The effect of lifestyle practices on blood glucose levels and the development of diabetic complications in women diagnosed with type II diabetes mellitus in Guyana

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Abstract

Type 2 diabetes mellitus (T2DM) is a major health problem in Guyana especially among women. This study evaluated the effects of lifestyle habits on blood glucose control and the development of complications in T2DM female patients. A pretested questionnaire was administered to a total of 39 women between the ages of 44 to 65 years who were previously diagnosed with T2DM for a period of no less than 5 years at the West Demerara Regional Hospital Diabetic Clinic. The patients were divided into two groups, those who adhered to healthy lifestyle habits (group 1) based on body mass index (BMI) and those who did not (group 2). Information for each group was based on lifestyle practices, fasting blood glucose (FBS), random blood glucose (RBS) and diabetic complications. The results show that the mean RBS and FBS values for patients who practised "healthy lifestyle habits" were significantly ($p<0.05$) lower when compared to those who practised "unhealthy lifestyle habits". A significant majority of these patients also controlled their blood glucose with the use of one medication when compared to group 2 patients who had unhealthy lifestyle habits and who also needed two or more medications to treat their diabetes. Patients in group 1 who controlled their blood glucose levels and adhered to healthy life style habits had less diabetic complications. It was concluded that patients who adapted healthy lifestyle practices had lower mean RBS and FBS levels when compared to those who did not. These patients also had lower BMI and showed a reduced risk for the development of diabetic-induced long term complications. It can be concluded that a healthy diet and regular exercise are the mainstay therapy for patients with T2DM and to achieve this, the patients must adhere to life style changes to enjoy a better quality of life.

Keywords: Guyana, type 2 diabetes, life style habits, diet, exercise, medication

Introduction

Diabetes mellitus (DM) is a generalized chronic disorder characterized by certain abnormalities in carbohydrate, fat, electrolyte and protein metabolism.[13] DM occurs either because of a lack of insulin or because of the presence of factors that oppose the action of insulin.[9] This in turn results in an increase in blood glucose concentration (hyperglycaemia) that ultimately leads to several acute and chronic complications including neuropathy, nephropathy, retinopathy, cardiomyopathy, microangiopathy, atherosclerosis and foot ulcers.[13,23]

Conversely, if properly controlled by the adaptation of healthy practices i.e. correct, diet, regular exercise, consistent medication use, constant blood glucose monitoring, then the patients can experience a healthy and a better quality of life with less or possible no related complications.[20,22] The occurrence of congestive heart

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failure in the diabetic population and failure of the cardiovascular system are considered to be the leading cause of death in diabetics.[2,10,12,21] The presence of diabetes has reportedly increased the chance of cardiovascular problems by 2 fold in the male population and 3-5 fold in the female population.[5] Three major factors to largely account for the increased incidence of cardiovascular dysfunctions during diabetes include major vessel disease in the form of atherosclerosis, micro-vascular alterations and primary myopathic disorders in cardiac muscle.[1,2,6,8]

Symptoms in patients with T2DM are similar, but insidious in their onset. Many cases are diagnosed incidentally or because of the presence of diabetic complications such as renal failure, erectile dysfunction, blindness, slow wound healing and arterial diseases.[2,6,13]

T2DM patients carry a high risk of large vessel complications, hyperlipidemia and obesity and these may contribute to atherosclerosis and in turn induce hypertension.[13,14] Myocardial infarction is also common and accounts for about 60% of the deaths. Generally, cardiovascular complications are the most common cause of morbidity and mortality in diabetic patients.[10,13,14]

T2DM can be controlled by proper treatment. The immediate goal of treatment is to lower high blood glucose

levels and the long term goals are to prevent diabetes-related complications. The treatments commonly used for T2DM are exercise, diet and medication.[15,17] Some persons diagnosed with T2DM can reduce the dependency on medications with a proper exercise programme and an ideal diet.[3,17,18] Scientific evidence has shown that diet high in dietary fibre or complex carbohydrates is protective against diabetes.[7,11] Fiber is capable of slowing down the digestion and absorption of carbohydrates and increasing the sensitivity of tissues to insulin, thereby preventing the rise in blood glucose.[7,11] In addition, alpha lipoic acid enhances the glucose uptake and improves diabetes nerve damage. Omega- 3 protects against the hardening of arteries and omega 6 fatty acids protect against the development of neuropathy.[19] Being overweight contributes to insulin resistance since fat interferes with the body's ability to use insulin. Therefore, regular exercise lowers blood glucose levels even without medication and helps to burn excess calories and fat.[21] Moreover, exercise improves blood flow and blood pressure, decreases insulin resistance even without weight loss. In addition, exercise increases the body' energy level, lowers tension and improve one's ability to handle stress.[17]

Adequate use of medication in controlling T2DM is also effective in lowering blood glucose levels. Metformin, the most commonly used medication in Guyana's diabetic population, stimulates the liver to produce less glucose and helps muscle, fat and liver cells to absorb more glucose from the blood stream which lowers blood glucose levels. However, this must be accompanied by healthy lifestyle practices in order to control blood glucose levels.[4, 24, 25]

Background of the Problem
Data from the Ministry of Health Statistical Bulletin in 2006 have shown that there was a significant rise in T2DM patients attending Health Centers and clinics across the country. Between the years 2000 and 2005, the number of females diagnosed with diabetes increased from 4,788 to 7,514, representing a 36% increase compared to males whose numbers increased from 2,542 to 3,553. In region 3, where this study was conducted diabetes accounted for 7.1% of all first visit, with the majority being females. Data from the Ministry of Health Bulletin in Guyana[16] also suggested that nationally, diabetes was listed as the major cause of deaths among females between the age group 45 to 64 (18%). In 2006, diabetes was ranked as the third major cause of deaths in Guyana.[16]

Diabetic induced-long tem complications have long been associated with inadequate blood glucose (hyperglycaemia), plasma lipids and blood pressure monitoring, poor adherence to medication, unhealthy eating practices, sedentary life style, smoking and alcohol consumption among others. In Guyana, T2DM-induced cardiovascular diseases account for about 15% of the total health sector budget.[16] Records from the diabetes register in Region 2, (a border region of 3) found that of 226 diabetic patients, 209 have already had some form of diabetic complications. In light of these statistics on T2DM, this study was designed to evaluate the healthy lifestyle practices (diet, exercise, adherence to medication, adequate blood glucose

monitoring) of diabetic women who attended the Diabetic Clinic at the West Demerara Regional Hospital in Region 3, one of 10 administrative regions in Guyana. The rationale was to ascertain whether life style habits contributed to the increase in the number of T2DM cases among women in this region and what steps could be taken to reduce both the number and the cost to the national health services in Guyana. Several studies in other parts of the world have shown that lifestyles may have in impact on blood glucose levels and the development of diabetic induced-long term complications.[5,17]

Materials and Methods
Study Design
A pretested questionnaire was randomly administered to a total of 39 women between the ages of 44 to 65 years and who have been previously diagnosed with T2DM either on or before 2005 and who attended the West Demerara Regional Hospital Diabetic Clinic which was held once weekly. Only patients who had been diagnosed with T2DM for a minimum of five years were recruited for the study. The 39 subjects were placed into 2 groups, namely group 1 and group 2. The criteria that were used to place a person into a group was the Body Mass Index (BMI). Patients who had a BMI less than 25 were placed into group 1 while those with BMI greater than 25 were placed into group 2. There were 18 women in group 1 and 21 in group 2.

Ethical permission was granted from the Regional Health Officer and ethical clearance was obtained from the National Ethics Committee. Those patients who were willing to participate in the study were required to sign a consent form. Patients suffering from any known mental illness and those unwilling to participate were excluded. Religion and race were not considered as defining factors for the sample population. Information such as blood glucose monitoring, food choices, exercise and adherence to medication after being diagnosed with T2DM for the past five years was obtained from the questionnaire. In addition, the Body Mass Index (BMI) was done on the day when the patient attended the clinic. The mean random blood sugar (RBS), fasting blood glucose (FBS), and the presence of diabetic complications were obtained from the patient's clinical records, in addition to the questionnaire.

The study design took a cross sectional approach as persons with established diabetic conditions were recruited and interviewed to determine the patients' health and other related complications.

Variables
The independent variable
For this research, the independent variable used was time.

Dependent variable
The blood glucose levels and the onset and severity of related complications were the dependent variable used.

Method used for measuring each variable.
Independent Variable
An interview was done with each patient to determine who followed a healthy diet, participated in exercise on a regular

Table 1: Comparison of the 2 groups of T2DM patients with regards to age, body mass index and lifestyle habits. Data are mean values; n=18 in group 1 and 21 in group 2.

Lifestyle habits	Group 1	Group 2
Mean age	55	53
Mean Body Mass Index	24	28
Percentage that exercised 2-3 times per week for minimum of 1 hr	67	19
Percentage that consumed fruits and 2-3 times per week	77	23
Percentage that consumed vegetables 2-3 times per week	88	29
Percentage that consumed foods rich in omega-3 and omega-6, 2-3 times per week	55	19
Percentage that consumed complex carbohydrate 2-3 times per week	77	48
Percentage that consumed foods rich in refined carbohydrates 2-3 times per week	11	71
Percentage that consumed foods rich in saturated fats and trans fats 2-3 times per week	22	52
Percentage that consumed foods rich in sodium 2-3 times per week.	11	61

basis and taken their medication on time compared to those who did not over a period of five years. Patients were allowed to indicate what type of food they consumed from a given list. They also stated the type of exercise they participated in, duration and how often, their adherence to medication on a regular basis and the consistency of blood glucose measurement and blood pressure monitoring.

Dependent Variable
An interview was done with the patients to determine who had healthier lifestyle habits and with less- related complications. Patients BMI were determined by measuring their weight and height to determine if obese. In addition, the blood glucose levels for the past five years were collected from the patients' clinic cards whereby two values were randomly selected per year and then evaluated. The study also selected from a given list of certain diseases that had developed in their lives after diagnosis with T2DM. The diagnosis of these diseases was supported by evidence on their clinic cards or from any other relevant documents that indicated diagnosis of the diseases. In addition, the change of the types of medication was recorded.

Statistical analysis
 All data analyses were performed using the statistical package for social science (SPSS for Windows version 13.0 Chicago, Il). Data were expressed as mean +_ standard errors of the means (SEM). Data for group 1 were compared with group 2 using Student's t-test. A value of p<0.05 was taken as statistically significant.

Results
In this study, "healthy lifestyle habits" were considered by a combination of the following practices. They included regular exercise at least 2-3 times a week for a minimum time of 1 hr per session, consumption of "health foods " such as fruits and vegetables, consumption of red and purple fruits, foods rich in omega 3 and omega 6 fatty acids, and complex carbohydrates at least 2-3 times a week. "Unhealthy lifestyle habits" were considered by a combination of the following criteria. They included those who exercised less than twice per week, ate "unhealthy foods" with saturated fats, trans fats, refined carbohydrates and high sodium at least 2-3 times per week.

Table 1 shows the comparison of the data obtained for the two groups of T2DM patients. The results show that group 1

which consisted of 18 women had mean age of 55 years and a mean BMI of 24 compared to group 2 which comprised of 22 diabetics who had mean age of 53 years and mean BMI of 28. With regards to exercise, 67 % of the women in group 1 exercised 2-3 times per week for a minimum of 1 hour per session compared to only 19% in group 2 who exercised 1-2 times per week. In terms of food consumption group 1 diabetics consumed 77 % fruits at least 2-3 times per week, 88% vegetables 2-3 times per week, 55 % diets that were rich in omega 3 and omega 6-fatty acids and 77 % ate foods rich in complex carbohydrates. In contrast, diabetics in group 2 consumed 23 %   fruits,   29 % vegetables, 19 % foods rich in omega 3 and omega 6-fatty acids and 48 % foods rich in complex carbohydrates at least 2-3 times a week. Overall, the consumption of healthy foods" for group 1 was 66 % compared to 22% in group 2. With regards to foods that were considered unhealthy, 22 % from group 1 consumed foods rich in saturated fatty acids and trans fatty acids, 11 % consumed foods rich in refined carbohydrates and 11% consumed foods rich in sodium at a minimum 2-3 times per week. In relation to the consumption of unhealthy foods by the diabetic women in group 2, 71 % consumed foods rich in saturated fatty acids, 52 % consumed foods rich in trans fatty acids, 61 % consumed high sodium diet and 76 % consumed refined carbohydrate at least 2-3 times per day. Overall, group 2 diabetics were significantly (p<.05) obese compared to group 1 and they exercised significantly (p<0.05) less and consumed significantly (p<0.05) more unhealthy foods compared to group 1. The main reason given for the consumption of unhealthy foods was the cost, indiscipline to diet and lack of knowledge.

Table 2 shows the comparison of blood monitoring and the number of medications taken by the 2 groups. The results show that 33% of the women in group 1 monitored their blood glucose weekly compared to 14% in group 2. Similarly, 22 % and 44 % monitored their blood glucose monthly and every three months, respectively for group 1 compared to 19% and 66% for group 2, respectively. Group 1 also had mean RBS and FBS of 187 mg/dl and 124 mg/dl, respectively compared to group 2 who had mean RBS and FBS of 264 mg/dl and 177 mg/dl, respectively. These results clearly show that group 1 diabetic patients had significantly (p<0.01) less RBS and FBS compared to group 2 diabetics and this was probably due to the effort and

Table 2: Comparison of blood glucose monitoring and number of medications used between the 2 groups of diabetics patients. Data are mean values; n=18 for group 1 and 21 for group 2

	Group 1	Group 2
Percentage of women who did weekly blood glucose monitoring	33	14
Percentage of women who did monthly blood glucose monitoring	22	19
Percentage of women who did 3 monthly blood glucose monitoring	44	66
Mean RBS (mg/dl)	187	264
Mean FBS (mg/dl)	124	177
Percentage of women taking 1 medication for T2DM	71	20
Percentage of women taking 2 or more medications for T2DM	29	80

Table 3: Comparison of the prevalence of T2DM complications among the two groups of diabetic patients. Data are mean values; n=18 for group 1 and 21 for group 2.

Diabetic complications	Group 1 (%)	Group 2 (%)
Coronary artery disease	0	9
Renal problems	0	19
Skin ulceration	0	12
Strokes	11	37
Numbness in hands and feet	33	90
Dental complications	2	71
Blurred vision	22	80
Hypertension	33	85
High blood cholesterol	22	47

care group 1 diabetics employed in monitoring their blood glucose. Table 3 shows the comparison of prevalence of T2DM-induced complications among the two groups of diabetic patients. The results show that group 1 patients had such complications as blurred vision (22%), strokes (11 %), numbness in feet or neuropathy (33 %), hypertension (33 %), high elevated blood cholesterol (22 %) and dental problems (2 %). In contrast, group 2, women had complications such as coronary artery disease (9%), renal problems (19%), skin ulceration (12%), strokes (37 %), numbness in feet or neuropathy (90 %), blurred vision (80 %), dental problems (71%), hypertension (85%) and high blood cholesterol (47 %). Over all, group 2 diabetics had significantly (p<0.05) more severe complications and in larger numbers compared to group 1 diabetics.

Discussion

The results of this study have demonstrated the roles played by unhealthy life style habits on blood glucose levels, BMI and T2DM-induced long term complications. The results have clearly shown that healthier life style habits including regular exercise and blood glucose monitoring, proper diet and adherence to regular medication can either delay or prevent the development long term complications induced by T2DM. These in turn can lead to a better quality of life for diabetic patients. However, maintaining healthier life style habits can be more costly compared to adherence to unhealthy life style habits. The main reason given for consuming an unhealthy diet included the cost of food, indiscipline to the diet and the lack of knowledge of healthy food choices. Some patients even indicated that they preferred to eat foods that were very tasty because in their opinion "diabetic foods" are neither tasty nor attractive. The results obtained from the questionnaire in this study have clearly indicated that several T2DM patients lacked the knowledge of what types of food that were best suited for controlling their diabetes. This was due to the fact that the West Demerara Hospital had neither a Health Educational Programme nor a Nutritionist to help diabetic patients with information relating to healthier lifestyle habits. From the interview with each patient, it was noted that the only source of information was through the Government Medical Doctor who only spent about three to five minutes with each patient during weekly visits.

With regards to T2DM medications, the results showed that 77% of the patients in group.1 used daonil compared to 23% who used a combination of metformin and daonil. This was in contrast to the findings in group 2, where 80% of the patients used a combination of metformin and daonil and only 20% used one drug. This was probably due to the fact that a significant majority of the group 2 patients practised unhealthy lifestyle habits and hence, experienced poor glycaemic control. The mean FBS and RBS values for patients within group 2 were 177 mg/dl and 264 mg/dl, respectively. These values were significantly lower in group 1 patients who had mean RBS and FBS of 124 mg/dl and 187 mg/dl, respectively. In addition, patients in group 1 reportedly practised significantly healthier lifestyle habits. The results also show that a significant majority of the patients in group 1 was only prescribed daonil, when compared to those in group 2 who had both metformin and daonil.[13] This finding suggests that a more rigorous control of blood glucose level was required for those patients who adapted unhealthy lifestyle habits. Together, the present results correlate closely with several similar studies that have been reported in the literature.[13,15,25] The results from this study have shown that lifestyle changes and treatment with either metformin or daonil were effective in controlling blood glucose levels in diabetic patients.

Careful analysis of the present data also revealed that diseases that developed after the diagnosis of T2DM were more common among patients in group 2 compared to group 1. The present findings are consistent with those that were reported by The Centre for Health Studies of the United Kingdom Prospective Diabetes Study in 2004. This latter study investigated the depression, diabetes self-care, medication adherence and preventive care in patients with type 2 diabetes.

The results of this study also show that some of the long term complications seen in group 2 patients were closely related to their unhealthy lifestyle habits. It is well documented that T2DM patients who practised unhealthy life style habits are at more risk in developing diabetic complications.[5,6,13] Some of the complications that were reported in group 2 included coronary artery problems, hypertension, strokes, ulcerated skin, renal problems, dental caries, blurriness in vision and consistent numbness. These findings correlate closely with those reported in the literature[5,6,13] in which they attributed the development of diabetic complications to poor glycaemic control and unhealthy life style habits.

Conclusions

In conclusion, the results of this study have clearly shown that patients who adapted healthy lifestyle habits had lower mean RBS and FBS levels when compared to those who did not. These patients also had lower BMI and showed a reduce risk for the development of long term T2DM complications. In addition, T2DM patients who adapted to healthier lifestyle habits also showed a reduce dependency on medication for the management of their diabetic condition. From this study, it can be concluded that a healthy diet and regular exercise are the mainstay therapy for patients with T2DM and to achieve this, the patients must adhere to life style changes in order to enjoy a better quality of life.

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