	16,818	41	42	47
7	Plaines Wilhems	93,762	226	226	447

Source: Created by author

HHs: Households

** For year 2000*

The sample size was 739 households (1319 individuals).

3.3.2 Interviewers

Nine interviewers were employed to collect data. The interviewers were selected based on the district they come from. As a result, one interviewer was selected from each district. Prior to the start of the study, the interviewers were trained for a period of two days on how to undertake the data collection process. They were trained on the sampling method and on how to carry out interviews.

3.3.3 Sampling Strategy

Cluster random sampling was used so as to maximise the dispersion of the sample throughout the community in order to fully represent the diversity (Aday & Cornelius, 2006). The nine districts were used as clusters and random sampling was used to select the households from each district.

Random sampling was used to select the households to be interviewed. Each interviewer was assigned the district they live in to conduct the data collection. Each interviewer started collecting data from his/her own house and randomly interviewed households in his/her neighbourhood. This method is not random but we assumed that it would not affect the sampling strategy and would provide an extra observation. This could have been a cause of bias, since the households interviewed only come from a restricted section of the district, that is, the region where the interviewer lives. However, these interviewers were selected based on the fact that their house was found in the main residential area in their district.

The random sampling methods used to select the households to be interviewed are the "toss-a-coin" method (dichotomous technique) and the "spin-the-bottle"/"spinning-the-pen" method. These methods are simple unbiased ways in selecting between different choices and are often justified as ways to avoid costly and time-consuming listing of all households in the selected cluster. It is essential to point out that these two methods are not frequently used but have proven to be both cost-effective and efficient in practice and appropriate for the particular survey context. The original method presented in the proposal of this study to randomly select the households differs from the actual method used in practice ("toss-a-coin" and "spin-the-bottle" method). Geographical maps of the districts were supposed to be used to pre-select the households to be interviewed prior to the start of the study using a random method of selection. However, these maps were not available and having the maps drawn would have been too costly and time-consuming. As a result, alternative methods of random selection were chosen. The households selected using the toss-a-coin" and "spin-the-bottle" methods are representative of the whole Mauritian population since cluster sampling was used and all the nine districts were included in the sample.

The toss-a-coin" and "spin-the-bottle" methods are explained in more details below. After interviewing his/her own house, with his/her back against his/her house, the interviewer tossed a coin in order to choose between the left or right direction. He/she would spin a bottle if he/she deems that there is more than two possible directions to proceed (e.g. left, right, ahead and behind) and wherever the bottle points at would be the direction to start follow. Interpretation of the direction indicated by the bottle was in such a way that if the bottle did not clearly point towards a particular road, the road closest to the direction pointed was selected. In case it was difficult to clearly identify which road was closest to the direction indicated by the bottle, the latter was spun a second time. When a route has been selected, all households along that street were interviewed. As soon as an alternative route(s) presents itself, the interviewer tossed a coin or spun the bottle on even ground to randomly select between the possible alternative routes.

3.3.4 Questionnaire & Interview

A 20-minute structured questionnaire was administered to all eligible (over 18 years old) members of a household. The questionnaire was developed, piloted and validated prior to the start of the study. Questions on demographic, lifestyle and socio-economic status were included (See Table 1 and 2 and questionnaire in the appendix). It consisted of 3 open questions, 15 closed questions, 9 quantity-type questions, 4 list-type and 5 category-type questions. Self-reported methods was used for diabetes status, weight and height.

In case no members of a particular household meet this criterion (only member over the age of 18 should be allowed to participate), that particular household was removed from the study. All eligible members of a household were asked to participate in the study. If **ALL ELIGIBLE** members of a particular household were unavailable at the time of study, the particular household was also removed from the study.

Interviewers/field workers administered questionnaires to households after normal working hours and on weekends as much as possible. This was to ensure that a maximum number of individuals were interviewed within each household and to capture both employed and unemployed individuals and thus avoid any bias. It is presumed that this strategy helped reduce non-response rate to the barest minimum.

All field workers were either bilingual or trilingual. He/she was at least fluent in both English and Creole, the national language in Mauritius.

3.4 Quality Assurance

There was continuous evaluation to assess the implementation of the research and to resolve any conflict of interest. Field workers have been monitored twice during their field visits by the UCT researcher. This was done to establish and address potential weaknesses in data collection, as well as to provide support for the field workers. This evaluation included observation of survey administration to assess interview style, skill and accuracy of questionnaire completion. The data management system was also evaluated during this time.

In order to have a greater degree of reliability in this study, the same questionnaire was administered to all participants. Participants were allowed to choose the language he/she could best communicate in.

3.5 Data Management

Completed survey questionnaires were immediately reviewed by the field worker in order to identify any questions that were omitted or any errors made and thus, make necessary amendments. The questionnaires were then sequentially numbered and handed over to the data entry clerk on a daily basis.

A data entry clerk was employed for the duration of the study. That person was responsible for developing unique survey questionnaire identification codes. Furthermore, he entered data from the survey questionnaires into a database using Microsoft Excel as soon as the data was available and was responsible for the archiving and safe storage of all data collected by the research team.

Entered data was only accessed and assessed by the researcher. Data stored on computers was protected by passwords, and all other materials and data was stored in a locked cupboard. The data will be destroyed five years after the completion of the study.

Data cleaning was performed on the data set and immediately after, the data was analysed.

3.6 Statistical Data Analysis

Data has been entered and cleaned on Microsoft Excel. It was then exported to STATA version 8 for analysis. Three separate analyses were conducted. These are explicitly described in section 3.6.3.

3.6.1 General Points to Note & Definitions

At this point, it is important to discuss briefly some fine details about the analysis in general. Firstly, non-responses, that is, when an individual answers the questionnaire as a whole but is reluctant or unable to answer a particular question, have been coded as “missing values” in the dataset (Jones, 2006). Non-responses can be a source of bias if observations with missing values are systematically different from those who respond to the question. For instance, those who are self-employed may be more reluctant to disclose information about their income than those in paid employment (*ibid*).

Secondly, per capita household expenditure has been used as a proxy for socio-economic status and was obtained from total household expenditure and household size. Household expenditure data was obtained by asking the respondents how much was spent by the entire household per month. However, using the amount quoted by a respondent in the analysis may be misleading if the household size is not taken into consideration. It is obvious that the larger the household, the smaller the expenditure per individual will be. Thus, in order to incorporate the effect of the household size on expenditure, the household expenditure was divided by the household size to obtain the per-capita household expenditure. This measure of socio-economic status represents the socio-economic status of all the members of the household. The use of this measure of socio-economic status is one of the shortcomings of this study since other more reliable measures such as asset index or deprivation are present in the literature. However, these alternatives could not be applied in this study because the variables were not collected on the field.

Thirdly, Body Mass Index (BMI) was calculated as kg/m^2 (weight in kilos divided by height squared). Fourthly, it is worth mentioning that the level of analysis of this study is at individual level.

Another point to note is that family history has been used as a proxy for the genetics variable and the diet variable was measured as whether an individual has low or high vegetable intake. Also, the squared term of age was included in the analysis to examine the quadratic effect of age and to allow for a flexible relationship between age and the outcome of interest. The squared form of per-capita expenditure was included for the same reasons. It is also important to note that the terms prevalence and status, with regards to diabetes, have been used interchangeably. Other important points to note are as follows:

Only those with type 1 and 2 diabetes were considered as diabetics and not those with impaired glucose tolerance which is a stage in the transition from normality to diabetes.

Our results for the various models show robust standards errors (see tables of the results section). These errors were computed to correct for heteroskedasticity. Analyses for model 1 and 2 include the goodness of fit of the model. The Wald Chi^2 test evaluates the null hypothesis that all coefficients in the model, except the constant, equal zero. The Pseudo R^2 statistic compares the fit of different models for the same dependent variable ('diabetes status' for model 1 and 'number of visits' for model 2).

3.6.2 Testing for Multicollinearity

Several factors have been shown in the literature to affect diabetes prevalence and diabetes care utilisation. One would be tempted to collect data for these various factors and throw them all in the regression analysis. However, it is wise to test for multicollinearity before doing so. It is very often the case that variables have an influence on one another. An example is income, which has an effect on numerous other variables such as whether the individual performs physical exercise. Income also has a great influence on the type of housing an individual lives in (Naidoo & Wills, 1994).

Testing for multicollinearity shows the presence of relationships between the independent variables in the model. It also shows the type of relationship, be it strong or weak. If there is a strong relationship between certain factors, the more secondary factor will be dropped. Thus, the effect of the secondary factor is assumed to be captured by the more primary factor. For example, if a strong association is shown to be present between income and education level, education level will be dropped. The effect of income on diabetes prevalence will be assumed to incorporate the effect of education level on diabetes prevalence. Therefore, a positive change in income will automatically be followed by a positive change in education level.
A correlation matrix of the variables is shown in Appendix B.

3.6.3 Analyses & Model Specification

Three different groups of analyses were performed in order to meet each one of the three objectives of this study. Objective 1 which is "To identify the factors associated with the prevalence of diabetes" has been achieved through a logistic regression, whilst in order to achieve objective 2, that is, "To identify the factors associated with the utilisation of diabetes health care services amongst Mauritian diabetics", a negative binomial regression model has been employed. Analysis of Variance has been used to "To identify the common link between diabetes prevalence and utilisation of diabetes care services" which is the third objective of this study.

The first two models (Models 1 & 2) were analysed in five stepwise stages using the conceptual framework as a guide. The stepwise analysis was carried out in order to assess the effect and magnitude of including the various categories of independent variables in the model, knowing fully well that the effect and significance will vary depending on the number of independent variables included in the regression.

The first step in each model was to determine the effect of only the un-modifiable factors such as age and ethnic group, on the dependent variable. The second one consisted of the modifiable factors like smoking and obesity and the third analysis combined both un-modifiable and modifiable factors. The fourth analysis assessed the association of diabetes status and the enabling factors and the fifth combined all the factors.

3.6.3.1 Model 1

Analysis 1 was performed to assess the association between the diabetes prevalence and certain risk factors that have been identified in the literature. In model 1, diabetes status was used as the dependent variable. This variable is a dummy variable with outcomes No = 1 and Yes = 1. 'Yes' and 'No' indicate whether the individual interviewed has diabetes or not respectively. The 'Don't Know' outcome of the dependent variable was coded as missing values. Since the dependent (response) variable is a qualitative binary variable, a qualitative binary response model, namely a logit model, has been used for the regression analysis.

The logit model is as follows (Jones, 2006):

When y equals 0 or 1, the conditional expectation of y is,

$E(y_i|x_i) = P(y_i= 1|x_i) = F(x_i)$

In our case the variable y denotes whether or not an individual has diabetes.

The logit model can be given a latent variable interpretation.
Let,

$y_i \quad = 1 \text{ iff } y^*_i > 0$
$\quad\;\; = 0 \text{ otherwise}$

where,

$$y^*_i = x_i\beta + \varepsilon_i$$

Then,

$P(y_i=1| x_i) = P(y^*_i >0| xi) = P(\varepsilon_i >-x_i\beta) = F(x_i\beta)$

The independent variables included in the regression model are listed and described in table 11 below. The mathematical expression for this analysis is:

d_status = f (**age, age2, eth_grp_1, eth_grp_2, eth_grp_3, sex_1, parents_d_status_1, relatives_d_status_1, smoke_cig_1, perform_phy_act2_1, num_drinks_month2_1, hw_often_veg2_1, overweight_1, obese_1, percap_exp, percap_exp2, educlev_2, educlev_3, residence_1, med_aid_1**)

Table 11 also shows the general direction of the expected effect of changes in the independent variables on diabetes status as per the literature.

Table 11: Description of the dependent variable and the independent variables for analysis 1.

Variable Name	Description	Comments	Expected Signs
d_status	Whether or not an individual has diabetes.	Dummy variable: 0 = does not have diabetes 1= has diabetes	n/a[4]
age	Age of the individual in years.	Continuous variable	positive
age2	Squared form of age	Continuous variable	positive
eth_grp	Ethnic group/race of the individual.	Categorical variable with 5 outcomes: 0 = eth_grp_0 = Creole (base category) 1 = eth_grp_1 = Hindu 2 = eth_grp_2 = Muslim 3 = eth_grp_3 = Chinese 4 = eth_grp_4 = Other (merged with 'Chinese)	Creoles are predicted to be less likely to develop diabetes, thus, the other ethnic groups will have a positive sign when compared to the Creole base population group.
sex	Gender of individual.	Dummy variable: 0 = sex_0 = female (base category) 1 = sex_1 = male	positive
parents_d_status	Whether or not an individual's parents (first degree relative) have diabetes.	Dummy variable: 0 = parents do not have diabetes (base category) 1 = parents have diabetes	positive
relatives_d_status	Whether or not an individual's relatives (second degree relative) have diabetes.	Dummy variable: 0 = they do not have diabetes (base category) 1 = they have diabetes	positive
smoke_cig	Whether or not an individual smokes cigarettes.	Dummy variable: 0 = smoke_cig_0 = does not smoke (base category) 1 = smoke_cig_1 = smokes	positive
perform_phy_act2	Whether or not the individual performs physical activity.	Dummy variable: 0 = perform_phy_act2_0 = does not perform physical activity (base category) 1 = perform_phy_act2_1 = performs physical activity	negative
num_drinks_month2	Whether an individual drinks alcohol	Dummy variable: 0 = num_drinks_month2_0 = does not consume alcohol (base category) 1 = num_drinks_month2_1 = consumes alcohol	negative
hw_often_veg2	Whether an individual has a low or high intake of vegetables.	Dummy variable: 0 = hw_often_veg2_0 = low intake (base category) 1 = hw_often_veg2_1 = high intake	negative
overweight	Whether an individual is overweight or not ($25kg/m^2$<BMI≤$30kg/m^2$)	Dummy variable: 0 = not oveweight (base category) 1 = overweight	positive
Variable Name	**Description**	**Comments**	**Expected Signs**

[4] n/a stands for "not applicable" in cases where the expected sign for the particular variable cannot be predicted or is difficult to predict.

obese	Whether an individual id obese or not ($BMI>30kg/m^2$)	Dummy variable: 0 = not obese (base category) 1 = obese	positive
percap_exp (per capita household expenditure)	Total household expenditure over household size	Continuous variable	negative
percap_exp2 (per capita household expenditure)^2	(Total household expenditure over household size)^2	Continuous variable	negative
edulevel	Highest level of education attained by individual.	Categorical variable with 3 outcomes: 1 = educlev_1 = primary (base category) 2 = educlev_2 = secondary 3 = educlev_3 = tertiary	negative (with respect to the base category)
residence	Place of residence of an individual	Dummy variable: 0 = rural (base category) 1 = urban	negative
med_aid	Whether individual has medical aid or not.	Dummy variable that identifies those with some form of medical aid: 0 = no medical aid (base category) 1 = has medical aid	negative

Source: Created by author

3.6.3.2 Model 2

In analysis 2, the association of health care utilisation among diabetics and socio-economic status as well as several other factors was assessed. In model 2, utilisation among diabetics was used as the dependent variable. This variable is a numerical variable, thus, a counts data regression tool, namely negative binomial regression, has been used. A binomial regression model is preferred over a Poisson model since ordinary Poisson regression will have difficulty with overdispersed data, that is, where the variance is much larger than the mean.

The negative binomial regression is as follows:

The negative binomial specification allows for overdispersion by specifying,

$\exp(x_i\beta+\mu_i) = [\exp(x_i\beta)]\eta_i,$ where η_i is a gamma distributed error term. Then,

$P(y_i) = \{\Gamma(y_i+\psi_i)/\Gamma(\psi_i)\Gamma(y_i+1)\}\ (\psi_i/(\lambda_i+\psi_i))^{\psi i}(\lambda_i/(\lambda_i+\psi_i))^{yi}$

where $\Gamma(.)$ is the gamma function. Letting the "precision parameter" $\psi=(1/a)\lambda^k$, for a>0,
gives,

$E(y) = \lambda$ and $Var(y) = \lambda + a\lambda^{2-k}$

This leads to two special cases: setting k=1 gives the negbin 1 model with the variance proportional to the mean, $(1+a)\lambda$; and setting k=0 gives the negbin 2 model where the variance is a quadratic function of the mean, $\lambda + a\lambda 2$. Setting a=0 gives the Poisson model, and this nesting can be tested using a conventional t-test. In our case, k will be set to 1.

The independent variables included in this analysis are listed and described in table 12 below. The mathematical expression for this analysis is:

num_visitsS = f (age, age2, eth_grp_1, eth_grp_2, eth_grp_3, sex_1, parents_d_status_1, relatives_d_status_1, smoke_cig, physical32, physical35, num_drinks_month332, num_drinks_month333, num_drinks_month334, percap_exp, percap_exp2, educlev_2, educlev_3, residence_1, med_aid_1)

The table below also shows the general direction of the expected effect of changes in the independent variables on utilisation.

Table 12: Description of the dependent variable and the independent variables for analysis 2.

Variable Name	Description	Comments	Expected Signs
num_visitsS	Number of times an individual with diabetes visited a health care provider due to his/her diabetes in the past year (utilisation standardized by sex & age)	Numerical variable	n/a
age	Age of the individual in years.	Continuous variable	positive
age2	Squared form of age	Continuous variable	positive
eth_grp	Ethnic group/race of the individual.	Categorical variable with 5 outcomes: 0 = eth_grp_0 = Creole (base category) 1 = eth_grp_1 = Hindu 2 = eth_grp_2 = Muslim 3 = eth_grp_3 = Chinese 4 = eth_grp_4 = Other (merged with 'Chinese)	Creoles are predicted to be less likely to develop diabetes, thus, are predicted to use less services. The other ethnic groups will have a positive sign when compared to the Creole base population group.
sex	Gender of individual.	Dummy variable: 0 = sex_0 = female (base category) 1 = sex_1 = male	negative
parents_d_status	Whether or not an individual's parents (first degree relative) have diabetes.	Dummy variable: 0 = parents do not have diabetes (base category) 1 = parents have diabetes	n/a
relatives_d_status	Whether or not an individual's relatives (second degree relative) have diabetes.	Dummy variable: 0 = they do not have diabetes (base category) 1 = they have diabetes	n/a

Variable Name	Description	Comments	Expected Signs
smoke_cig	Whether or not an individual smokes cigarettes.	Dummy variable: 0 = smoke_cig_0 = does not smoke (base category) 1 = smoke_cig_1 = smokes	positive
Variable Name	**Description**	**Comments**	**Expected Signs**
physical3	Perform medium level of physical activity	Categorical variable with 4 outcomes: 1 = physical31 = none (base category) 2 = physical32 = high 5 = physical35 = low	negative (with respect to the base category)
num_drinks_month33	Alcohol consumption	Categorical variable with 4 outcomes: 1 = num_drinks_month331 = none (base category) 2 = num_drinks_month332 = low 3 = num_drinks_month333 = medium 4 = num_drinks_month334 = high	negative (with respect to the base category)
percap_exp (per capita household expenditure)	Total household expenditure over household size	Continuous variable	positive
percap_exp2 (per capita household expenditure)^2	(Total household expenditure over household size)^2	Continuous variable	positive
edulevel	Highest level of education attained by individual.	Categorical variable with 3 outcomes: 1 = educlev_1 = primary (base category) 2 = educlev_2 = secondary 3 = educlev_3 = tertiary	negative (with respect to the base category)
residence	Place of residence of an individual	Dummy variable: 0 = rural (base category) 1 = urban	negative (with respect to the base category)
med_aid	Whether individual has medical aid or not.	Dummy variable that identifies those with some form of medical aid: 0 = no medical aid (base category) 1 = has medical aid	negative (with respect to the base category)

Source: Created by author

3.6.3.3 Model 3

Analysis 3 was performed to identify the common linkage between diabetes prevalence and the utilisation of diabetes care services. Two-way ANOVA (Analysis of Variance) was used to measure the education and socio-economic differences between two groups. We want to examine whether these differences are significant. Through this analysis we can assess the interaction effects between the variables to influence scores on the response variable. These two groups are shown in the table below.

Table 13: Comparison groups in analysis 3.

Group 1		Group 2	
Diabetes Prevalence	**Utilisation**	**Diabetes Prevalence**	**Utilisation**
Yes	Yes	Yes	No

Source: Created by author

3.7 Ethics and Ethical Considerations

3.7.1 Ethics Approval

Ethics Approval was obtained from the University of Cape Town Ethics Committee prior the start of the study.

3.7.2 Participant Withdrawal

Study participation may be discontinued for any of the following reasons:

- The participant withdraws her consent. Participants may withdraw from study participation at any time, for any reason.
- Study interviewers (fieldworkers) determine it to be in the best interest of the subject for a non-medical reason.

3.7.3 Informed Consent

Written informed consent was obtained from all study participants by the interviewer. The rationale of the study, procedural details and investigational goals were explained to each participant together with potential risks and benefits via the informed consent form. Each subject was assured that she is free to withdraw at any time.

3.7.4 Risks and Discomforts

- The risks of taking part in the study were small, if any. Some questions made the participant uncomfortable or shy. Participants could refuse to answer any of the questions and could leave the interview at any time.

3.7.5 Benefits

- There was no direct benefit to the participant for taking part in this study.
- An indirect benefit was the opportunity to help researchers find out about the factors correlated risk of developing diabetes or utilizing diabetes care services.

3.7.6 Confidentiality

The information on individual participants arising from this study was considered confidential and transmitted only in a form that did not permit identification of the individual. All records were in a secure storage area with limited access.

3.7.7 Econometric Issues

3.7.7.1 Introduction

The choice of a model to analyse data is often tricky and several issues have to be taken into account in order to do so. Below is a discussion of the various econometric issues that have to be considered in the analysis of health care data, especially utilisation data, in order to select the appropriate model for analysis.

3.7.7.2 Major econometric issues around health care data

There are various econometric issues that one must consider in the choice of a model for analysis. In this study we will discuss four that are relevant for this study. These issues are: (1) the presence of a large mass of individuals with zero utilisation (or expenditures) during a given time period; (2) consumption amongst those with care is very skewed (e.g. visits, hospitalisations, expenditures); (3) the dependent variable often responds in a non-linear manner to many covariates and (4) the demand response to covariates may change by the level of demand (e.g. outpatient to inpatient, or low to high levels). All these issues arise as a result of the characteristics of health care utilisation data. Health care utilisation variables are seldom normally distributed since they tend to contain a mode at zero with a distribution bearing a long, heavy right tail (Diehr *et al*., 1999). Utilisation data is, also, not independent. One reason for this could be because there may be several hospitalisations for the same patient (*ibid*). Furthermore, homoscedasticity is not satisfied since the variance is not the same for any fixed combination of covariates, but the standard deviations tend to increase with the square root of the mean like in a Poisson distribution (*ibid*). Thus, utilisation data does not satisfy the standard assumptions for the OLS method (discussed in section 2.7.2.1) which requires the dependent variable to satisfy normality, homoscedasticity and independence (Diehr *et al*., 1999). Consequently, alterations have to be made to the data in order to utilise the OLS method. These alterations will be discussed in the later sections.

The four econometric issues mentioned above can be categorised under three main topics in econometrics namely the skewness, the causality problem and evaluation problem. They will each be briefly described below.

(A) The Evaluation Problem

The evaluation problem is how to identify causal effects from empirical data (Jones, 2006). Consider an outcome y_{it}, for individual i at time t. The aim in any analysis is to identify the effect of a treatment on y. Let us assume y is the individuals i's use of health care services and the treatment is health insurance. "The causal effect of interest is the difference between the outcome with the treatment and the outcome without the treatment" (Jones, 2006). However, this pure treatment effect cannot be identified from empirical data since the counterfactual can never be observed. Thus, the main problem is that the individual i "cannot be in two places at the same time t"; that is, it is not possible to observe their use of health care, at time t, both with and without the influence of insurance (*ibid*). Halls, Summers & Obenchain (2003) also conducted a utilisation study to compare the cost and utilisation amongst insulin lispro (a rapid-acting human insulin analog with a faster onset and shorter duration of action compared to regular insulin) and regular insulin. In order to achieve their objectives, they adopted a retrospective study design whereby medical and pharmacy claims data from 14 health plans were used for continuously enrolled subjects using insulin lispro or regular insulin between January 1, 1998, and December 21, 1999. The subjects (a total of 11,443 subjects with 3,341 lispro insulin subjects and 8,102 regular insulin subjects) were matched on the propensity to receive lispro insulin versus regular insulin (two treatment groups). This method is called the propensity score-matched method and is used to control "for confounding when numerous characteristics are related to the outcome of interest or when 2 populations are known to differ due to selection bias" (Halls, Summers & Obenchain, 2003: 264). It is thus a method used to balance the treatment groups at baseline (D'Agostino, 1998). This method was chosen over standard regression which can handle several regressor variables but can provide misleading results due to the small differences in numerous covariates which can accumulate into a significant overall difference. "Two treatment groups may differ in a multivariate direction to an extent that cannot be discerned in the separate analyses of each covariate" (cited in Halls, Summers & Obenchain, 2003, 264; Rubin, 1997). Halls, Summers & Obenchain (2003) used baseline characteristics as independent predicators in a multivariate logistic regression model which was constructed to predict the probability (score) or receiving lispro versus regular insulin. The subjects were matched (1 to 1) on propensity scores within ±0.01. In order to ensure that all significant differences between the treatment groups had become significant, baseline characteristics were compared before and after matching. Some of the independent variables used in the model are age, gender, physical speciality, comorbidities, related comorbidities, oral hypoglycemic use and so on. The dependent variables for measuring health services utilisation were physician office visits, outpatient hospital visits, inpatient hospitalisation, emergency room visits, pharmacy and laboratory/radiology tests. Costs were defined as the sum of both health plan and enrolee liability. The authors used *T* tests to detect significant differences between treatment groups with respect to follow-up cost and utilisation. Results showed that lispro insulin users were younger, more often had type 1 diabetes and a history of insulin use, had fewer comorbidities, visited endocrinologists more often than family practice physicians, and had lower total costs than regular insulin users. Only 1,832 subject pairs were retained after matching on propensity score within ±0.01. Lispro users were found to have significantly more office visits and pharmacy prescriptions but fewer inpatients hospital visits than the other treatment group but costs were found to be similar for both treatment groups and total costs were not significantly different between the two treatment groups. Some limitations of this study are (1) since the two treatment groups were quite different at baseline, the matching technique likely resulted in the pairing of a "sicker" lispro subject and a "healthier" regular insulin subject at baseline, (2) the study only used 12 months of follow-up data. It would be quite beneficial to repeat the study with a longer follow-up period data and with more current data, (3) a subject was included in the lispro treatment group if he/she has had at least one lispro prescription during the subject identification period. Thus, the subject could have easily switched therapy during the study period. However, it was found that less than 1% of the regular insulin users filled a lispro prescription during the follow-up period. This suggests that alternative therapy did not attribute to outcomes observed during the follow-up period.

(B) The Causality Problem

Causality is a theoretical concept which is defined as the relationship between two events, one being the cause and the other being the effect. However, a lot of debate has prevailed around its definition. Some have suggested replacing the term "causality" with an uncommitted term, for example, "functional relation" or "predictability" (cited in Wold, 1954). However, an attempt to explain the meaning of causality is not an easy task and is ultimately a philosophical problem (cited in McCrorie & Chambers, 2006). As Granger (1980: 330) reported, ''Attitudes towards causality differ widely, from the defeatist one that it is impossible to define causality, let alone test for it, to the populist viewpoint that everyone has their own personal definition and so it is unlikely that a generally acceptable definition exists" (cited in McCrorie & Chambers, 2006: 318). But one thing is clear is that the causality issue arises when, on some occasions, there exists a difficulty in deciding the direction of causality between two related variables and also whether or not feedback is occurring (Granger, 1969).

The concept of 'Granger causality' is designed as an operational definition such that real statements can be made about causality on the basis of statistical data. The general principle is as follows (cited in McCrorie & Chambers, 2006: 318):

Ω_t represents all the information in the universe at time T. Let $F(A|B)$ be the conditional distribution of A given B and consider two series Y_t and X_t. Then if

$$F(X_{t+k}|\Omega_t) = F(X_{t+k}|\Omega_t - Y_t) \quad (\forall k > 0)$$

where Ω_t - Y_t is all the information in the universe apart from the values Y_t taken up to time t, then Y_t does not cause X_t. If the condition above does not hold, then Y_t could be said to cause X_t on the grounds that there is special information contained in Y_t about X_t that is not available elsewhere.

(C) Skewness

Skewness, on the other hand, is a common problem with utilisation and household health expenditure data where there are many small values and a long right-hand tail with a few exceptionally expensive cases for example (Jones, 2006). Transformation of the raw scales before running the data is often needed in the regression analyses of these kinds of skewed data (*ibid*). These transformations can be in the form of logarithms or Box-Cox transformations. These will be explained in more detail in the next section.

3.7.7.3 Solutions to the Econometric Issues

There are various solutions to counteract the econometric issues faced by researchers. In fact, econometric strategies for the analysis of data bearing the econometric issues mentioned above, have been broadly discussed (Blough, Madden & Hornbrook, 1999; Duan *et al*., 1983; Jones, 2000; Manning, 1998; Mullahy, 1998). Count variables are those which do not take negative values and sometimes referred to as non-negative integer valued counts, y = 0,1,2,…, where y is measured in natural units on a fixed scale (Cameron & Trivedi, 1998). Utilisation is an example of a count variable and for such variables alternative models such as Poisson and negative binomial models are used in order to counteract the econometric issues (Jones, 2000; Cameron &

Trivedi, 1998). Other solutions to tackle these econometric issues are presented below.

(A) Log & (B) Box-Cox Transformations

As mentioned earlier in this paper, health care/utilisation data is often non-normal, skewed and heteroscedastic (Diehr *et al*., 1999). If the data is very large, then performing OLS regression on the untransformed data might produce unbiased estimates of the regression parameters (*ibid*). Moreover, the OLS method on this type of skewed data can often produce out-of-range predictions (i.e. $y_{hat} = x\beta_{hat} < 0$). Log or Box-Cox transformations are used on skewed data in order to reduce heteroscedasticity as well as the effect of outliers, thus improving the distribution (Diehr *et al*., 1999). After transformation, the data can be analysed with the OLS method. However, the data must be retransformed back to the original scale to facilitate the economic interpretation of the results (Jones, 2006). This is particularly true in the presence of heteroscedasticity (*ibid*).

(A)

In a log transformation, the dependent variable can be logged to produce a more symmetric distribution of errors and gain precision and robustness. Below is an example of a log transformation. Using log transformation implies that second moments often matter.

Let us assume $\log(y|g) \sim N(\mu_g, \sigma_g)$, where treatment g = A, B. Then we know:

- $E(y|g=A) = \exp[\mu_a + 0.5(\sigma_a)^2]$.
- $E(y|g=A)/E(y|g=B) = \exp[(\mu_a - \mu_b) + 0.5\{(\sigma_a)^2 - (\sigma_b)^2\}]$

We see from the second equation above, that the second moment of the distributions matters if there is heteroscedasticity, but not if there is homoscedasticity (i.e. $\sigma_a = \sigma_b = \sigma$)

(B)

Box & Cox (1964) proposed a parametric power data processing technique to reduce discrepancies such as non-additivity, non-normality and heteroscedasticity (Box &

Cox, 1964). Indeed, this technique makes data more normal distribution-like and improves the correlation between variables. Box-Cox transformation of y is as follows (Box & Cox, 1964):

$$y^{(\lambda)} = \begin{cases} \dfrac{y^{\lambda}-1}{\lambda} & (\lambda \neq 0), \\ \log y & (\lambda = 0), \end{cases}$$

Where y to $y^{(\lambda)}$ is a parametric family of transformations and λ is the parameter defining a particular transformation. Thus,

- $[(y^{\lambda}- 1)/\lambda] = x\beta + \varepsilon$, if $\lambda \neq 0$
- $\log(y) = x\beta + \varepsilon$, if $\lambda=0$

MLE as well as Bayesian methods for the estimation of the parameter λ using were proposed by Box & Cox (1964) in order to minimise the skewness in the residuals. It is common to test whether the estimator of the Box-Cox transformation parameter conforms to a hypothesised value (cited in Guerrero & Johnson, 1982). The asymptotic distribution of the likelihood ratio to test some hypotheses about the parameter was used by Box & Cox (1964). A test for the value of the parameter whose null distribution is known and which is easier to calculate was further proposed by Andrews (1971) (cited in Guerrero & Johnson, 1982).

(C) Count data model & (D) Two-part model

Another solution to the econometric issues is the use of alternative models such as the two-part model or the count data model.

(C)

Count data in health economics is very common. The number of doctor visits, hospitalisations and ER visits are all types of count data. A count data regression is appropriate in cases where the dependent variable represents a count of events (Cameron & Trivedi, 1998; Jones, 2006). Examples of count data models are the Poisson regression model and the negative binomial model (Cameron & Trivedi, 1986) used for the analysis of count data. Usually, count data regression is applied when the distribution of the dependent variable is skewed. If this is the case, then the data will usually contain a large proportion of zero observations, for example, in this case, those who make no use of health care during the specified period, as well as a long right hand tail of individuals who make particularly heavy use of health care (Jones, 2006). The basic statistical model for count data assumes that the probability of an event occurring (λ) during a brief period of time is constant and proportional to the duration of time. λ is known as the intensity of the process and the Poisson process is the starting point for a count data regression (*ibid*). A common assumption in order to turn this into an econometric model where the outcome y depends on a set of explanatory variables x, is that $\lambda = \exp(x\beta)$. This exponential function is used in order to ensure that the intensity of the process, which can also be interpreted as the mean number of events, given x (*ibid*).

The Poisson regression assumes the response variable Y has a Poisson distribution, and also assumes that the logarithm of its expected value can be modelled by a linear combination of unknown parameters (Cameron & Trivedi, 1998). The model takes the following form in the simplest case where only a single independent variable x is present:

$$\log(E(Y)) = a + bx$$

a and b can be estimated by maximum likelihood if the number of distinct x values is at least 2 and if Y_i are independent observations with corresponding values x_i of the predictor variable. Thus, Poisson regression models are generalised linear models with the logarithm as the link function, and the Poisson distribution function (*ibid*). In a Poisson distribution, a common characteristic is that its mean is equal to its variance. In certain cases when the observed variance is found to be greater than the mean, this indicates that the model is not appropriate. This phenomenon is known as over-dispersion and it usually is the result of the omission of relevant explanatory variables. Another common problem with Poisson regression is excess zero whereby if two processes are at work where one determines whether there are zero events or any events, and a Poisson process which determines how many events there are, there will be more zeros than a Poisson regression would predict (*ibid*). In that case, other generalised linear models such as the negative binomial model may be more appropriate.

The negative binomial model or the negbin model, unlike the Poisson model, is more flexible and allows for over-dispersion since it assumes that the individual error term comes from a particular probability distribution (the gamma distribution) (Jones, 2006). It is possible to write down a new probability function for y by assuming the gamma distribution and hence estimate the model by maximum likelihood estimation (*ibid*). In practice, two special cases of the negbin model exist: (1) the variance of y is proportional to the mean of y and (2) the variance is a quadratic function of the mean (*ibid*). Interestingly, the negbin model nests the Poisson model as a special case and this can be tested using a conventional t-test on the coefficient that reflects over-dispersion (*ibid*).

(D)

The two-part model is used to analyse utilisation data in which many observations tend to clump at zero, that is, when there is a concentration of zero values (Diehr *et al*., 1999). In the two-part model, one equation predicts that the probability that a person has any use whilst the second equation predicts the level of use for the users only (Diehr *et al*., 1999). In addition, the expected level of use of an individual is calculated by multiplying these two estimates (*ibid*). An attractive feature of the two-part model is that it provides insight into the utilisation process (*ibid*).

In a two-part model, we decompose the expected value as follows:

- $E(y|x) = P(y>0)*E\{y|y>0\} + P(y=0)*0 = P(y>0)*E\{y|y>0\}$

Now we must estimate P(y>0) and E(y|y>0) separately. The first part term can be estimated with a probit model [$P(y>0)=\Phi(x\alpha)$. On the other hand, the second part, the y term can be logged to take skewness into account. If the log-scale error term is normally distributed, then:

- $Y_{hat}=\Phi(x\alpha)*\exp(x\beta + 0.5\sigma^2)$, where β and σ are estimated from the data.

If the log-scale error term is not normally distributed, then one can use the following formulation:

- $Y_{hat}=\Phi(x\alpha)*\exp(x\beta)*D$
- $D=N^{-1}\Sigma\exp[\varepsilon]=N^{-1}\Sigma\exp[\ln(y|y>0)-x\beta_{ols}]$

On the other hand, the one-part model is simpler and is fit to the data for all people, whether they used any services (*ibid*).

CHAPTER FOUR
RESULTS

4.1 Introduction

The previous chapter described the research design, the methodology, the statistical analysis as well as the ethical considerations and the study limitations. This chapter presents, first of all, some descriptive statistics, with the aim of providing an insight on the sample and on diabetes prevalence as well as the utilisation of the population of Mauritius. The next section of this chapter presents the empirical results from the three models used.

4.2 Broad Descriptive Statistics

4.2.1 Household size and Population Structure

Before the start of any analysis, a total of 739 households (1319 individuals) were included in the survey. The average household size is 3.54. This figure is very similar to the average household size obtained from the 2000 Household and Population Census conducted on the Mauritian population which is 3.9 (Central Statistics Office, 2010). The smallest household size in the sample consisted of 1 person whilst the largest consisted of 10 members. The standard deviation and the variance are 1.36 and 1.85 respectively. The *Skewness* is 0.79 and the *Kurtosis* is 4.84. Thus, the sample is positively skewed and the distribution is said to be left-skewed.

The mean age in the sample is 44.56 with a standard deviation of 15.91 and a variance of 253.23. The minimum age is obviously 18, since only those above 18 years were interviewed, and the maximum age is 88. Also, 75% of the sample has age values less than 55 years. In addition, the *Skewness* is 0.23 and the *Kurtosis* is 2.31.

There are slightly more females (55.18%) in the sample than males (44.82%). Comparing these figures to the sex distribution in Mauritius (sex ratio: 0.97 males/females)[5] which is 50.7% of females and 49.2% of males, shows that the data is a good representation of the sex distribution of the Mauritian population.

The ethnicity-population structure of the population is shown below. These figures reflect the ethnicity distribution of the whole sample before any observations were dropped. The ethnicity distribution of our sample is very close to that of the whole Mauritian population as illustrated in table 14. Thus, this suggests that our data are a good representation of the ethnicity distribution of the Mauritian population.

Table 14: Ethnicity distribution of population.

Ethnic Group	Frequency	Percentage (in sample)	Cumulative Percentage (in sample)	Percentage (in Mauritius)[5]	Cumulative Percentage (in Mauritius)
Creole	218	16.59	16.59	27	27
Indo-Mauritian (Hindu & Muslim)	819+235= 1054	62.33+17.88= 80.21	16.59+80.21= 96.8	68	95
Sino-Mauritian (Chinese)	26	1.98	98.78	3	98
Other	16	1.22	100	2	100
Total	**1,314**	**100**			

5 Data Source: World Factbook. 2009. [Online]. Available: https://www.cia.gov/library/publications/the-world-factbook/geos/mp.html [2009, October 8]

4.2.2 Household Expenditure

Table 15: Per-capita household expenditure distribution.

Per-capita Household Expenditure (Mauritian Rupees, Rs)[6]	Frequency	Percentage
0-3000	674	53.92
3000-6000	388	31.04
6000-9000	95	7.60
9000-12000	52	4.16
12000-15000	22	1.76
>15000-	19	1.52
Total	**1250**	**100**

The table shows the per-capita household expenditure (grouped into quintiles) of all respondents who provided their income and household size information. From the data depicted above, it is clear that close to half of the sample spends less than Rs 3,000 ($ 98.17 - applying the same exchange rate as in the footnote) in a month. More than half spend less than Rs 6,000 ($ 196.33). These figures are unfortunately rather low even by Mauritian standards, considering that the gross national per capita income was at (PPP international $): 10,640 (WHO, 2009b). Applying the same exchange rate as above, this figure comes to Rs 325,164.35 per annum which is Rs 27,097.029 ($ 886.67) monthly.

4.3 Descriptive Statistics Derived from Objectives

4.3.1 Diabetes Status/Prevalence

This section presents some descriptive statistics derived from objective one which relates to diabetes status/prevalence. The first table depicts the distribution of diabetes in the sample. The next tables are cross-tables of diabetes status and various factors that are believed to be associated with it. The cross-tables show frequencies and row percentages.

[6] $ 1.00 was worth Rs 30.56 as at 12 October 2009 at exactly 11.21a.m.

4.3.1.1 Distribution of Diabetes in Sample

Table 16 below shows the distribution of the diabetes status of the sample. 17.05% of the sample has diabetes whilst 82.95% of the sample is free from the condition. Comparing this figure to the prevalence of diabetes in Mauritius which was 19.3% in 2004 (cited in NSFD, 2007), shows that our data is a good representation of the diabetes distribution in the Mauritian population.

Table 16: Diabetes status distribution.

Diabetes Status	Frequency	Percentage	Cumulative Percentage
Without Diabetes	968	82.95	82.95
With Diabetes	199	17.05	100
Total	**1,167**	**100**	

4.3.1.2 Diabetes Status, Age & Sex

The sample was divided into four age groups namely age 18 to 40, age 40 to 60, age 60 to 80 and age 80 to 100 (note that the oldest respondent is 88 years old). These four age groups reflect a younger working age group, an older working age group, the pensioners and oldest adults in the sample respectively. The table below is the cross-tabulation of diabetes status and these four age groups. 5.05% of those who have diabetes in the sample are from the 18-40 age group, that is, the younger working age group. 47.98% of diabetics come from the 40-60 age group which is the older working age group. On the other hand, 40.91% of all diabetics in the sample are from the pensioners group while only 6.06% are from the oldest age group.

The main reason for this low prevalence in the oldest age group is probably due to the small number of observations in this age group (see table 18). Diabetes is least prevalent in the youngest age group even though this age group contains the second largest number of observations. This shows that type 2 diabetes is least prevalent amongst the young population and this finding coincides with the literature. Diabetes is most prevalent in the older working age groups, probably because it contains the greatest number of observations. The pensioners' age group contains only 197 individuals but it still had 40.91% of all the diabetics in the sample. This implies again that diabetes tends to be more prevalent in older age groups as indicated in various literatures.

Table 17: Diabetes status by age.

	Age (years)				
Diabetes Status	**18-40**	**40-60**	**60-80**	**80-100**	**Total**
Without Diabetes	444	393	116	5	**958**
%	46.35	41.02	12.11	0.52	**100**
With Diabetes	10	95	81	12	**198**
%	5.05	47.98	40.91	6.06	**100**
Total	**454**	**488**	**197**	**17**	**1,156**[7]
	39.27	**42.21**	**17.04**	**1.47**	**100**

Table 18: Age distribution.

Age Distribution	Number of Observations	Mean	Standard Deviation	Minimum Value	Maximum Value
18-40	454	28.37665	6.307883	18	39
40-60	488	49.21516	5.436663	40	59
60-80	197	67.06091	5.525114	60	79
80-100	17	82.70588	2.756009	80	88

In our sample, 44.72% of those who have diabetes are females and 55.28 % are males (table 19). These figures corroborate with those obtained by Williams *et al*. (2003) who reported a higher diabetes prevalence in males than females in Mauritius.

Table 19: Diabetes status by sex.

	Sex		
Diabetes Status	**Female**	**Male**	**Total**
Without Diabetes	555	413	**968**
%	57.33	42.67	**100**
With Diabetes	89	110	**199**
%	44.72	55.28	**100**
Total	**644**	**523**	**1,167**
	55.18	**44.82**	**100**

[7] The number differs from the total number of respondents (1,167) due to non-responses.

4.3.1.3 Diabetes Status & Family History

78.35% of those who had diabetes have parents who either are suffering or suffered from the same condition. On the other, 21.65% of those with diabetes do not have a family history of diabetes. These results agree with the literature that diabetes has a strong genetic factor.

Table 20: Diabetes status by family history: parents' diabetes status.

	Parents' Diabetes Status		
Diabetes Status	**Without Diabetes**	**With Diabetes**	**Total**
Without Diabetes	568	395	**963**
%	58.98	41.02	**100**
With Diabetes	42	152	**194**
%	21.65	78.35	**100**
Total	**610**	**547**	**1,157**[8]
	52.72	**47.28**	**100**

Not only parents (first degree relatives) but other relatives such as grandparents, aunts, uncles (second degree relatives) are also accountable for the genetic transmission of diabetes. Figure 21 shows that 77.20% of those with diabetes have/had one direct relative or more, other than parents with the condition.

Table 21: Diabetes status by family history: relatives' diabetes status.

	Relatives' Diabetes Status		
Diabetes Status	**Without Diabetes**	**With Diabetes**	**Total**
Without Diabetes	463	498	**961**
%	48.18	51.82	**100**
With Diabetes	44	149	**193**
%	22.80	77.20	**100**
Total	**507**	**647**	**1,154**[8]
	43.93	**56.07**	**100**

4.3.1.4 Diabetes Status & Ethnicity

Table 22 below shows that the prevalence of diabetes is considerably higher (72.86%) amongst Hindus than in other ethnic groups. Diabetes prevalence is 13.57% amongst

[8] The number differs from the total number of respondents (1,167) due to non-responses.

Creoles, 10.05% amongst Muslims, 2.01% amongst Chinese and only 1.51% amongst the European descent ('other') individuals. The Indian (Hindus and Muslims) population in the sample comprises 165 diabetics over a total number of 199 diabetics. The high diabetes prevalence in the Indian population of our sample as corresponds to that reported in the literature and statistics in Mauritius.

Table 22: Diabetes status by ethnicity.

	Ethnicity					
Diabetes Status	**Creole**	**Hindu**	**Muslim**	**Chinese**	**Other**	**Total**
Without Diabetes	173	579	180	22	11	**965**
%	17.93	60.0	18.65	2.28	1.14	**100**
With Diabetes	27	145	20	4	3	**199**
%	13.57	72.86	10.05	2.01	1.51	**100**
Total	**200**	**724**	**200**	**26**	**14**	**1,164**
	17.18	**62.20**	**17.18**	**2.23**	**1.20**	**100**

4.3.1.5 Diabetes Status & Obesity

Our findings depicted in the table below reveal that almost half (49.25%) of those who have diabetes are overweight. This is sadly a high percentage of the sample and reflects the weight problem in Mauritius amongst diabetics. However, only 16.08% of diabetics in the sample are obese (see table 24).

Table 23: Diabetes status by overweight status.

	Overweight		
Diabetes Status	**No**	**Yes**	**Total**
Without Diabetes	622	346	**968**
%	64.26	35.74	**100**
With Diabetes	101	98	**199**
%	50.75	49.25	**100**
Total	**723**	**444**	**1,167**
	61.95	**38.05**	**100**

N.B.: BMI of more than 25 kg/m^2 but less or equal to 30 kg/m^2 is regarded as overweight (WHO, 1998)

Table 24: Diabetes status by obesity status.

	Obese		
Diabetes Status	**No**	**Yes**	**Total**
Without Diabetes	861	107	**968**
%	88.95	11.05	**100**
With Diabetes	167	32	**199**
%	83.92	16.08	**100**
Total	**1,028**	**139**	**1,167**
	88.09	**11.91**	**100**

N.B.: BMI of more than 30 kg/m^2 is regarded as obese (WHO, 1998)

4.3.1.6 Diabetes Status & Physical Activity

No sharp difference exists between diabetics who perform physical activity (49.24%) and those who do not (50.76) (table 25).

Table 25: Diabetes status by physical activity.

	Physical Activity		
Diabetes Status	**Do Not Perform**	**Perform**	**Total**
Without Diabetes	443	523	**966**
%	45.86	54.14	**100**
With Diabetes	100	97	**197**
%	50.76	49.24	**100**
Total	**543**	**620**	**1,163**[9]
	46.69	**53.31**	**100**

4.3.1.7 Diabetes Status & Smoking

80.30% of those who have diabetes do not smoke whilst 19.70% smoke. On the other hand, 80.12% of the non-diabetics do not smoke and 19.88% smoke. This finding shows that smoking is not very prevalent in Mauritius since a majority from both diabetics and non-diabetics do not smoke.

[9] The number differs from the total number of respondents (1,167) due to non-responses.

Table 26: Diabetes status by smoking status.

	Smoke		
Diabetes Status	**No**	**Yes**	**Total**
Without Diabetes	774	192	**966**
%	80.12	19.88	**100**
With Diabetes	159	39	**198**
%	80.30	19.70	**100**
Total	**933**	**231**	**1,164**[10]
	80.15	**19.85**	**100**

4.3.1.8 Diabetes Status & Socio-Economic Status

The highest prevalences (68.48% and 24.46%) of diabetes are found in the lowest socio-economic quintiles as shown in the table 27 below. The two richest quintiles both have a zero prevalence of diabetes.

Table 27: Diabetes status by socio-economic status.

	Per-Capita Household Expenditure (in Thousand Rupees)						
Diabetes Status	**0-5**	**5-10**	**10-15**	**15-20**	**20-25**	**25-30**	**Total**
Without Diabetes	675	170	50	17	**7**	2	**921**
%	73.29	18.46	5.43	1.85	0.76	0.21	**100**
With Diabetes	126	45	11	2	0	0	**184**
%	68.48	24.46	5.98	1.09	0	0	**100**
Total	**801**	**215**	**61**	**19**	**7**	**2**	**1,105**[10]
	72.49	**19.46**	**5.52**	**1.72**	**0.63**	**0.18**	**100**

N.B.: Per-capita household expenditure has been used as a proxy for socio-economic status and was obtained by dividing total household expenditure by household size.

4.3.2 Utilisation of Diabetes Care Services

This section presents some descriptive statistics derived from objective two which relates to the utilisation of diabetes care services. The first table depicts the distribution of diabetes care utilisation of diabetics in the sample. The other tables of this section are cross-tables of utilisation and its associative factors showing frequencies and row percentages.

[10] The number differs from the total number of respondents (1,167) due to non-responses.

4.3.2.1 Distribution of Diabetes Care Utilisation Amongst Diabetics.

Utilisation has only been measured amongst diabetics as the number of diabetes-related visits the diabetic had to a health facility in the year 2008. The table below summarises the results found. Out of 199 diabetics in the sample, only 163 reported their utilisation behaviour. 7% of diabetics reported not to have used health services with regards to their condition.

Table 28: Distribution of the diabetes care utilisation amongst diabetics.

Number of Visits to a Health Facility Due to Diabetes During the Past Year (2008)	Frequency	Percentage	Cumulative Frequency
0	7	4.29	4.29
1	13	7.98	12.27
2	32	19.63	31.9
3	25	15.34	47.24
4	40	24.54	71.78
5	3	1.84	73.62
6	5	3.07	76.69
10	2	1.23	77.91
12	31	19.02	96.93
24	2	1.23	98.16
25	1	0.61	98.77
50	1	0.61	99.39
96	1	0.61	100
Total	**163**	**100**	

Source: Created by author

N.B.: Utilisation information was collected from the diabetics only.

4.3.2.2 Utilisation, Age & Sex

Among the diabetics, those who make more use of the diabetes care services are from both the 40 to 60 (44.23%) and the 60 to 80 (44.23%) age groups. These two age groups have the same utilisation and they also have the highest diabetes prevalence as reported above, which explains their increased use of these services.

Table 29: Utilisation by age.

	Age (years)				
Utilisation	**18-40**	**40-60**	**60-80**	**80-100**	**Total**
Do Not Utilise	1	6	0	0	**7**
%	14.29	85.71	0	0	**100**
Utilise	8	69	69	10	**156**
%	5.13	44.23	44.23	6.41	**100**
Total	**9**	**75**	**69**	**10**	**163**
	5.52	**46.01**	**42.33**	**6.13**	**100**

N.B.: Utilisation information was collected from the diabetics only.

Utilisation of diabetes care services is slightly more amongst male diabetics (51.92%) than female diabetics (48.08%). Since diabetes has been reported to be more prevalent in males than in females, these results coincide with our expectations.

Table 30: Utilisation by sex

	Sex		
Utilisation	**Female**	**Male**	**Total**
Do Not Utilise	2	5	**7**
	28.57	71.4367.44	**100**
Utilise	75	81	**156**
	48.08	51.92	**100**
Total	**77**	**86**	**163**
	47.24	**52.76**	**100**

N.B.: Utilisation information was collected from the diabetics only.

4.3.3.3 Utilisation & Ethnicity

The table below shows a higher utilisation amongst Hindus with diabetes as compared to those from the other ethnic groups. 77.56% of those who utilise diabetes care services are Hindus. This figure is remarkably higher than those in the other ethnic groups and can be explain by the significantly high diabetes prevalence amongst the Hindus (72.86%). Only 1.92% of diabetes care services users are Chinese and none are from the European descent ethnic group (‘other’).

Table 31: Utilisation by ethnicity.

	Ethnicity					
Utilisation	**Creole**	**Hindu**	**Muslim**	**Chinese**	**Other**	**Total**
Do Not Utilise	3	2	1	1	0	**7**
%	42.86	28.57	14.29	14.29	0	**100**
Utilise	18	121	14	3	0	**156**
%	11.54	77.56	8.97	1.92	0	**100**
Total	**21**	**123**	**15**	**4**	**0**	**163**
	12.88	**75.46**	**9.20**	**2.45**	**0**	**100**

N.B.: Utilisation information was collected from the diabetics only.

4.3.3.4 Utilisation & Socio-Economic Status

64.38% of the users of diabetes care services are from the lowest quintile. The second lowest quintile contains 28.08% of the diabetes services users while the third lowest quintile only contains 6.16% of the users. The two richest quintiles both have been reported to have a zero prevalence of diabetes (table 27). Thus, it was expected that these quintiles would have zero utilisation. From these findings, it can be deduced that as per-capita household expenditure (socio-economic status) increases, the utilisation of diabetes care services decreases.

Table 32: Utilisation by socio-economic status.

	Per-capita Household Expenditure (in Thousand Rupees)						
Utilisation	**0-5**	**5-10**	**10-15**	**15-20**	**20-25**	**25-30**	**Total**
Do Not Utilise	6	1	0	0	0	0	**7**
%	85.71	14.29	0	0	0	0	**100**
Utilise	94	41	9	2	0	0	**146**
%	64.38	28.08	6.16	1.37	0	0	**100**
Total	**100**	**42**	**9**	**2**	**0**	**0**	**153**[11]
	65.36	**27.45**	**5.88**	**1.31**	**0**	**0**	**100**

N.B.: Per-capita household expenditure has been used as a proxy for socio-economic status and was obtained by dividing total household expenditure by household size.

[11] This number differs from the total number of service users due to non-responses.

4.4 Empirical Results

In this section, the empirical results from the three different models are presented in tables and the results are interpreted. A more elaborate interpretation and discussion of these results are found in the next chapter.

The outcome of model 1, 'diabetes status' whether is an individual has diabetes or not, is the outcome variable and the outcome variable of model 2 is 'number of visits' which is used as a measure of diabetes care services utilisation.

Each table below presents the results of each analysis and shows the variable code, its name, the odds ratio/coefficient, the (robust) standard error, and the p-value. The last row of each table describes the goodness of fit of the model.

4.4.1 Model 1

This section presents the results of the model 1, which is the prevalence model.

4.4.1.1 Un-modifiable Factors

The table below shows the results of the logistic regression performed with the un-modifiable factors namely age, age squared, ethnic group, gender, and the family history variables which are 'whether parents have diabetes' and 'whether other relatives have diabetes'. Diabetes status is the response variable.

Table 33: Results of the logit Model 1 (un-modifiable factors only).

Variable Name	Variable	Odds Ratio	Robust Standard Error	P>|z|
age	Age of the individual in years	1.194**	0.050845	0.000
age2	Age of an individual to the square	0.999*	0.000388	0.022
eth_grp_1	Hindu	1.387	0.384918	0.238
eth_grp_2	Muslim	0.636	0.243892	0.238
eth_grp_3	Chinese & Other (European descent)	2.001	0.920525	0.132
sex_1	Male	1.486*	0.276191	0.033
parents_d_status_1	Parents have diabetes	5.077**	1.190544	0.000
relative_d_status_1	Relatives have diabetes	1.322	0.301849	0.221
Wald chi2(8) = 164.98 Prob > chi2 = 0.0000 Pseudo R2 = 0.2850				

*p < 0.05 (5% level of significance) **p < 0.01 (1% level of significance)

N.B.:

- Creole (eth_grp_0) was omitted, and used as the base category.
- Female (sex_0) was omitted, and used as the base category.
- Parents do not have diabetes (parents_d_status_0) was omitted, and used as the base category.
- Relatives do not have diabetes (relatives_d_status_0) was omitted, and used as the base category.
- eth_grp_3 (Chinese) and eth_grp_4 (other – European descent) have been merged and renamed eth_grp_3 since they both only contained a small number of observations.

From the table 33, the probability of the Chi^2 value greater than 164.98, with eight degrees of freedom is zero which is less than 0.01. As a result, we reject the null hypothesis that all the independent variables in this model have an insignificant effect on the dependent variable, diabetes status. The overall fitness of the model is good. The core results depicted in the table are interpreted below.

The variable 'age' bears an odds ratio greater than one (1.194) and is significant at the 1% level. This indicates the presence of a positive relationship between age and diabetes status. As age increases, so does the probability of an individual having diabetes. To be more precise, for a unitary increase in age, the odds of an individual having diabetes goes up by a factor of 1.194. In other words, older individuals are more likely to be diabetics than younger ones. However, when the age variable is squared, the relationship shifts to a very weak negative one since the odds ratio is almost one (0.999). It is, however, significant at the 5% level. As for ethnicity, the Hindus are 1.387 more likely to have diabetes than the Creoles, Creole being the base category. The 'eth_grp_1' variable (Hindu) is, however, not significant at the 5% level indicating that this variable does not greatly affect the outcome variable and omitting it from the analysis will not have a considerable impact on the overall results. Similarly, eth_grp_2 (Muslim) and the eth_grp_3 (Chinese and European descent) are not significant at the 5% significance level. Individuals from the Chinese and the European ethnic groups are 2.001 more likely than the Creoles to have the condition. However, the Muslims are 0.636 less likely to have diabetes than the base ethnic group indicated by its odds ratio being less than one.

Sex is positively associated with diabetes status, that is, males are 1.486 more likely than females to have diabetes mellitus (significant at the 5% level). Family history is highly associated with diabetes status. The 'parents have diabetes' (parents_d_status_1) variable bears an odds ratio of 5.077 showing the presence of a strong positive correlation with diabetes status. For discrete movements (from 0 to 1) of 'parents_d_status_1', the chances of an individual having diabetes increases by this factor. This variable is significant at the 1% level. Likewise, the 'relative_d_status_1' also bears a positive odds ratio, which is, however, of a lower magnitude (1.322) and it is not significant. Those individuals who have a family history of diabetes from a second degree relative (grand-parents, aunts and uncles) are more likely to be diabetics than those who do not.

4.4.1.2 Modifiable Factors

The table below shows the results of the logistic regression performed on the modifiable factors. It also shows that the probability of the Chi^2 value greater than 29.42, with six degrees of freedom is 0.0001 which is less than 0.01. As a result, we reject the null hypothesis that all the independent variables in this model have an insignificant effect on the dependent variable, diabetes status. The overall fitness of the model is good.

Table 34: Results of the logit model 1 (modifiable factors only).

Variable Name	Variable	Odds Ratio	Robust Standard Error	P>|z|
smoke_cig_1	Smokes	0.659	0.1804067	0.128
perform_phy_act2_1	Performs physical activity	0.615*	0.1326422	0.024
num_drinks_month2_1	Drinks alcohol	2.324**	0.5773416	0.001
hw_often_veg2_1	High intake of vegetables	1.103	0.263579	0.683
overweight_1	An individual is overweight ($25kg/m^2<BMI\leq30kg/m^2$)	2.140**	0.5041044	0.001
obese_1	An individual is obese ($BMI>30kg/m^2$)	0.998	0.3194768	0.994
Wald chi2(6) = 29.42 Prob > chi2 = 0.0001 Pseudo R2 = 0.0520				

*p < 0.05 (5% level of significance) **p < 0.01 (1% level of significance)

N.B.:

- Does not Smoke (smoke_cig_0) was omitted, and used as the base category.
- Does not perform physical activity (perform_phy_act2_0) was omitted, and used as the base category.
- Does not drink alcohol (num_drinks_month2_0) was omitted, and used as the base category.
- Low intake of vegetables (hw_often_veg2_0) was omitted, and used as the base category.
- An individual is not overweight (overweight_0) was omitted, and used as the base category.
- An individual is not obese (obese_0) was omitted, and used as the base category.

These results (table 34) reveal that 'smoke_cig_1' negatively affects an individual's diabetes status. A unitary increase in the smoking variable from 0 to 1 decreases the chances of an individual of having diabetes by a factor of 0.659. In other words, a smoker is less likely to have diabetes than a non-smoker. However, the smoking variable is not significant at the 5% level and, thus, it does not affect the response variable, diabetes status, by much. Those who perform physical activity are 0.615 less likely to have diabetes than those who do not perform any physical activity. This variable is significant at the 5% level. However, those who consume alcohol are 2.324 more likely to have the condition than those who do not and this variable is significant at 1% significance level.

High intake of vegetables is positively associated (1.103) with diabetes status, that is, those who consume a lot of vegetables are more likely to be diabetics than those with low vegetable intake. However, this variable has little effect on the response variable as it is not significant at the 5% level and the association is a weak one since the odds ratio is close to one. Discrete movements in the 'overweight_1' variable (from 0 to 1) increase the chances of an individual being diabetic by a factor of 2.140. In other words, those individuals who are overweight are 2.140 more likely to have diabetes than those who are not. Alternatively, those who are obese are less likely to be diabetics than those who are not by a factor of 0.998. This association is, however, a weak one (odds ratio = 0.998). It is important to note that 'overweight_1' is significant at the 1% level whilst 'obese_1' is not significant.

4.4.1.3 Un-Modifiable & Modifiable Factors

The table below shows the results of the logistic regression performed on both the un-modifiable and the modifiable factors. As shown in the same table, the probability of the Chi^2 value greater than 98.27, with 14 degrees of freedom is zero. Since this probability is less than 0.01, we reject the null hypothesis that all the independent variables in this model have an insignificant effect on the dependent variable, diabetes status. The overall fitness of the model is good.

Table 35: Results of logit model 1 (both un-modifiable & modifiable factors).

Variable Name	Variable	Odds Ratio	Robust Standard Error	P>|z|
age	Age of the individual in years	1.328**	0.1019419	0.000
age2	Age of an individual to the square	0.998*	0.0006856	0.011
eth_grp_1	Hindu	0.963	0.3275455	0.911
eth_grp_2	Muslim	0.590	0.2762294	0.260
eth_grp_3	Chinese & Other (European descent)	2.265	1.316905	0.160
sex_1	Male	1.574	0.5218243	0.171
parents_d_status_1	Parents have diabetes	5.725**	1.807694	0.000
relative_d_status_1	Relatives have diabetes	1.453	0.4559018	0.234

Variable Name	Variable	Odds Ratio	Robust Standard Error	P>|z|
smoke_cig_1	Smokes	0.666	0.2442553	0.267
perform_phy_act2_1	Performs physical activity	0.678	0.18073	0.145
num_drinks_month2_1	Drinks alcohol	1.126	0.3880969	0.730
hw_often_veg2_1	High intake of vegetables	0.756	0.2272843	0.352
overweight_1	An individual is overweight ($25kg/m^2$<BMI≤$30kg/m^2$)	1.895*	0.5380039	0.024
obese_1	An individual is obese (BMI>$30kg/m^2$)	0.923	0.3610911	0.838
Wald chi(14) = 98.27 Prob > chi2 = 0.0000 Pseudo R2 = 0.3439				

*p < 0.05 (5% level of significance) **p < 0.01 (1% level of significance)

N.B.:

- Creole (eth_grp_0) was omitted, and used as the base category.
- Female (sex_0) was omitted, and used as the base category.
- Parents do not have diabetes (parents_d_status_0) was omitted, and used as the base category.
- Relatives do not have diabetes (relatives_d_status_0) was omitted, and used as the base category.
- Does not Smoke (smoke_cig_0) was omitted, and used as the base category.
- Does not perform physical activity (perform_phy_act2_0) was omitted, and used as the base category.
- Does not drink alcohol (num_drinks_month2_0) was omitted, and used as the base category.
- Low intake of vegetables (hw_often_veg2_0) was omitted, and used as the base category.
- An individual is not overweight (overweight_0) was omitted, and used as the base category.
- An individual is not obese (obese_0) was omitted, and used as the base category.

When both un-modifiable and modifiable factors are run in one single regression analysis, the odds ratios only change slightly for most of the variables. However, the Pseudo R2 increased drastically to 0.3439. ‘Age’ remains significant at the 1% level of significance and its odds ratio remains positive but increased by 0.1. The association between square form of age and diabetes status barely changes. It is still significance at 5%. However, the association between the Hindu ethnic group and diabetes status shifts from a weak positive relationship (1.387) to a weak negative one (0.963) but remains statistically insignificant at the 5% level. Similarly, 'eth_grp_2 (Muslim) also remains insignificant at the 5% level and negatively associated with diabetes status, but its odds ratio decreased by a small extent.

The positive association between sex and diabetes status increases and this variable is now insignificant at the 5% level. Also, the association between family history and diabetes status grew stronger. 'Parents have diabetes' (parents_d_status_1) is still statistically significant at the 1% level and 'relatives have diabetes' (relative_d_status_1) remained statistically insignificant.

No significant change occurred to the smoking variable. On the other hand, the physical activity variable is now insignificant at the 5% level even though its odds ratio only slightly increased but remained less than one, giving evidence than physical activity is still negatively associated with diabetes status. Substantial changed occurred to the 'individual drinks' (num_drinks_month2_1) variable. In this combined analysis, it is statistically insignificant and its odds ratio decreased by a considerable amount (from 2.324 to 1.126). Individuals with high intake of vegetables are less likely to have diabetes according to this combined analysis, however, the variable is still insignificant at the 5% level. The positive association still prevails between overweight and diabetes status and it remains significant at the 5% level. Likewise, a weak negative association is still present between obesity and diabetes status and it remains insignificant at the 5% level.

4.4.1.4 Enabling Factors

The table below shows the results of the logit regression performed on the enabling factors only. We reject the null hypothesis that all the independent variables in this model have an insignificant effect on the dependent variable, diabetes status. This is because, from the table, the probability of the Chi^2 value greater than 42.16, with six degrees of freedom is zero which is less than 0.01. The overall fitness of the model is good.

Table 36: Results of logit model 1 (enabling factors only).

Variable Name	Variable	Coefficient	Standard Error	P>|z|
percap_exp	Per-capita household expenditure	0.0003**	0.0001024	0.002
percap_exp2	Squared form of per-capita household expenditure	-1.87e-08**	7.04e-09	0.008
educlev_2	Highest education level attained is secondary	-0.877**	0.2047607	0.000
educlev_3	Highest education level attained is tertiary	-1.827**	0.3961765	0.000
residence_1	Place of residence is urban	0.365	0.1885668	0.053
med_aid_1	Possesses medical aid	0.432	0.2355941	0.067
constant	-	-2.203	0.2924041	0.000
LR chi2(6) = 42.16 Prob > chi2 = 0.0000 Pseudo R2 = 0.0511				

*p < 0.05 (5% level of significance) **p < 0.01 (1% level of significance)

N.B.:

- Highest education level attained in primary (educlev_1) was omitted, and used as the base category.
- Place of residence is rural (residence_0) was omitted, and used as the base category.
- Does not possess medical aid (med_aid_0) was omitted, and used as the base category.

The table 36 also shows the presence of a positive relationship between both per-capita household expenditure and place of residence, and diabetes status since both their coefficients bear positive signs. However, per-capita household expenditure is very weakly associated with diabetes prevalence since its coefficient is very close to zero. An increase in per-capita household expenditure and 'residence' increases the chances of an individual of having diabetes. In other words, those with high per-capita household expenditures and those living in urban areas are more likely to have diabetes than their counterparts with lower per-capita household expenditures and living in rural areas. 'percap_exp' (per-capita household expenditure) is significant at the 1% level whilst 'residence_1' (place of residence is urban) is not. The reverse association was obtained when per-capita household expenditure was squared but the 'percap_exp2' variable (squared form of per-capita expenditure) remained statistically significant at the 1% level of significance.

'educlev_2' (highest educational level attained is secondary) and 'educlev_3' (highest educational level attained is tertiary) are both statistically significant at the 1% level and are negatively associated with diabetes status. In other words, individuals who have attained secondary and tertiary education levels at most are less likely to have diabetes than those who have only attained primary education (base category). Place of residence is positively associated with diabetes status since its coefficient is positive but it is statistically insignificant at the 5% level. This means that individuals living in urban areas are more likely to be diabetics than those in rural areas. In addition, individuals possessing medical aid are found to be more likely to be diabetics than those who do not possess medical aid. All the variables are significant at varied level except for 'educlev_3' (highest educational level attained is tertiary) and 'residence_1' (place of residence is urban).

4.4.1.5 All Factors

The table below shows the results of the logistic regression performed on all the factors namely the un-modifiable factors, the modifiable factors and the enabling factors. The table also shows that the probability of the Chi^2 value greater than 101.39, with 20 degrees of freedom is zero. As a result, we reject the null hypothesis that all the independent variables in this model have an insignificant effect on the dependent variable, diabetes status. The overall fitness of the model is good. This model shows the highest Pseudo R2 of 0.3860.

Table 37: Results of logit model 1 (all factors).

Variable Name	Variable	Odds Ratio	Robust Standard Error	P>|z|
age	Age of the individual in years	1.431**	0.1419011	0.000
age2	Age of an individual to the square	0.998**	0.0008838	0.007
eth_grp_1	Hindu	2.344	1.434137	0.164
eth_grp_2	Muslim	3.013	2.177298	0.127
eth_grp_3	Chinese & Other (European descent)	8.858**	6.808348	0.005
sex_1	Male	2.212	0.9674873	0.070
parents_d_status_1	Parents have diabetes	6.376**	2.549384	0.000
relative_d_status_1	Relatives have diabetes	2.352*	1.014684	0.047
smoke_cig_1	Smokes	0.773	0.3098873	0.521
perform_phy_act2_1	Performs physical activity	0.929	0.2940112	0.816
num_drinks_month2_1	Drinks alcohol	1.253	0.4941581	0.568
hw_often_veg2_1	High intake of vegetables	0.927	0.3598167	0.844
overweight_1	An individual is overweight ($25kg/m^2$<BMI≤$30kg/m^2$)	1.426	0.5084058	0.320
obese_1	An individual is obese (BMI>$30kg/m^2$)	1.541	0.745143	0.372
percap_exp	Per-capita household expenditure	1.0002	0.0001521	0.109
percap_exp2	Squared form of per-capita household expenditure	1.000*	8.52e-09	0.024
educlev_2	Highest education level attained is secondary	1.325	0.5257293	0.479
educlev_3	Highest education level attained is tertiary	1.268	0.9794713	0.758

Variable Name	Variable	Odds Ratio	Robust Standard Error	P>|z|
residence_1	Place of residence is urban	2.452*	0.8989103	0.014
med_aid_1	Possesses medical aid	1.428	0.5336901	0.340
Wald chi2(20) = 101.39 Prob > chi2 = 0.0000 Pseudo R2 = 0.3861				

*p < 0.05 (5% level of significance) **p < 0.01 (1% level of significance)

N.B.:

- Creole (eth_grp_0) was omitted, and used as the base category.
- Female (sex_0) was omitted, and used as the base category.
- Parents do not have diabetes (parents_d_status_0) was omitted, and used as the base category.
- Relatives do not have diabetes (relatives_d_status_0) was omitted, and used as the base category.
- Does not Smoke (smoke_cig_0) was omitted, and used as the base category.
- Does not perform physical activity (perform_phy_act2_0) was omitted, and used as the base category.
- Does not drink alcohol (num_drinks_month2_0) was omitted, and used as the base category.
- Low intake of vegetables (hw_often_veg2_0) was omitted, and used as the base category.
- Highest education level attained in primary (educlev_1) was omitted, and used as the base category.
- Place of residence is rural (residence_0) was omitted, and used as the base category.
- Does not possess medical aid (med_aid_0) was omitted, and used as the base category.
- An individual is not overweight (overweight_0) was omitted, and used as the base category.
- An individual is not obese (obese_0) was omitted, and used as the base category.

Age remained positively associated with diabetes status with an odds ratio of 1.431 in this combined analysis and it is still statistically significant at the 1% level. The association between diabetes status and the squared form of age remains fairly constant and significant at the 1% level with an odds ratio of 0.998. In this third analysis, 'eth_grp_1' (Hindu) and 'eth_grp_2' (Muslim) remained statistically insignificant at both 5% and 1% level, however, the odds ratios has increased substantially to 2.344 and 3.013 respectively and they both now show the presence of a positive relationship between the Hindu and the Muslim ethnic group with diabetes status. In other words, from this analysis, we can state that Hindus and Muslim are more likely to have diabetes than Creoles (base category). The odds ratio of 'eth_grp_3' (Chinese and European ethnic groups) has also increased by a large extent from 2.001 and 2.265 in the first and second analyses respectively to 8.858 in the third analysis. Thus, those from the Chinese and European ethnic groups are significantly more likely to be diabetics than those from the Creole ethnic group. Unlike, 'eth_grp_1' and'eth_grp_2' which are insignificant, 'eth_grp_3' is significant at the 1% level in this combined analysis.

On the other hand, 'sex_1' (male) is insignificant at the 5% level and its odds ratio is still greater than one but has, however, increased indicating a stronger positive association with diabetes status. Both family history variables ('parents_d_status' and 'relatives_d_status') are significant and bear higher odds ratios. 'Parents have diabetes' (parents_d_status_1) is significant at the 1% level whilst 'relatives have diabetes' (relatives_d_status_1) is insignificant at the 5% level of significance. A unitary increase in family history increases the chances of an individual being a diabetic.

'The individual smokes' (smoke_cig_1), 'the individual performs physical activity' (perform_phy_act2_1), 'the individual drinks alcohol' (num_drinks_month2_1), 'the individual has high vegetable intake' (hw_often_veg2_1), 'the individual is overweight' (overweight_1), and 'the individual is obese' (obese_1) are all statistically insignificant. As a result, they do not greatly affect the outcome variable. 'num_drinks_month2_1', 'overweight_1', and 'obese_1' bear odds ratios of greater than one showing the presence of a positive relationship with diabetes status. However, 'smoke_cig_1', 'perform_phy_act2_1' and 'hw_often_veg2_1' are negatively associated with the response variable, diabetes status. From these six variables, only two, namely, 'hw_often_veg2_1' and 'obese_1' have a reversed associated with diabetes status in this combined analysis as compared with the previous analyses.

Most of the enabling factors are all insignificant except for 'percap_exp2' and 'residence_1'. All enabling factors have an odds ratio of greater than one and thus, are all positively associated with diabetes status except for 'percap_exp2' whose odds ratio is one. A unitary increase in these variables increases the chances of an individual of having diabetes. However, 'per-cap_exp2' is not associated with diabetes status and has no effect on diabetes status according to this particular analysis. This variable bore a very weak negative association with the response variable in the previous analysis.

Per-capita household expenditure is only weakly associated (1.0002) just like in the earlier analysis. Since 'percap_exp' changed from being significant in the previous analysis to insignificant in this analysis, this means that others factors when controlled for influence the effect of income or reduce the influence of income. Both 'educlev_2' (secondary) and 'educlev_3' (tertiary) shifted from being negatively associated in the previous analysis to being positively associated in this one. These variables also changed from being significant at the 1% level to being insignificant in this run. Place of residence is still positively associated with diabetes status but is now significant. However, possession of medical aid remains insignificant and positively associated with diabetes.

4.4.2 Model 2

This section presents the results of the model 2 analysed five times with different sets of variables. Model 2 is the utilisation model where 'number of visits' is the response variable.

4.4.2.1 Un-modifiable Factors

The table 38 shows the results of the negative binomial regression performed on the un-modifiable factors namely age, age squared, ethnic group and the family history variables 'whether parents have diabetes' and 'whether other relatives have diabetes'. The probability of the Chi^2 value greater than 13.74, with eight degrees of freedom is 0.0888, as shown in the same table. Since this value is greater than 0.05, we accept the null hypothesis that all the independent variables in this model have an insignificant effect on the dependent variable, number of visits.

Table 38: Results of negative binomial model 2 (un-modifiable factors).

Variable Name	Variable	Coefficient	Robust Standard Error	P>|z|
age	Age of the individual in years	0.013	0.0513482	0.797
age2	Age of an individual to the square	-0.0001	0.0004349	0.788
eth_grp_1	Hindu	-0.182	0.3222782	0.573
eth_grp_2	Muslim	-0.471	0.4293792	0.273
eth_grp_3	Chinese & Other (European descent)	-0.873	0.8211139	0.287
sex_1	Male	0.111	0.2113902	0.600
parents_d_status_1	Parents have diabetes	0.499*	0.2117675	0.018
relative_d_tatus_1	Relatives have diabetes	0.188	0.1819765	0.301
constant	-	1.068	1.49266	0.474
Wald chi2(8) = 13.74 Prob > chi2 = 0.0888 Pseudo R2 = 0.0156				

*p < 0.05 (5% level of significance) **p < 0.01 (1% level of significance)

N.B.:

- Creole (eth_grp_0) was omitted, and used as the base category.
- Female (sex_0) was omitted, and used as the base category.
- Parents do not have diabetes (parents_d_status_0) was omitted, and used as the base category.
- Relatives do not have diabetes (relatives_d_status_0) was omitted, and used as the base category.

The results indicate a positive association between age and the utilisation of diabetes services as shown from the positive coefficient. It is, however, not significant at the 1% level and omitting it from the analysis will not make a significant difference. An increase in age increases the chances of a diabetic to use the diabetes care services. Interestingly, the ‘age2’ variable is very weakly associated with utilisation and the association is a negative one. It is also not significant at the 5% level. All three ethnic groups namely Hindu, Muslim and Chinese together with those from European descent are negatively associated with the response variable. These ethnic groups utilise less of the diabetes care services than the Creoles. However, all three ethnic groups are insignificant at the 5% level and they do not greatly affect the response variable.

Similarly, 'sex_1' is insignificant but is found to be positively associated with the utilisation of diabetes care services. Thus, male diabetics have more medical visits to treat their diabetes than female diabetics. Family history is positively associated with the response variable as both 'parents have diabetes' (parents_d_status_1) and 'relatives have diabetes (relatives_d_status_1) bear a positive β coefficient. Those diabetics with a family history of the disease have a higher utilisation of the services than their counterparts who do not have a family history of diabetes. It is worthwhile to note that 'parents_d_status_1' is significant at the 5% level whilst 'relatives_d_status_1' is not.

4.4.2.2 Modifiable Factors

The table above shows the results of the negative binomial regression performed on a set of modifiable factors. From the same table, the probability of the Chi^2 value greater than 33.31, with six degrees of freedom is zero. Since this value is less than 0.01, we reject the null hypothesis that all the independent variables in this model have an insignificant effect on the dependent variable, number of visits. The overall fitness of the model is good.

Table 39: Results of negative binomial model 2 (modifiable factors).

Variable Name	Variable	Coefficient	Robust Standard Error	P>|z|
smoke_cig_1	Smokes	-0.736**	0.234108	0.002
physical32	Perform high level of physical activity	0.185	0.175891	0.293
physical35	Perform low level of physical activity	-0.412*	0.171596	0.016
num_drinks_month_332	Low alcohol consumption	0.167	0.241211	0.488
num_drinks_month_333	Medium alcohol consumption	1.290**	0.355258	0.000
num_drinks_month_334	High alcohol consumption	-0.921**	0.299545	0.002
constant	-	1.743	0.101639	0.000
Wald chi2(6) = 33.31 Prob > chi2 = 0.0000 Pseudo R2 = 0.0519				

*p < 0.05 (5% level of significance) **p < 0.01 (1% level of significance)

From the table above, we can observe that consumption of cigarette is negative and it is significant at the 1% level. This shows that there is a negative relationship between cigarette smoking and the utilisation. For discrete movements (from 0 to 1) of 'smoke_cig_1' (the individual smokes), the chances of an individual with diabetes to use more of the medical services decrease. In other words, those diabetics who smoke have a lower utilisation of diabetes care services than those diabetics who do not smoke cigarettes at all (no smoking is the base category).

Performing a high level of physical activity is positively associated with utilisation, meaning that discrete increments in this variable increase the chances of a diabetic of using the diabetes services. Put differently, diabetics who perform high levels of exercise utilise more of the diabetes services than those who do not exercise at all (no exercise is the base category). However, this variable does not have significant effect on the utilisation variable. The opposite is true for the 'low physical activity' variable which is significant at the 5% level and bears a negative relationship with utilisation.

Low and medium consumption of alcohol are both positively associated with utilisation, yet, the latter is significant at the 1% level whilst the former is not significant at either the 5% or the 1% level of significance. Individuals with diabetes who consume low to medium level of alcohol are more likely to utilise more of the diabetes services than those who do not consume alcohol at all (no alcohol consumption is the base category). Conversely, those who have high alcohol consumption have a lower utilisation of diabetes care services than those who do not consume any alcohol. This variable is significant at the 1% level.

4.4.2.3 Un-modifiable Factors & Modifiable Factors

The table below shows the results of the negative binomial regression performed on both the un-modifiable factors and a set of modifiable factors. From the same table, the probability of the Chi^2 value greater than 47.57, with 14 degrees of freedom is zero. Since this value is less than 0.01, we reject the null hypothesis that all the independent variables in this model have an insignificant effect on the dependent variable, number of visits. The overall fitness of the model is good.

Table 40: Results of negative binomial model 2 (un-modifiable factors & modifiable factors).

Variable Name	Variable	Coefficient	Robust Standard Error	P>|z|
age	Age of the individual in years	0.004	0.036681	0.911
age2	Age of an individual to the square	-3.4E-05	0.000308	0.913
eth_grp_1	Hindu	-0.185	0.271109	0.494
eth_grp_2	Muslim	-0.215	0.371749	0.562
eth_grp_3	Chinese & Other (European descent)	-0.783	0.64677	0.226
sex_1	Male	-0.042	0.160247	0.794
parents_d_status_1	Parents have diabetes	0.389*	0.165281	0.019
relative_d_tatus_1	Relatives have diabetes	0.148	0.178488	0.408
smoke_cig_1	Smokes	-0.696**	0.228955	0.002
physical32	Perform high level of physical activity	0.155	0.1688	0.358
physical35	Perform low level of physical activity	-0.411*	0.180174	0.023

Variable Name	Variable	Coefficient	Robust Standard Error	P>|z|
num_drinks_month_332	Low alcohol consumption	0.166	0.219052	0.448
num_drinks_month_333	Medium alcohol consumption	1.230**	0.375931	0.001
num_drinks_month_334	High alcohol consumption	-0.997**	0.303243	0.001
constant	-	1.407	1.065415	0.186
Wald chi2(14) = 47.57 Prob > chi2 = 0.0000** Pseudo R2 = 0.0644				

*p < 0.05 (5% level of significance) **p < 0.01 (1% level of significance)

N.B.:

- activity) were dropped due to collinearity.
- Creole (eth_grp_0) was omitted, and used as the base category.
- Female (sex_0) was omitted, and used as the base category.
- Parents do not have diabetes (parents_d_status_0) was omitted, and used as the base category.
- Relatives do not have diabetes (relatives_d_status_0) was omitted, and used as the base category.

In table 40, it is observed that all the six statistically insignificant un-modifiable variables namely 'age', 'age2', 'eth_grp_1', 'eth_grp_2', 'eth_grp_3', and 'sex_1' remained insignificant in this combined analysis. Also, the sign of their β coefficients remained constant except for that of 'sex_1' which changed from being positive to negative. From this analysis, we can state that male diabetics utilise less of the diabetes services than female diabetics. 'parents have diabetes' and 'relatives have diabetes' retained both their positive β-coefficient and their significance and insignificance respectively at the 5% level. Similarly, neither the signs of the β coefficients nor the significance of the modifiable factors changed.

4.4.2.4 Enabling Factors

The table below shows the results of the negative binomial regression performed on the enabling factors. The same table shows a probability of the Chi^2 value greater than 88.27, with six degrees of freedom of zero. This value is less than 0.01. We, therefore, reject the null hypothesis that all the independent variables in this model have an insignificant effect on the dependent variable, number of visits. The overall fitness of the model is good.

Table 41: Results of negative binomial model 2 (Enabling Factors).

Variable Name	Variable	Coefficient	Robust Standard Error	P>|z|
percap_exp	Per-capita household expenditure	-0.0001*	0.0000745	0.046
percap_exp2	Squared form of per-capita household expenditure	1.57e-08**	6.02e-09	0.009
educlev_2	Highest education level attained is secondary	-0.064	0.1435129	0.653
educlev_3	Highest education level attained is tertiary	0.038	0.2823361	0.892
residence_1	Place of residence is urban	-1.009**	0.1476183	0.000
med_aid_1	Possesses medical aid	-0.061	0.1958711	0.755
constant	-	2.461	0.2338289	0.000
Wald chi2(6) = 88.27 Prob > chi2 = 0.0000** Pseudo R2 = 0.1108				

*p < 0.05 (5% level of significance) **p < 0.01 (1% level of significance)

N.B.:

- Highest education level is primary (educlev_1) was omitted, and used as the base category.
- Place of residence is rural (residence_0) was omitted, and used as the base category.
- Does not possess medical aid (med_aid_0) was omitted, and used as the base category.

In this analysis of enabling factors, three out of six variables are statistically significant at 1% and 5% level. These variables are ‘per-capita household expenditure’ (percap_exp), the ‘squared form of per-capita household expenditure’ (percap_exp2) and ‘place of residence is urban’ (residence_1). Per-capita household expenditure bears a negative coefficient and is thus, negatively associated with utilisation. In other words, an increase in this variable decreases the chances of a diabetic to utilise the medical services. Individuals with a high socio-economic status have a lower utilisation than those with a lower socio-economic status. However, when this variable is squared, the reverse is true and this variable is significant at the 1% level of significance.

Diabetics who have attained a secondary level of education are less likely to utilise the diabetes services than those who have only attained a primary level of education (base category). On the other hand, diabetics who have attained a tertiary level of education are more likely to utilise the diabetes services than those who have only attained a primary level of education. Both these education variables are insignificant. Place of residence is negatively associated with utilisation of diabetes services and is significant at the 1% level. Those living in urban areas have a lower utilisation of the diabetes services than those living in rural areas. Similarly, those who possess medical aid are less likely to use the diabetes services than those who do not, however, this variable is statistically not significant.

4.4.2.5 All Factors

The table below shows the results of the negative binomial regression performed on all the factors. It also shows that the probability of the Chi^2 value greater than 228.98, with 20 degrees of freedom is zero. Therefore, we reject the null hypothesis that all the independent variables in this model have an insignificant effect on the dependent variable, number of visits. The overall fitness of the model is good and shows the highest Pseudo R2 of 0.1959.

Table 42: Results of negative binomial model 2 (all factors)

Variable Name	Variable	Coefficient	Robust Standard Error	P>|z|
age	Age of the individual in years	-0.078*	0.031425	0.013
age2	Age of an individual to the square	0.0007*	0.000273	0.017
eth_grp_1	Hindu	-0.186	0.21158	0.379
eth_grp_2	Muslim	-0.429	0.286092	0.134
eth_grp_3	Chinese & Other (European descent)	-0.029	0.447638	0.949
sex_1	Male	-0.351*	0.156412	0.025

Variable Name	Variable	Coefficient	Robust Standard Error	P>|z|
parents_d_status_1	Parents have diabetes	0.086	0.167799	0.607
relative_d_status_1	Relatives have diabetes	-0.419**	0.149984	0.005
smoke_cig_1	Smokes	-0.340*	0.169162	0.045
physical32	Perform high level of physical activity	-0.149	0.1313	0.256
physical35	Perform low level of physical activity	-0.255	0.16472	0.121
num_drinks_month_332	Low alcohol consumption	-0.496**	0.188915	0.009
num_drinks_month_333	Medium alcohol consumption	-0.022	0.266946	0.934
num_drinks_month_334	High alcohol consumption	-1.888**	0.287386	0.000
percap_exp	Per-capita household expenditure	-0.0002**	6.94E-05	0.002
percap_exp2	Squared form of per-capita household expenditure	1.92E-08**	5.41E-09	0.000
educlev_2	Highest education level attained is secondary	0.067	0.156656	0.667
educlev_3	Highest education level attained is tertiary	0.199	0.328095	0.544
residence_1	Place of residence is urban	-1.534**	0.14457	0.000
med_aid_1	Possesses medical aid	-0.302	0.200062	0.132
constant	-	6.073	0.916572	0.000
Wald chi2(20) = 228.98 Prob > chi2 = 0.0000 Pseudo R2 = 0.1959				

*p < 0.05 (5% level of significance) **p < 0.01 (1% level of significance)

N.B.:

- Creole (eth_grp_0) was omitted, and used as the base category.
- Female (sex_0) was omitted, and used as the base category.
- Parents do not have diabetes (parents_d_status_0) was omitted, and used as the base category.
- Relatives do not have diabetes (relatives_d_status_0) was omitted, and used as the base category.
- Highest education level is primary (educlev_1) was omitted, and used as the base category.
- Place of residence is rural (residence_0) was omitted, and used as the base category.
- Does not possess medical aid (med_aid_0) was omitted, and used as the base category.

The 'age' variable shifted from being positively associated with utilisation in the previous analyses to being negatively associated in this last analysis. Here, an increase in age decreases the chances of a diabetic to utilise the health services. The relationship between 'age2' and utilisation has also changed from being a very weak negative one to a very weak positive association. Both 'age' and 'age2' (age squared) are both significant at the 5% level unlike in the previous analyses where they were insignificant.

Both 'eth_grp_1' (Hindu) and 'eth_grp_2' (Muslim) remained negatively associated with utilisation whilst 'eth_grp_3' (Chinese and European descent) is now positively associated with utilisation. Hindus and Muslims with diabetes have a lower utilisation of the diabetes services than Creoles (the base category). On the other hand, individuals from the Chinese ethnic group and those from European descent who have diabetes have a higher utilisation than the Creoles. In this analysis, 'sex_1' (male) is negatively associated with utilisation, thus, male diabetics utilise less of the diabetes care services then female diabetics and this variable is significant.

The coefficient of 'parents have diabetes' remained positive, as a result, those diabetics whose parents have diabetes have a higher utilisation of the diabetes services than those whose parents do not have the condition. Alternatively, from this analysis, it can be deduced that diabetics whose second degree relatives (grand-parents, aunts and uncles) have diabetics have a lower utilisation of the services since the 'relatives have diabetes' variable has a negative coefficient.

Similarly, most modifiable factors are insignificant at various significant levels except for low and high alcohol consumption. All the other modifiable factors do not have a significant effect on the utilisation variable. This last combined analysis shows that all the modifiable factors are negatively associated with the utilisation of diabetes services and that an increase in them would decrease the chances of a diabetic of using the diabetes care services.

Three enabling factors out of six are significant at the 1% level of significance level. These variables are 'per-capita household expenditure' (percap_exp), the 'squared form of per-capita household expenditure' (percap_exp2) and 'place of residence is urban' (residence_1). The same was obtained in the earlier run with 'percap_exp2' and 'residence_1' whilst 'percap_exp' was only significant at the 5% level. Those variables that are insignificant are 'educlev_2' (highest level of education attained is secondary), 'educlev_3' (highest level of education attained is tertiary) and 'med_aid_1' (the individual possesses medical aid). The 'percap_exp' variable remained negatively associated with utilisation, thus, as mentioned earlier, an increase in this variable causes the utilisation variable to decrease. In other words, as income increases, utilisation becomes negative. Similarly, 'percap_exp2' retained its positive β coefficient.

Conversely, 'educlev_2' (highest level of education attained is secondary) shifted from a negative association with utilisation to a positive one. Discrete movements in 'educlev_2' are now found to increase the chances of a diabetic to utilise diabetes services. In other words, individuals who have attained a secondary level of education utilise more services compared to those who have only attained a primary level (primary level is the base category). The association between utilisation and 'tertiary education attained' remained unchanged and so did the one with 'place of residence is urban' and 'individual possesses medical aid'. In fact, out of all the enabling variables, only 'secondary education attained' had a reversed association with utilisation.

4.4.3 Model 3

This section aims at achieving objective three and examines the common factors between diabetes prevalence and the utilisation of diabetes care services. Two groups have been compared in terms of their per-capita household expenditure, their educational level and their place of residence using ANOVA. These two groups are group 1 which consists of those individuals who have diabetes and use the diabetes care services and group 2 which consists of those diabetics who do not utilise diabetes care services.

Table 43: Two-way ANOVA test 1 between group 1 and group 2 (per-capita household expenditure).

Source	Partial SS	df	MS	F	Prob > F
Model	22418053.5	2	11209026.8	0.99	0.3732
group1	2012721.65	1	2012721.65	0.18	0.6739
group2	19364391.4	1	19364391.4	1.70	0.1920
Residual	1.2521e+10	1102	11361854.3		
Total	1.2543e+10	1104	11361577.4		

Number of obs = 1105 R-squared = 0.0018
Root MSE = 3370.73 Adj R-squared = -0.0000

From the table above, all p-values are greater than 0.05, thus, there is no significant per-capita household expenditure differences between the means of group 1and group 2. In other words, there is no difference in the population means of group 1 or group 2 in terms of their per-capita household expenditure.

Table 44: Two-way ANOVA test 2 between group 1 and group 2 (educational level).

Source	Partial SS	df	MS	F	Prob > F
Model	11.9445876	2	5.9722938	15.18	0.0000
group1	7.91263079	1	7.91263079	20.11	0.0000
group2	4.75040673	1	4.75040673	12.07	0.0005
Residual	389.555916	990	0.393490824		
Total	401.500504	992	0.404738411		

Number of obs = 993 R-squared = 0.0297
Root MSE = 0.627288 Adj R-squared = 0.0278

From the table above, all p-values are less than 0.05, thus, we reject the null hypothesis and conclude that there is a significant difference between the averages of group 1 and group 2 in terms of their educational level. There is a difference in the population means of group 1 or group 2 in terms of their educational level.

Table 45: Two-way ANOVA test 3 between group 1 and group 2 (place of residence).

Source	Partial SS	df	MS	F	Prob > F
Model	6.69906274	2	3.34953137	13.90	0.0000
group1	3.34173015	1	3.34173015	13.87	0.0002
group2	2.84406603	1	2.84406603	11.81	0.0006
Residual	280.42176	1164	0.240912165		
Total	287.120823	1166	0.246244273		

Number of obs = 1167 R-squared = 0.0233
Root MSE = 0.490828 Adj R-squared = 0.0217

From the table above, all p-values are very significant and thus, we reject the null hypothesis. There is a significant difference between the averages of group 1 and that of group 2 in terms of their place of residence.

4.4.4 Summary

This section provides a clear summary of the results obtained from the three models. Only those variables that are significant in at least one analysis are presented below and are discussed in the next chapter.

4.4.4.1 Model 1

Table 46: Summary of results from model 1.

Type of Association	
Positive	**Negative**
Age	Physical activity
Ethnicity (Chinese and European descent-strong association)	Age squared (very weak association)
Sex	Per-capita household expenditure squared (weak association in first analysis and no association in second analysis)
Family history (whether parents have/had diabetes-fairly strong association)	Educational level (secondary and tertiary)
Family history (whether second degree relatives have/had diabetes)	
Alcohol consumption	
Overweight	
Per-capita household expenditure	
Place of residence	

4.4.4.2 Model 2

Table 47: Summary of results from model 2.

Type of Association	
Positive	**Negative**
Age squared	Age
Family history (whether parents have/had diabetes)	Sex
Medium consumption of alcohol	Cigarette smoking
Per-capita household expenditure squared	Low level of physical activity
	Low and high consumption of alcohol
	Per-capita household expenditure
	Place of residence

4.4.4.3 Model 3

There is no difference between the means of group 1 and group 2 in terms of their per-capita household expenditure. However, significant differences exist between the averages of group 1 and group 2 in terms of their educational level and their place of residence. From our results, there exist no significant per-capita household expenditure differences between diabetics who utilise services and those who do not. On the other hand, these two groups of diabetics significantly different educational level and place of residence.

CHAPTER FIVE
DISCUSSION OF KEY FINDINGS

5.1 Introduction

This chapter discusses the key findings of this study in light of previous findings made by other researchers and show how they agree or disagree with previously published work. The relevant results from all the different analyses for each model will be discussed. The principles, relationships and generalisations that come out of the results of the study are presented. Only those variables which are significant in at least one analysis are discussed.

5.2 Discussion

5.2.1 Diabetes Prevalence

From the sample, it is clear that the age of an individual has a strong positive influence on his/her diabetes status and is an influential factor of diabetes prevalence. The age variable remained statistically significant and its positive sign was constant in all the different analyses. Thus, older individuals are more likely to have diabetes than younger ones. This finding coincides with the literature which predicts a sharp increase of the risk of diabetes with age (Wild *et al*., 2004). In fact, this result was predictable since one can assume that as the age of an individual increases so does his/hers vulnerability to diseases. Another consistently significant variable was the age squared variable. It was included in the analysis to understand the quadratic effect of age and it was found to be very weakly associated with the latter (odds ratio=0.999). The more age increases, the higher the likelihood of being a diabetic, however, based on the squared age variable, it will get to a point where the likelihood of being diabetic reduces as age increases.

The study confirmed the association between ethnicity and diabetes prevalence. It showed that the Chinese population as well as those from European descent are more likely to be diabetics than the Creoles. Indeed, from the NCD survey conducted by the Ministry of Health & Quality of Life in 2004, the prevalence of diabetes amongst the Chinese population was 17.2% versus a prevalence of 15.8% in the Creole population. However, our descriptive statistics and statistics from the NCD surveys showed the highest diabetes prevalence amongst the Indian population. There is no concrete evidence from our findings that the other Indian ethnicities (Hindus and Muslims) have a measurable effect on diabetes prevalence since statistically significant results have not been obtained. A strong positive association between the Indian population groups (Hindus and Muslims) and diabetes prevalence was expected; however, this has not been the case. The reason for this positive association between diabetes prevalence and the Chinese population group is unclear but worrisome. What is even worrisome is that the Chinese people in Mauritius have been reported with the highest prevalence on Impaired Glucose Tolerance (IGT) which has been recognised as being a stage in the transition from normality to diabetes (International Diabetes federation, 2005; Ministry of Health & Quality of Life, 2004).

The gender of an individual was found to be positively associated with diabetes status. From our analysis, males have been shown to be more likely to be diabetics than females. The global figures on diabetes do not agree with these results which state than the female gender possesses a higher prevalence than the male gender. However, in Mauritius, a slightly higher diabetes prevalence has been reported amongst men (22.0%) as compared to women (21.8%) (Williams *et al.*, 2003). Thus, our results are supported by statistics obtained from the same Mauritian setting.

Family history in the form of whether parents have/had diabetes is significantly associated with diabetes prevalence. It bears a large odds ratio and thus, demonstrates a strong positive relationship with diabetes prevalence. This result is in line with previous works done that demonstrated the genetic implications of diabetes. Family history in the form of whether second degree relatives have diabetes or not, is also positively associated with diabetes status/prevalence confirming once again the strong genetic factor of diabetes.

The association of physical activity with diabetes status being negative suggests that those who perform physical activity of any sort are less likely to be those suffering from diabetes. These results were expected and agree with numerous empirical works (Jeon *et al*., 2007; Manson *et al*., 1991). However, due to the cross-sectional nature of our study we cannot conclude that physical activity prevents the development of diabetes like some papers in the literature have reported (Manson *et al*., 1991; Manson *et al*., 1992). Our results only indicate a very strong association between diabetes prevalence and physical activity.

Alcohol intake was found to be positively associated with diabetes prevalence. In other words, those who consume alcohol are more likely to be diabetics than those who do not consume. It also means that discrete increments of alcohol increase the chances of an individual being diabetic. However, it does not mean that alcohol causes diabetes since our study design is cross-sectional and did not involve a follow-up. Our results, however, demonstrated that diabetics are more likely to consume alcohol which is recommended as per some scientific papers which reported that moderate alcohol intake can reduce the risk of type 2 diabetes (Parillo & Riccardi, 2004; Wannamethee *et al*., 2003).

Overweight ($25kg/m^2<BMI \leq 30kg/m^2$) was significantly associated with diabetes status in two out of three analyses. Our results agree with the general consensus that a high body corpulence is positively associated with diabetes. Even though obesity was not significant, we believe that overweight is a good enough indicator of an individual's excess weight. From these results, it seems diabetics need to be educated further on how to better self-manage their condition, and maintain a healthy weight in order to avoid complications.

Another associative factor of diabetes is per-capita household expenditure which we used as a measure of socio-economic status. This association is, however, a weak positive one. Those with a higher per-capita household expenditure (higher income) have been found to be more likely to be diabetics than those of lower per-capita household expenditure (lower income). The squared form of this variable shows the non-linearity in the relationship between the prevalence and per-capita household expenditure. The full interpretation taking the squared form into consideration is slightly different. The more income increases, the higher the likelihood of being a diabetic, however, based on the squared per-capita household expenditure variable, it will get to a point where the likelihood of being diabetic reduces as the income increase. The positive association between per-capita household expenditure and diabetes prevalence contradicts certain papers in the literature which report a negative association between diabetes prevalence socio-economic status. They report a higher prevalence amongst poorer populations or socio-economically disadvantaged groups (Brancati *et al*., 1996; Langenberg *et al*., 2007). It is, however, crucial to point out that contrasting results exist on the type of association between socio-economic status and diabetes prevalence. A negative relationship has been reported in developed countries but the reverse is true in developing countries where the most affluent sections of the society having the higher prevalence (Xu *et al*., 2006; Abu Sayeed *et al*., 1997; Herman *et al*., 1995). As stated in the literature review, these differing results suggest that the association between diabetes prevalence and socio-economic status depends on the income level or development level of the country. Since Mauritius is a developing country, the positive relationship from our results is thus, justified.

This study also revealed that if an individual has attained either secondary or tertiary education, he/she is less likely to a diabetic than those whose highest education level attained is primary. In certain studies, the number of years of education completed can be used to measure socio-economic status. In line with this statement, our result agrees with other empirical works where high diabetes prevalences have been reported in poor populations of both developed and developing countries. Those individuals with a higher educational level are more informed about diabetes and they might be undergoing preventive measures unlike those with a lower educational level. Also, the more educated ones are in most cases, better off and can afford healthier lifestyles in terms of healthier diets and regular physical activity. Place of residence is positively associated with diabetes prevalence. In other words, those living in urban areas (the districts of Port-Louis and Plaines-Wilhems) are more likely to have diabetes than those living in rural areas (all the other seven districts). If place of residence is regarded as a measure of socio-economic status, then these results agree with the fact that in a developing nation like Mauritius, those of higher socio-economic status are more likely to have diabetes

5.2.2 Utilisation of Diabetes Care Services

In our study, the measure of utilisation used is the number of visits an individual had in the year 2008 to a health facility to treat his/her diabetes. We examined the association between utilisation and several variables. Only those variables that have been found to be significant are discussed below.

Starting with gender, we report a negative relationship with utilisation which corroborate with the literature. We found that males have less medical visits to treat their diabetes than females who suffer from the same condition even though we also reported a higher prevalence of diabetes in male diabetics than in female diabetics. Similarly, Bertakis *et al*. (2000) reported analogous results. They reported a low medical care service utilisation in males and a significantly higher one in females. They also used number of visits as their measure of utilisation. Numerous explanations have been suggested to support these findings, one of them being the differentials in health perceptions and reporting of illness of the two genders (Hibbard & Pope, 1983; Mechanic & Greenley, 1982; Vanbrugh & Wingard, 1987).

From our results, per-capita household expenditure, used as a proxy for socio-economic status, bears a negative relationship with utilisation. Thus, diabetics with a high per-capita household expenditure make fewer visits to a health facility or doctor to treat their condition. These results coincide with our descriptive statistics which reveal a decrease in utilisation moving from the lowest quintiles to the highest quintiles. When the quadratic form of this variable is taken into account, the results reveal that the more income increases, the lower the likelihood of a diabetic to utilise the services, however, it will get to a point where the likelihood of utilising the services will increase as income increases. These findings go against the general consensus in the literature which shows that those higher socio-economic status have a higher utilisation. Indeed, Gotsadze *et al*. (2005) found that the main reason for not seeking care was a lack of money to pay for treatment, thus, reported that poorest households are less likely to seek care than more affluent households. Dunlop, Coyte & McIsaac, 2000 also showed a positive relationship between socio-economic status and utilisation. However, our results show quite the contrary. We have shown that individuals of higher socio-economic status are less likely to utilise while those of lower socio-economic status are more likely to utilize diabetes care services. A strong justification for our results is that health care in Mauritius is free and diabetics of lower socio-economic status can easily access health care. Indeed, in the public sector, all levels of care, that is, primary health care (PHC), curative and high-tech medical care, are free at the point of service for the entire population. Thus, the increased utilisation among diabetics of lower socio-economic status has been justified. The reason why those of higher socio-economic status utilise less can be explained as follows. Those individuals are more educated and more knowledgeable about their condition. It is thus, not surprising if they are more aware of the self-management regimes related to their condition. Individuals belonging to a higher socio-economic status are also more able to afford healthy diets and perform exercise, at the gym for example. As a result, these individuals do not feel the need to consult and thus, have a lower utilisation as compared to those belonging to the lower socio-economic status.

The negative association of age with diabetes care utilisation suggests that older people consult less more than younger ones. The opposite was expected since intuitively older individuals are more at risk of developing the disease and are those who require more medical attention. When the quadratic form of age is considered, the interpretation is as follows: The more age increases, the likelihood of utilising the diabetes services decreases; however, based on the squared age variable, it will get to a point where the likelihood of utilising the services will increase as age increases. The negative association of age can be explained by the fact that diabetes mellitus is a self-manageable disease. Thus, low utilisation of diabetes services by the elderly can be justified. Initially, as age increases, diabetics acquire more knowledge about their condition and learn how to self-manage it. However, as age increases further, diabetics are less able to self-manage due to old age and to the presence of multiple diabetes complications. At this point, these older individuals will revert back to utilising diabetes care services which offer more appropriate treatment for their advanced condition. From this point on, utilisation will increase as age increases.

No significant association was found between ethnicity and utilisation of diabetes care services. The Indian population (Hindus and Muslims) was expected to utilise more of the diabetes services since from our descriptive statistics they have the highest diabetes prevalence. However, this has not been observed in our study. The non-association of these ethnicities with the utilisation of diabetes care services can be explained by their non-association with diabetes prevalence

The positive association of family history with utilisation implies that diabetics with a family history of diabetes use more of the diabetes services than those who do not have a family history of the disease. This finding could be explained by the fact that individuals who have a family history of the disease are more aware and more knowledgeable about this disease through their relatives who are suffering or have suffered from it. As a result, they are more concerned about their state and thus, these individuals are more ready to consult. They probably even have a family doctor who treats all the members of the family affected by the condition. On the other hand, those individuals who do not have a family history of diabetes are less willing to consult due to their lack of knowledge about the condition.

Cigarette consumption is negatively associated with utilisation of diabetes care services. In other words, diabetics who smoke cigarettes have a lower or reduced utilisation than those who do not smoke at all (no smoking is the comparison variable). No plausible explanation was able to be put forward to support this observation and evidence in the literature on the issue is sparse. However, it could be that diabetics who smoke are less concerned about their ill state than those who do not smoke. Their lower concern about their health could explain their reduced utilisation.

Similarly, low physical activity is negatively associated with utilisation, suggesting that those diabetics who perform low levels of physical exercise have less medical visits to treat their diabetes than those who do not perform exercise. We reported that physical acitivity is negatively associated with diabetes prevalence. Thus, it was expected that physical activity (even low levels) would also be negatively associated with utilisation. Moreover, individuals who perform physical exercise might be more knowledgeable about their condition and are aware that physical exercise is part of the management regime of diabetes. As a result, these individuals manage their diabetes through exercise amongst others and do not feel the need to visit their physicians for care since self-management is one of the bases of effective diabetes care (NSFD, 2007).

Low and high alcohol consumption are both negatively associated with the utilisation of diabetes care services. However, medium consumption of alcohol is positively associated with the latter. This observation can, unfortunately, not be backed up by solid explanation and evidence to support it in the literature.

Place of residence, as mentioned earlier in this paper, is one of the measures of socio-economic status. The fact that this factor is negatively associated with utilisation tells us that diabetics living in rural areas have more frequent visits to a health facility than those living in urban areas. This finding contradicts what scholars have previously reported on the relationship between socio-economic status and utilisation. Low utilisation is, unfortunately, prevalent amongst individuals of a lower socio-economic and similar finding has been found amongst diabetics and those individuals are more predominant in rural areas than in urban ones (Yudkin *et al*., 1980; Williams *et al*., 1990; Burrows *et al*., 1987). However, health care is, fortunately, free of charge in Mauritius for the entire population and thus, individuals belonging to a lower socio-economic status have easy access to health care. Moreover, three out of the five major hospitals are found in rural areas. Dispensaries as well as community health centres are located all over the island and are readily accessible. Another justification could be due to differences in health perceptions. Those diabetics living in rural areas may have a different perception of health than those living in urban areas which in turn affect their utilisation behaviour. Also, those living in rural areas might be less aware of diabetes self-management and feel more comfortable or more reassured when they consult a doctor about their diabetes.

5.2.3 Diabetes Prevalence & Utilisation of Diabetes Care Services

Three relevant factors namely per-capita household expenditure, educational level and place of residence were compared between two groups. Group 1 consists of those individuals who have diabetes and use the diabetes care services, whilst group 2 consists of those diabetics who do not utilise diabetes care services. The per-capita household expenditure of both groups 1 and 2 were found to bear no difference whilst the educational level of the two groups differed significantly. Since per-capita household expenditure (SES) is used as a proxy for socio-economic status, it can be deduced that a diabetic's socio-economic status does not significantly affect his/her utilisation of diabetes care services considerably. This finding does not, however, mean that SES is not associated with utilisation since from our earlier results, a negative association was revealed between them. On the other hand, these two groups of diabetics differ in terms of educational level and place of residence to a considerable extent. Thus, educational level and place of residence are factors that are linked to both diabetes prevalence and utilisation, unlike per-capita household expenditure.

5.2.4 Limitations

The study is limited due to its cross-sectional nature. Our findings are applicable to the Mauritian setting as a whole and but only within the time period in which the study has been conducted. Thus, these findings may not be indicative of the diabetes prevalence or how diabetes services are utilised elsewhere in other settings. Also, only associations were deduced and certainly not causality. However, even if our results are not generalisable to other settings and time periods, they are however, representative of the whole population since samples were taken from all the nine districts of the country.

A second limitation is that we relied exclusively on self-reports. No medical tools which could aid in the diagnosis of diabetes was used, glucometers for example. Similarly, when individual reported their average weight and height, no measuring tool was used to confirm this data. Differential in reporting or recall problems might have been a cause of bias.

A third limitation of this study is the use of per-capita household expenditure as a proxy for socio-economic status. More reliable measures such as asset index or deprivation are present in the literature. However, these alternatives require more data thus, more money and time. As a result, they could not be applied in this study because the variables were not collected in the field.

Another limitation is that data collected did not capture the care pathway of diabetics. Data on facility and services type was not collected. Some important factors on utilisation such as diabetes service type or efficacy were not included in the survey. Thus, we were not able to evaluate the type and quality of service delivered to the diabetics. However, this was not the basis of the study. Similarly, the fact that utilisation has not been disaggregated into different diabetes control services and by different providers is a limitation of this study. Utilisation in general was reported and modelled and not curative, preventive or rehabilitative utilisation. Time constraints did not permit us to go into these depths, thus, we only investigated utilisation in general and as a whole.

Diabetes is a disease that can be treated by self-management. Diabetics who do not use the diabetes care services might not need to because their diabetes might only need self-management and not because of reduced access to the services. This is another limitation of this study.

Yet another limitation is that no indicator was used to assess the severity of diabetes. As a result, it cannot be determined whether a diabetic should be using diabetes care services or not.

This study was prone to information bias in the form of recall bias for certain questions where participants are responsible for judging and recalling their own health and lifestyle. In order to lessen the extent of bias, all variables were measured in the exact same manner on everyone who participates in the survey.

Knowledge of disease may be poor and this might have given rise to reluctance to take part in the study and increase the non-response rate. The main problem with non-responders is that they often differ from respondents and this can affect the validity of the conclusions (Marshall, 2005). However, interviewers assisted in encouraging non-responders to participate to reduce the non-response rate.

A last limitation is due to the weak sampling techniques employed in this study. The sampling strategy used was not fully random since maps were not used to identify households to be interviewed. Instead, interviewers from all nine districts were selected and they interviewed households in their neighbourhood, including their own. The fact that the households interviewed only come from a restricted section of the district, that is, the region where the interviewer lives, could have been a cause of bias. However, these interviewers were selected based on the fact that their house was found in the main residential area in their district.

CHAPTER SIX
CONCLUSION & RECOMMENDATIONS

6.1 Introduction

This chapter concentrates on providing a conclusion to this study and highlighting certain recommendations that can be drawn from the findings.

6.2 Conclusion

This paper provides a framework for the determination of those factors that have the most influence on diabetes prevalence and the utilisation of diabetes care services in Mauritius. Moreover, analyses were conducted to establish the link between prevalence and utilisation. The results of this paper can be viewed as indicative of what the actual diabetes situation is in Mauritius.

A summary of the main findings reveals that age is positively associated with diabetes prevalence so is gender, suggesting than males are more likely to be diabetics than females. The Chinese and European population group are more like to suffer from the condition than the Creoles. However, the other ethnic groups, namely, Hindu and Muslim were not significantly associated with diabetes status. Family history was found to be a strong factor associated of diabetes. Overweight was positively associated with diabetes prevalence as well as alcohol consumption. However, physical activity was negatively associated as well as educational level (secondary and tertiary) attained. Thus, those who have attained secondary and tertiary education are less likely to be diabetics than those who have only completed primary education. Per-capita household expenditure was found to bear a weak positive association with diabetes prevalence. Place of residence also bore a positive association. Smoking was not significantly associated to diabetes prevalence.

Utilisation was found to be positively associated with family history and negatively associated with age. As people with diabetes get older, they were found to have a tendency to use less of the diabetes services. A negative association also exists between utilisation and gender, thus male diabetics utilise less than female diabetics. Those diabetics whose parents have/had diabetes are more likely to utilise services than those who do not have a family history of the disease. Diabetics who smoke cigarettes utilise less than those who do not smoke. Similarly, diabetics who perform low levels of exercise utilise less of the services than those who do not perform any form of physical activity. Also, diabetics who consume low and high levels of alcohol utilise less of the services than those who do not drink while those who have medium alcohol consumption utilise more of the services than those who do not drink. Both per-capita household expenditure and place of residence are negatively associated with utilisation. Those diabetics who have high incomes and who reside in urban areas are less likely to utilise the diabetes services than their counterparts who have low incomes and reside in rural areas.

Both objective one and two have been achieved. Similarly, objective three has also been achieved and the common links between diabetes prevalence and the utilisation of diabetes services have been identified to be educational level and place of residence. Only three factors, including per-capita household expenditure were tested in this analysis, however, they were those that were believed to be most relevant to investigate.

Our results clearly indicate areas where more effort from the government has to be done. Our findings provide new evidence about the factors associated with of diabetes in Mauritius that should be targeted for diabetes prevention primarily. Those who are at risk require more targeted resources and more primary prevention. Those findings that are not straightforward and cannot be explained or justified have to be subjected to future more in depth research. For example, the reason behind the fact that, those who have higher per-capita household expenditure are those who are more likely to be diabetics and still make fewer visits to treat their illness, has to be unravelled. Similarly, the reason why older diabetics have a lower utilisation than younger ones needs to be understood. Next, some relevant policy recommendations are presented.

6.3 Policy Recommendations

Our results reveal the association of certain factors with diabetes prevalence and the utilisation of diabetes care services. They provide considerable information in order to assist in formulating adequate policies so as to attend to the problem of increasing diabetes prevalence in Mauritius.

The fact that age is one of the factors positively associated with diabetes status means that health policy should focus on the elderly. These individuals are more prone to diabetes, thus if policies are directed specifically at them, this would have a beneficial effect on diabetes prevalence in Mauritius. Diabetes screening can be focused on the elderly, for instance, old age homes and elderly clubs and associations, can be the starting point of diabetes screening campaigns. Moreover, home visits can be provided to elderly diabetics since they are more likely to use less of the services than the younger population even though they are more affected by the condition. These home visits could simultaneously offer screening, diabetes education on self-management and general diabetes consultation including the detection of complications and drug prescription. Diabetes education should also aim towards encouraging individuals to seek diabetes care as much as possible.

The strong association that family history bears with diabetes prevalence is a crucial information that should not be overlooked. This piece of information can be used in order to target those individuals with diabetes are not aware of their status. Doctors should be compelled to screen all individuals in a family if one individual in that family is diagnosed with diabetes. All members of the family should be offered free informative sessions on how to manage their diabetes or how to prevent diabetes in cases where they are diagnosed disease-free.

More attention should be given to the common links between diabetes prevalence and utilisation which have been identified as educational level and place of residence. These factors affect both prevalence and utilisation, thus, if they are primarily tackled, the effect could be an effective diabetes control in Mauritius.

Empirical studies should be conducted to further comprehend the association of certain factors with diabetes prevalence and utilisation. These studies can be costly and policies should be put in place for their funding. For example, the results of our study can be investigated further through in-depth research in order to gain a better understanding of the effect of certain factors on diabetes prevalence and utilisation. Those results which could not be justified and backed up by evidence in the literature should be subjected to more rigorous research as mentioned earlier.

Concerning overweight and obesity, policies should be put in place in order to educate the population about proper eating habits and lifestyle changes in general so as to prevent/manage not only diabetes but other non-communicable diseases. Clearly, overweight is still prevalent amongst the diabetics in Mauritius. As a result, it can be concluded that the efforts made by the Mauritius Diabetes Association (MDA) and other non-governmental and governmental institutions in providing diabetes awareness seminars and talks to the Mauritian population may need to be enhanced. Since education is key and forms the basis of diabetes prevention, health education at the early stages of an individual's life is essential. Thus, health education should be more present in schools at primary and secondary levels.

Fortunately, some of these policies have already been implemented for some years now, most of which have not yet yielded positive results due to the increasing prevalence of diabetes each year. Consequently, these policies have to be reviewed and strengthened.

This study set out to achieve three objectives, mainly the identification of factors associated with (1) diabetes prevalence; (2) the utilisation of diabetes care services; and (3) identifying the common factors between prevalence and utilisation. All three objectives have been achieved. As a result, these recommendations presented above provide important indications that can guide the Mauritian government to make the most appropriate policies that would effectively address the issue of increasing diabetes mellitus prevalence in the country.

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APPENDICES

Appendix A: Correlation Matrix

```
. corr age sex eth_grp parents_d_status relatives_d_status d_type age_d_diag how_diag_made med_type where_treatmt
> typ_caregiver_gp typ_caregiver_pharmcist typ_caregiver_specialist typ_caregiver_dietician typ_caregiver_nurse ty
> p_caregiver_other typ_caregiver_none smoke_cig_yes_no perform_phy_act num_drinks_week hw_often_veg hw_often_meat
>  d_diet aware_alt_lifestyle adopt_alt_lifestyle occ_yes_no hh_exp bmi med_aid residence edulevel percaphhexp
(obs=125)
```

	age	sex	eth_grp	parent~s	relati~s	d_type	age_d_~g	how_di~e	med_type	where~mt	typ_ca~p
age	1.0000										
sex	0.1788	1.0000									
eth_grp	0.0009	0.1228	1.0000								
parents_d_~s	0.0545	0.0888	0.1014	1.0000							
relatives_~s	0.0627	0.0921	0.0609	0.4845	1.0000						
d_type	0.1444	-0.1983	-0.0532	-0.2175	-0.1570	1.0000					
age_d_diag	0.8054	0.1396	-0.0764	0.0166	0.0434	0.1054	1.0000				
how_diag_m~e	-0.1287	0.0656	-0.0570	0.0961	-0.0045	0.0408	-0.1769	1.0000			
med_type	-0.0326	0.0590	-0.0995	0.0912	-0.0457	0.0171	-0.0477	0.0537	1.0000		
where_trea~t	0.0470	-0.0182	-0.1398	-0.0054	0.0734	-0.1251	0.1443	0.1155	0.0108	1.0000	
typ_caregi~p	0.0201	0.0126	-0.0097	0.0428	0.0716	0.1447	0.1032	0.0267	0.0161	0.2370	1.0000
typ_car~cist	-0.0290	0.0302	0.0890	-0.1255	-0.0268	-0.0563	-0.0192	0.0895	-0.0794	-0.1919	-0.1638
typ_car~list	0.0298	0.0461	0.0021	-0.0100	0.0540	-0.1584	0.0270	-0.0781	-0.2049	0.0084	-0.6906
typ_caregi~n	-0.0261	0.0679	0.0041	0.1991	0.1266	-0.1717	-0.0883	0.2653	0.1009	-0.0565	-0.0126
typ_careg~se	-0.1110	-0.0666	0.1561	0.0954	-0.1422	0.0162	-0.0819	0.0585	0.0096	-0.0274	0.0190
typ_caregi~r	-0.1328	0.0891	-0.0316	0.0669	0.0622	-0.0903	-0.0983	-0.0459	0.2876	-0.0653	-0.1149
typ_careg~ne	-0.2151	-0.1285	-0.1547	-0.1711	-0.1842	0.0797	-0.1888	-0.0323	0.2025	0.1815	-0.0809
smoke_cig_~o	-0.0429	0.3436	0.1433	0.1503	0.1236	-0.0870	-0.0155	-0.0428	0.0151	-0.1513	-0.1140
perform_ph~t	-0.1915	-0.1130	-0.0485	0.0210	-0.0468	0.0508	-0.1114	0.0853	0.1364	0.0343	-0.0081

num_drinks~k	-0.0670	0.3238	-0.0034	0.1663	0.1975	-0.1093	-0.0965	0.0537	0.1580	0.0342	0.0616
hw_often_veg	0.1262	-0.1212	-0.3195	-0.0813	-0.0698	-0.0404	0.2009	-0.1328	0.0634	0.1279	-0.0580
hw_often_m~t	-0.0137	0.2251	0.2169	0.1574	0.1276	-0.2008	-0.1768	0.0915	0.1608	0.0131	-0.0348
d_diet	0.1047	-0.1789	-0.1711	0.0292	-0.0406	0.0511	0.1676	-0.0791	-0.0509	0.0029	0.0080
aware_alt_~e	0.1034	-0.0434	0.1612	0.0216	-0.0445	-0.0234	0.0856	0.0495	-0.1098	-0.1499	-0.1588
adopt_alt_~e	0.0780	-0.1532	-0.1094	0.0237	-0.0837	0.0394	0.1562	-0.1552	-0.0389	-0.0239	-0.0211
occ_yes_no	-0.4571	0.1756	0.2043	-0.0527	-0.0109	-0.2125	-0.4404	-0.0378	-0.0836	-0.1226	0.0767
hh_exp	-0.1703	0.2242	0.0374	0.1235	-0.0947	-0.2721	-0.2269	0.0786	0.1618	-0.2255	-0.1082
bmi	-0.1278	0.0488	0.1242	0.0614	0.0002	-0.1286	-0.2240	-0.0746	0.1106	-0.0425	-0.1403
med_aid	-0.1191	0.0584	-0.0913	0.0852	-0.0864	-0.2400	-0.1215	0.0013	-0.0228	-0.0087	-0.0124
residence	-0.0616	-0.2953	-0.0334	-0.2958	-0.3289	0.3184	-0.0329	-0.1934	-0.1433	-0.2767	-0.2502
edulevel	-0.4457	0.0632	-0.0390	0.0732	0.0030	-0.2920	-0.3531	0.1293	-0.0390	-0.0638	-0.0782
percaphhexp	-0.1268	0.1468	-0.0169	0.1441	0.0059	-0.3316	-0.1358	0.0793	0.1006	-0.1438	-0.0118

	typ~cist	typ~list	typ_ca~n	typ_c~se	typ_ca~r	typ_c~ne	smoke_~o	perfor~t	num_dr~k	hw_oft~g	hw_of~at
typ_car~cist	1.0000										
typ_car~list	-0.1719	1.0000									
typ_caregi~n	-0.0863	-0.0768	1.0000								
typ_careg~se	-0.0331	-0.0809	0.0310	1.0000							
typ_caregi~r	-0.0232	-0.1206	-0.0606	-0.0232	1.0000						
typ_careg~ne	-0.0163	-0.0849	-0.0426	-0.0163	-0.0115	1.0000					
smoke_cig_~o	0.0078	0.0118	0.0325	0.0078	0.2320	-0.0494	1.0000				
perform_ph~t	0.0620	0.0005	0.0304	0.0620	-0.0190	-0.1014	-0.2119	1.0000			
num_drinks~k	-0.0737	-0.0389	0.0540	0.1192	0.1851	-0.0602	0.3553	-0.0749	1.0000		
hw_often_veg	-0.0448	0.1314	-0.0337	-0.1222	-0.0043	0.0733	-0.2283	0.0950	-0.2971	1.0000	
hw_often_m~t	-0.0961	0.0095	0.2540	-0.0130	-0.0382	-0.0269	0.1991	-0.0805	0.3809	-0.3275	1.0000
d_diet	-0.0227	0.1923	-0.0723	-0.0227	-0.0956	-0.1796	-0.1990	0.4077	-0.2588	0.3232	-0.3072
aware_alt_~e	0.0475	0.2472	0.0398	0.0475	0.0333	-0.3434	-0.0886	0.1030	-0.1368	0.0923	-0.1606
adopt_alt_~e	-0.0043	0.1936	0.0251	-0.0043	-0.0776	-0.1598	-0.1793	0.4142	-0.2194	0.2422	-0.2939

occ_yes_no	-0.0597	-0.0575	0.1266	0.1317	0.0923	-0.1240	0.1586	0.0254	0.1639	-0.1472	0.1248
hh_exp	0.0038	-0.0512	0.4016	-0.0150	-0.0184	-0.0612	-0.0676	0.1265	0.0711	0.0222	0.1744
bmi	0.0045	0.0565	0.0556	-0.0032	0.0698	0.2296	0.1910	-0.2303	0.0470	-0.0920	0.1039
med_aid	-0.1067	0.1063	0.0526	-0.0025	-0.0748	-0.0527	-0.0184	-0.0155	0.0734	0.0268	0.0252
residence	0.0015	0.1838	-0.2646	-0.0895	-0.1265	0.0905	-0.0146	-0.0223	-0.4275	0.0343	-0.3121
edulevel	0.0886	0.1083	0.1266	0.0886	-0.0458	-0.1082	0.0113	0.3381	0.0395	0.0511	-0.0767
percaphhexp	-0.0227	-0.0363	0.3372	-0.0565	-0.0396	-0.0822	-0.1035	0.0915	0.0835	0.0395	0.0703

	d_diet	aware_~e	adopt_~e	occ_ye~o	hh_exp	bmi	med_aid	reside~e	edulevel	percap~p
d_diet	1.0000									
aware_alt_~e	0.2778	1.0000								
adopt_alt_~e	0.7493	0.4653	1.0000							
occ_yes_no	-0.1516	0.1547	-0.0126	1.0000						
hh_exp	-0.0527	0.0750	0.0467	0.3223	1.0000					
bmi	-0.0780	-0.1333	-0.1351	0.0362	-0.0236	1.0000				
med_aid	-0.0275	0.0036	0.0292	0.1547	0.2772	0.0282	1.0000			
residence	0.0560	0.1287	0.0704	0.0447	0.0037	0.0455	-0.0320	1.0000		
edulevel	0.0948	0.0938	0.1065	0.3311	0.3799	-0.0867	0.3790	0.0503	1.0000	
percaphhexp	-0.0223	0.0742	0.0547	0.2886	0.8552	-0.0656	0.2445	-0.0947	0.3845	1.0000

Appendix B: Questionnaire

Field worker ID _______________ Form code (For office use only)_____________

N.B: Numerical answers should be circled or recorded in the box provided

SECTION 1	**RESPONDENT'S BIOGRAPHICAL INFORMATION**

1.1	**How old were you at your last birthday?** **(Age of the respondent)**	

INSTRUCTION	**DO NOT ASK; RECORD SEX**	**Male**	**Female**
1.2	**Sex of the respondent**	1	0

1.3	**What is your ethnic group/religion?**			
Creole	**Hindu**	**Muslim**	**Chinese**	**Other**
0	1	2	3	4

SECTION 2	**RESPONDENT'S PHYSICAL INFORMATION**

2.1	**How much did you weigh the last time you weighed yourself? (in kilos)**	**kg**

2.2	**What is your height in centimetres? (in cm)**	**cm**

SECTION 3	RESPONDENT'S DIABETES STATUS

3.1	Do any of your parents have diabetes?	Yes	No
		1	0

3.2	Do any of your other relatives have diabetes?	Yes	No
		1	0

3.3	Do you have diabetes?	No	Yes	Don't Know
		0	1	2
		Move to section 5 and continue	Move to question 3.3.1 and continue	Move to section 5 and continue

3.3.1	Which type of diabetes do you have?
Type 1 Diabetes	0
Type 2 Diabetes	1
Impaired Glucose Tolerance (IGT)	2
Don't Know	3

3.3.2	How old were you when you were diagnosed with diabetes? (in years)	

SECTION 4	RESPONDENT'S HEALTH CARE UTILISATION AND ACCESS INFORMATION (for those identified as diabetics only)

4.1	How was your diabetes diagnosis made?	
A	I recognized the symptoms myself	0
B	I went to the pharmacy and the pharmacist told me	1
C	A nurse or doctor made the diagnosis	2
D	Traditional healer told me	3
E	Laboratory test	4
F	A family member told me	5
G	Others (please specify)	6
H	Don't know/Don't remember	7

4.2	What type of medication are you using to treat your diabetes?
Oral agents only	0
Insulin only	1
Insulin & oral agents	2
No medication	3

4.3	Where do you usually go get your diabetes treatment?et your diabetes treatment?	
A	I treated myself with things I had at home	0
B	I asked the pharmacist to give me something	1
C	My doctor gave me medication or a prescription	2
D	Private hospital	3
E	Public hospital	4
F	Traditional herbalist/spiritualist	5
G	Others [please specify]	6

4.4	What type of care giver do you go to for diabetes care?
General practitioner (GP)	0
Pharmacist	1
Specialist	2
Dietician	3
Nurse	4
Other	5

4.5	How many times have you visited a health care provider in the past year because of diabetes (to the date of this interview)?	

4.6	Is the hospital/clinic/facility you use to treat your diabetes relatively far from your home?	Yes	No
		1	0

SECTION 5	RESPONDENT'S LIFESTYLE INFORMATION

5.1	Do you smoke cigarettes?	Yes	No
		1	0
		Move to 5.1.1 and continue	Move to 5.2 and continue

5.1.1	How much do you spend on cigarettes a day? (in Rupees)	R

5.1.2	How many cigarettes do you smoke on average in a day?				
	nil	1 to 5	5 to 10	11 to 19	20 or more
	1	2	3	4	5

5.2	Do you perform any physical exercise?	Yes	No
		1	0
		Move to 5.2.1 and continue	Move to 5.3 and continue

5.2.1	What physical exercise do you perform? (circle all that apply)
Walk	0
Run	1
Exercise at home or at the gym	2
Ride a bicycle	3
Do a team sport (i.e. swimming, play soccer, play tennis etc.)	4
Other, please specify (_______________________________________)	5

5.2.2	How often do you exercise?
5 – 7 days a week	0
3 – 5 days a week	1
1 - 3 days a week	2
Once a month	3
Less than once a month	4

5.3	On average, how many drinks containing alcohol do you consume in a week?				
	nil	1 to 2	3 to 5	6 to 10	11 or more
	0	1	2	3	4

5.4	How often do you eat vegetables?

0 times per week	0
Between 1 and 3 times per week	1
Between 4 and 6 times a week	2
Seven times a week	4
Everyday of the week	5

5.5	**How often do you eat meat?**
0 times per week	0
Between 1 and 3 times per week	1
Between 4 and 6 times a week	2
Seven times a week	4
Everyday of the week	5

5.6	**Are you on a specific diet to manage your diabetes?** **(To be answered by diabetics only)**	Yes	No
		1	0

5.7	**Are you aware of alternative lifestyles a diabetic may adopt to manage his/her diabetes?** **(To be answered by both diabetics and non-diabetics)**	Yes	No
		1	0

Move to 5.8 and continue	Move to section 6 and continue

5.8	**If yes, have you adopted any of them?**	Yes	No
		1	0

5.8.1	**If yes, please specify which ones? (in words)**	**1.** **2.** **3.**

SECTION 6	**RESPONDENT'S SOCIO-ECONOMIC INFORMATION**

6.1	**Are you engaged in any income-generating activity?**	Yes	No
		1	0
		Move to question 6.1.1 and continue	Move to question 6.2 and continue

6.1.1	**If yes, please specify your occupation.**	

6.1.2	**If yes, how much do you earn in total every month? (in Rupees)**	**R**

6.2	**In general, how much does the household spend in a month? (in Rupees)**	**R**

6.3	**How many people live in this household?**	

6.4	**What is your highest level of education attained? (in words)**	

6.5	**Do you have medical aid?**	Yes	No
		1	0

Appendix C: Consent Form

FACTORS INFLUENCING DIABETES PREVALENCE AND UTILISATION OF DIABETES CARE SERVICES IN MAURITIUS

SURVEY 2008

INFORMED CONSENT FORM

I am a Mauritian adult (male or female) between the age of 18 years and above and have been asked to take part in this study that is trying:

- To identify the factors associated with the occurrence of diabetes.
- To determine the relationship between socio-economic status and diabetes.
- To determine the differences between the lifestyle of diabetics and non-diabetics.
- To evaluate the awareness of diabetes management regimes amongst diabetics.
- To identify the factors associated with the utilisation of diabetes health care services.
- To identify potential factors common to the incidence of diabetes and utilisation of diabetes care.

I understand that you will interview me and that it will take approximately 25 minutes of my time. **I understand that I have the right not to answer any question.**

I understand that taking part in this study is voluntary and that I have a right to withdraw my consent to participate at any time without penalty. I will not be paid to take part in this interview. **I understand that confidentiality will be maintained at all times.**

I have read the consent form. It has also been explained to me, and I fully understand what it says.
I agree to participate in this study.

__________________________ __________________________

Signature of the respondent **Date and time of Signature**

__________________________ __________________________

Signature of the person obtaining consent **Date and time of Signature**

If you have any questions about this study or are dissatisfied at any time with any aspect of the study, you may contact – anonymously, if you wish – the University of Cape Town ethics on the toll free number (+27) 0800776224.

The extra copy of the consent form is for you to keep.

Appendix D: Budget

Table 48: Budget.

Activity	Description	Amount ($)
A. Personnel		
9 Interviewers	900 households with an estimated 2.5 adults per household = 900*2.5 questionnaires $1 per questionnaire cost = 1* 900* 2.5 = 2,250	**2,250**
1 Data entry clerk	$ 100 for 1 month of data entry	**100**
B. Operational costs		
Training of fieldworkers	Refreshment for training over 3 days	**25**
	Location hire for 3 days	**50**
Local travel	Vehicle hire (for researcher)	**500**
Stationery	Notebooks, pens, staples/stapler, & Miscellaneous	**25**
Printing	Printing cost = $0.1per page questionnaire: 7 pages each consent form: 2 pages each 900 households with an estimates 2.5 adults per household cost = (0.1*7*900*2.5) + (0.1*2*900*2.5) = 1575+450 = 2025	**2025**
Communication	Air time for monitoring and contacts with officials	**150**
	Total	**5,125**