DIABETES AND NUTRITION: FACTORS AFFECTING DIETARY CHOICES

A Research Paper

Submitted in Partial Fulfilment of the Requirements for the Degree of Doctor of Medicine in Family Medicine

of

The University of the West Indies

Dr. Sandi Ann-Marie Arthur

2016

Department of Family Medicine

Faculty of Medical Sciences

St. Augustine

ABSTRACT

Diabetes and Nutrition: Factors Affecting Dietary Choices

Dr. Sandi Arthur

Aims: To determine the patient factors affecting dietary choices in patients with type 2 diabetes mellitus attending two health centres in County St. Patrick, Trinidad. To evaluate adherence to the desired diet through their practices and to identify any differences in practices between a centre receiving usual dietary care and one receiving supplemental care from a primary care physician.

Methodology: Both centres serve communities along the southwestern coast of Trinidad and consist of individuals of both African and Indian descent. Usual dietary care, which is provided by a registered dietitian, was supplemented by group sessions given by a primary care physician in one of the health centres. A *de novo* survey, assessing knowledge, seven preferred dietary practices and barriers was formulated, pre-tested and administered to patients with type 2 diabetes attending both centres. To allow for comparison, a sample size of 288 was calculated for each centre using 75% as the prevalence of non-adherence. Data was analyzed using the Statistical Package for the Social Sciences where associations were assessed using chi-square and frequencies of factors analyzed.

Results: A total of 350 persons, two thirds of which were women, with a mean age of 62.5 years participated in the study. All seven of the preferred practices was followed by only 2 participants. ‘Eating whatever was available’, ‘fast foods being convenient’ and ‘lack of time to prepare appropriate foods’ were the

significant barriers identified. Both centres appeared to have similar rates of preferred practices throughout.

Conclusion: A very low number of individuals followed all the preferred practices and barriers to appropriate choices was variable. Intervention led by a primary care physician did not have an apparent impact on the dietary choices of individuals.

Keywords: diabetes; nutrition; factors; dietary choices; barriers

ACKNOWLEDGEMENTS

I wish to acknowledge Ms. Nialah Sookhoo, the registered dietitian who graciously gave her expert opinion without hesitation whenever it was required. Acknowledgement is also extended to the Point Fortin Borough Corporation's Public Health Department for providing information about registered food establishments. Finally, I would like to acknowledge the staff members of the Point Fortin and the La Brea Health Centres for accommodating the research process.

DEDICATION

I dedicate this work first and foremost to my heavenly Father, without whom none of this would be possible. Secondly, I dedicate it to my loving parents who have stood by me, encouraging me through thick and thin. Finally, to the rest of my "inner circle", you know who you are, thanks for being true friends!

TABLE OF CONTENTS

GLOSSARY OF TERMS

ADA	American Diabetes Association
AHA	American Heart Association
CHRC	Caribbean Health Research Council
DCCT	Diabetes Control and Complications Trial
DSMT	Diabetes Self-Management Training
HbA1c	Glycosylated haemoglobin
HOMA-IR	Homeostasis model of assessment-insulin resistance
LCMD	Low-carbohydrate Mediterranean Diet
LFD	Low fat diet
MD	Mediterranean Diet
MNT	Medical Nutrition Therapy
SPSS	Statistical Package for the Social Sciences
TMD	Traditional Mediterranean Diet
UKPDS	U. K Prospective Diabetes Study

LIST OF TABLES

FIGURES

LIST OF CHARTS

Introduction

Diabetes mellitus, one of the leading non-communicable diseases, has evolved into a global epidemic. Worldwide prevalence in 2014 was 9% of adults 18 years and older, with type 2 accounting for around 90% of cases. In 2012 diabetes was the direct cause of 1.5 million deaths and reports show that more than 80% of these deaths occur in low- and middle-income countries [1]. Regionally, it is estimated that diabetes affects more than 1 in 10 of the adult population and 1 in 5 in persons over 40 years of age [2]. Trinidad and Tobago ranks among countries with the most prevalent and fast-growing number of cases with an incidence of 1000 adults per year and a prevalence of 12% to 13% [3]. Understandably, as the prevalence of diabetes increases, so too does the economic burden it poses. In 1995, diabetes mellitus accounted for 13.6% of hospital admissions and 23% of hospital bed occupancy, with costs of admissions conservatively estimated as 10.66 million Trinidad and Tobago (TT) dollars [4]. Additionally, expenditure on anti-diabetic preparations increased from 3 million to 8.8 million TT dollars between 1993 and 2003 [5]. In 2007, the International Diabetes Federation estimated that almost 50 million US dollars was spent on diabetes care in Trinidad and Tobago, which was not inclusive of personal expenditure by individuals or households [6].

Because of the involvement of multiple organs and systems, diabetes mellitus can have a tremendous impact on an affected individual's quality of life. In a document entitled "Diabetes in the UK 2012", cardiovascular disease accounted for 52% of fatalities in people with type 2 diabetes and a 2-fold increased risk of

stroke within the first five years of diagnosis compared with the general population [7]. Similarly in Trinidad and Tobago, adults with diabetes have heart disease and stroke rates about 2 to 4 times higher than adults without diabetes and it is the leading cause of blindness [6]. In 2007, diabetes was the second most common cause of death [6]. Complications are present in half of diagnosed cases at the time of presentation, sometimes beginning 5 to 6 years prior to diagnosis [7].

The objective of diabetes mellitus management guidelines and interventions is to improve quality of care, prevent and treat acute and long-term complications and to promote education and empowerment of the patient, family, community and health care worker [2]. The American Diabetes Association states that medical nutrition therapy is important in preventing diabetes, managing existing diabetes, and preventing, or at least slowing, the rate of development of diabetes complications [8]. This is reiterated by the Caribbean Health Research Council which states that weight management, diet and physical exercise should be the first line of treatment for diabetes mellitus [2].

Diet, also referred to as medical nutrition therapy (MNT) in this paper, is one of the cornerstones of diabetes management and is of great importance as individuals are faced with the question several times each day “what shall I eat?”. Studies have shown that medical nutrition therapy can aid in achieving HbA1c goals which decreases the risk for microvascular complications. In addition, its positive impact on blood pressure and lipid levels can help reduce risk for cardiovascular disease events [9]. An individual’s food choices also have a direct effect on energy

balance and, therefore, on body weight, the loss of which, improves glycemic control and other metabolic indices like blood pressure and lipid levels [10].

Although diet or medical nutrition therapy has been incorporated into guidelines that govern the management of individuals with diabetes mellitus both internationally and regionally, many patients engage in harmful dietary practices, including frequent consumption of fast foods and heavily sweetened beverages, adding salt during cooking and eating fruits and vegetables only twice a week as revealed in a study at the Penal Health Centre in Trinidad [11]. Although this is alarming, it is in keeping with the evidence found, that many patients with chronic illnesses, including diabetes, have difficulty adhering to their recommended regimens. Poor adherence is the primary reason for suboptimal clinical benefit and it causes medical and psychosocial complications of disease, reduces patients' quality of life and wastes health care resources [12]. The results of research on adherence to prescribed dietary recommendations have been inconsistent but studies by Carvajal et al. in Cuba and Wing et al. in the United States, indicated that 70 – 75% of study participants reported not adhering to dietary recommendations in type 1 diabetes [12]. While those in India, indicate adherence in 37% of patients with type 2 diabetes [12]. If primary care providers and others involved in the care of patients with diabetes follow guidelines and actively promote lifestyle changes, like diet, and their benefits, why are so many patients non adherent to diet? What are the factors affecting dietary choices?

OBJECTIVES

- To ascertain the proportion of individuals following preferred dietary practices
- To determine factors affecting appropriate dietary choices in patients with type 2 diabetes mellitus at 2 health centres in south Trinidad
- To evaluate whether or not dietary advice given by a primary care physician had an impact on the dietary choices of participants

Literature Review

Joyce Green Pastors et al in their commentary in Diabetes Care 2002, demonstrated evidence supporting the effectiveness of MNT in diabetes management. **[Appendix I]**

The U.K. Prospective Diabetes Study (UKPDS) was a randomized controlled trial that included 30,444 newly diagnosed patients with type 2 diabetes. Both treatment and control groups received nutrition counseling from a dietitian for the first 3 months after study entry. This was the initial intervention after which they were split into intensive or conventional therapy groups. During this initial period, the mean HbA1c decreased by 1.9%, fasting plasma glucose was reduced by 46mg/dl and there were average weight losses of approximately 5kg [13].

In 1995, Franz et al published the results of another randomized, controlled trial comparing the usual nutrition care consisting of only one visit with a more intensive nutrition intervention, which included at least three visits with a

dietitian. It concluded that more intensive nutrition intervention changes in lifestyle can lead to significant improvements in glucose control, with a decrease in HbA1c of 0.9%. The average duration of type 2 diabetes for all subjects was 4 years. In the subgroup of subjects with a duration of diabetes < 1 year, the decrease in HbA1c was 1.9% [13]. This reduction in HbA1c was similar to the change seen in the newly diagnosed patients in the UKPDS trial. Within 6 weeks to 3 months, it was known if nutrition intervention had achieved target blood glucose goals, and if not, the dietitian made recommendations for changes in medications [13].

This study was significant because it was randomized, reducing selection bias and it compared intensities of nutritional intervention which meant that no participant was actually denied treatment. It also allowed for management of patient to be advanced if target blood glucose goals were not attained within 6 weeks to 3 months.

In 1996, Brown et al published a meta-analysis entitled “Promoting weight loss in type 11 diabetes”. The final sample consisted of 89 studies involving 1800 subjects, with data being extracted for outcome variables like weight and metabolic control. The results showed that diet alone had the largest statistically significant impact on weight loss (-20 lb) and metabolic control (-2.7% in glycosylated haemoglobin) [14]. All diets significantly improved fasting blood sugar. It concluded that dietary strategies were most effective for promoting short-term weight loss in type 2 diabetes but noted that a number of gaps existed in the

extant literature with regards to descriptions of subjects, interventions, or longitudinal outcomes beyond 12 months after intervention.

More recent studies investigating various dietary eating patterns, including the Mediterranean varieties, also support the use of dietary intervention in patients with type 2 diabetes mellitus. **[Appendix II]**

Ajala et al. performed a systematic review and meta-analysis of dietary approaches to the management of type 2 diabetes. Searches were conducted of PubMed, Embase and Google Scholar to August 2011 and randomized controlled trials with interventions that lasted ≥ 6 months that compared low-carbohydrate, vegetarian, vegan, low-glycemic index (GI), high fibre, Mediterranean and high protein diets with control diets including low-fat, high-GI, American Diabetes Association, European Association for the Study of Diabetes and low-protein diets [16]. A total of 20 RCTs were included and the results showed that the low-carbohydrate, low-GI, Mediterranean and high-protein diets all led to a greater improvement in glycemic control [glycated hemoglobin reductions of -0.12% ($P = 0.04$), -0.14% ($P = 0.008$), -0.47% ($P < 0.00001$) and -0.28% ($P < 0.00001$), respectively] compared with their respective control diets, with the largest effect size seen in the Mediterranean diet. Low-carbohydrate and Mediterranean diets led to greater weight loss with statistical significance ($P < 0.00001$) in the Mediterranean diet group and an increase in HDL seen in all diets except the high-protein diet [16]. They concluded that low-carbohydrate, low-GI, Mediterranean, and high-protein diets are effective in improving various markers

of cardiovascular risk in people with diabetes and should be considered in the overall strategy of diabetes management [16].

These studies showed that not any one diet was effective, although the Mediterranean diets seemed to be superior.

Dr. Bernard E. Bulwer in his book, “Your Doctor Can’t Make You Healthy”, highlights the fact that people are faced with competing challenges that influence what they eat and failure to appreciate why people choose the foods they do is itself a failure to grasp one of the most important determinants of health and disease [17]. He further elucidates that the reasons people choose the foods they do are a complex interaction of many factors and that the answer to the seemingly simple question of “What shall I eat?” depends on conscious and unconscious influences that are deeply rooted in culture, up-bringing, and socioeconomic realities [17].

In America, a survey by a consumer research group found that whereas about one quarter of the public considered nutrition to be very important and were very careful about what they eat, the rest fall almost equally into two groups that either don’t want to be bothered or that know what they ought to do but will not or cannot do it [18]. In another survey, conducted by the International Food Information Council Foundation, it found that 7 of 10 consumers said their diet needed some improvement but said they knew enough about nutrition and did not want to be told more [18]. This evidence indicates that providing our patients with information about healthy eating is not the only predictor of food choices and diet-related behaviours. Instead, food choice determinants are multifaceted,

involving biologically determined behavioural predispositions, experience with food, person-related and social/ environmental factors [18].

Personal beliefs and meanings given to certain foods have a significant impact on their use. We want our foods to be tasty, convenient, affordable, filling, familiar, or comforting and may also be motivated by how food will contribute to how we look, such as whether it will be fattening or, in contrast, good for our complexion [18].

Food availability and accessibility, cultural practices, public policy, economical resources and advertisement all play a critical role [18]. A review of studies completed in the United States suggests that neighbourhood residence who have better access to supermarkets and limited access to convenience stores tend to have healthier diets and lower levels of obesity [19]. Similarly, although less consistent, results from studies examining the accessibility of restaurants, suggest that residents with limited access to fast-food restaurants have healthier diets and lower levels of obesity [19]. Poor access to supermarkets and healthful food seem to be associated with residents of low-income, minority and rural neighbourhoods. Whereas, availability of fast-food restaurants and energy-dense food has been found to be greater in lower-income and minority neighbourhoods [19].

Todd Marcy et al performed a cross-sectional survey in a low income, urban population in an effort to identify barriers to appropriate dietary behaviour in patients with type 2 diabetes. These researchers looked at 3 main categories namely: determinants of food selection, importance of life challenges, and barriers to appropriate eating. They found that taste and cost were most important in food

selection, with stress causing over-eating or unhealthy food choices, difficulty resisting the temptation to eat unhealthy food and healthy food being too expensive are the frequently reported barriers to healthy eating [20].

S. Vijan et al. completed a two phase study, quantitative survey and qualitative focus groups, which explored the barriers to following dietary recommendations in Type 2 diabetes. Patients were recruited from the primary care population of a large academic medical centre and two Veterans Affairs Hospitals in Michigan and included patients from urban and suburban areas. The most commonly identified barrier was cost, followed by small portion sizes, support and family issues and quality of life and lifestyle issues [21]. Patients in the urban site, who were predominantly African-American, noted greater difficulties communicating with their provider about diet and social circumstances, and also that the rigid schedule of a diabetes diet was problematic [21]. It concluded that barriers to adherence to dietary therapies are numerous, but some, such as cost and in the urban setting, communication with providers, are potentially remedial. Interventions aimed at improving patients' ability to modify their diet need to specifically address these areas. Furthermore, treatment guidelines need to consider patients' preferences and barriers when setting goals for treatment [21].

Measuring Adherence to Diet

There is no "gold standard" for measuring adherence behaviour and the use of a variety of strategies has been reported in the literature [12]. One measurement approach is to ask providers and patients for their subjective ratings of adherence behaviour. Other subjective means for measuring adherence include standardized,

patient administered questionnaires. Questionnaires that assess specific behaviours that relate to specific medical recommendations (e.g. food frequency questionnaires for measuring eating behaviour and improving the management of obesity) may be better predictors of adherence behaviour [12].

Although objective strategies may initially appear to be an improvement over subjective approaches, each has drawbacks in the assessment of adherence behaviours. Remaining dosage units (e.g. tablets) can be counted at clinic visits; however, counting inaccuracies are common and typically result in overestimation of adherence behaviour and important information (e.g. timing of dosage and patterns of missed dosages) is not captured using this strategy [12]. Pharmacy database can be used to check when prescriptions are initially filled, refilled over time and prematurely discontinued. One problem with this approach is that obtaining the medicine does not ensure its use. A multi-method approach that combines feasible self-reporting and reasonable objective measures is the current state-of-the-art in measurement of adherence behaviour [12].

The glycosylated haemoglobin level (HbA1c), which is a marker used to assess long-term glycaemic control, is an objective measure that can be used to assess adherence in individuals with diabetes mellitus [26]. Various factors affect HbA1c levels including ones diet, exercise and use of hypoglycaemic agents [26]. Additionally, any condition that shortens erythrocyte survival or decreases mean erythrocyte age will falsely lower HbA1c test results regardless of the assay method used. Therefore, haemoglobinopathies like HbSS and HbSC adversely impact HbA1c as a marker of long-term glycaemic control. Iron deficiency

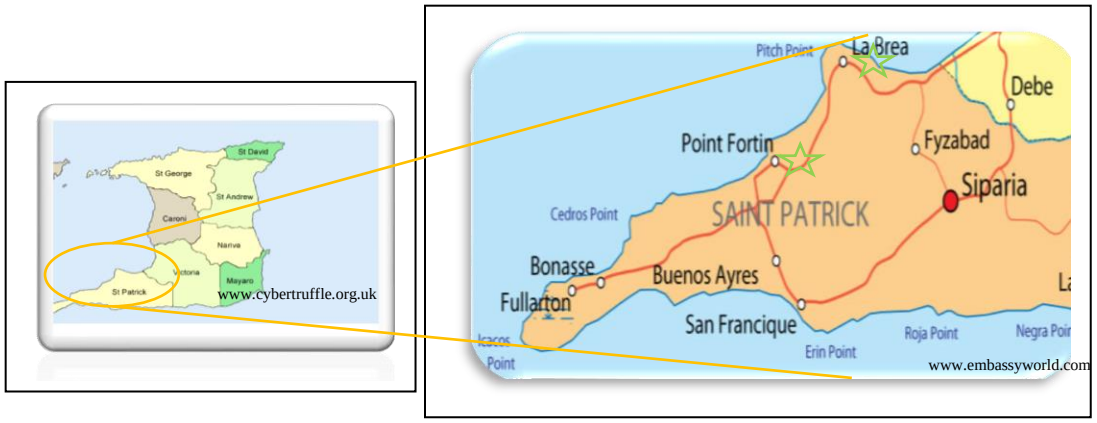
anaemia, a major public health problem in developing countries, is associated with higher HbA1c levels. This has been attributed to malondialdehyde, which is increased in patients with iron deficiency anaemia and enhances the glycation of haemoglobin. Chronic renal failure develops in many patients with diabetes. The role of glycaemic control and the value of HbA1c in renal disease are controversial. Recent reports suggest HbA1c underestimates glycaemic control of patients with diabetes on dialysis and that glycated albumin is a more robust indicator of glycaemic control [26].

Methodology

Setting

The provision of health care in Trinidad and Tobago is sub-divided amongst five Regional Health Authorities according to geographic location: South-West, North-Central, North-West, Eastern and Tobago. Each authority is further sub-divided into Counties. The County Medical Office of Health in St. Patrick falls under the jurisdiction of the South-West Regional Health Authority and has two divisions, east and west. The Point Fortin Health Centre and the La Brea Health Centre are both located in the western division of the County St. Patrick and will be the centres of focus in this study.

Diagram 1. Maps of Trinidad Highlighting Areas of Interest to Research



Point Fortin holds a costal location in the north-central portion of the South-West region of Trinidad, occupying a total area of approximately 23.88 square kilometres [22]. It has a total population of 20235 which is 1.5% of the country's population [23]. In the beginning of the twentieth century, three distinct and separately owned cocoa and coconut estates stretched half way across the area now known as Point Fortin [24]. These estates provided employment for a limited number of persons who dwelt in plantation style barracks rooms provided by the estate. As there was no shop and no village near enough for them to go to buy their foodstuff, the labourers depended upon the estates for supplies of groceries and other items [24].

In 1907, the Trinidad Oilfields Limited moved to Point Fortin in quest for oil and bought one of the estates and leased the mineral rights in the two neighbouring estates. Development of the village has in great measure followed the extension of the Company's operations with the striking change from agriculture to industry

[24]. There was a fast increase in the population and significant infrastructural changes like the development of access roads, schools and commercial business. Today, this once small agricultural village is a thriving borough with major industrial undertakings which involve the production of liquefied natural gas for export by Atlantic LNG and the offshore drilling activities by Petrotrin through its subsidiary Trinmar, commercial businesses as well as tourism, contributing to key economic activities [22].

This modernization era has been accompanied by an increase in consumption of fast foods with 36 registered food establishments apart from known franchises like KFC and Church's Chicken, the majority selling foods like roti, barbeque, Chinese food or bakery treats. **[Appendix III]**. Food is generally affordable and easily accessed.

As in Point Fortin, much of the early development of the La Brea district is linked firstly to the development of agriculture and then the development of the oil industry in Trinidad. During the 18th century, there were many sugar plantations followed by coffee and cocoa estates later on [25]. Similarly, as the oil industry grew, there were infrastructural developments in the area and many of the villages that were developed within the La Brea district seem to be closely associated with the companies in the area at the time [25].

The main providers of dietary health in this county are dietitians and dietetic technicians who are trained at the technical level of nutrition and dietetics practice for the delivery of safe, culturally competent, quality food and nutrition services. Their services are divided amongst the 14 health centres in the county on a

rotational basis. Unfortunately, dietary service is inconsistent across the county with staffing shortages and redirection of staff to service the hospitals as the main reasons proposed for the inefficiency of a much needed service. Individuals may also receive advice from other primary care providers but this is usually unstructured and not continuous. For the purpose of this study, this service will be considered as usual care for the dietary health in centres across County St. Patrick.

Prior to the commencement of this study, patients with type 2 diabetes mellitus attending the chronic disease clinic at the Point Fortin Health Centre, received consistent dietary advice for at least two years. This service was provided by a primary care physician and involved interactive group sessions at the beginning and midway through the allotted clinic time each week. Information was given on diabetes, the impact of diet on diabetes care, the nutrients received from different food groups, the timing of meals and the recommended daily servings of different food groups. A "plate model" **[Appendix IV]**, which was reviewed and sanctioned by a registered dietitian, was devised to provide a visual of how food should be served at meal times. Individuals were given the opportunity to ask questions so that concerns and misunderstandings could be addressed. These on-going group sessions were unique to Point Fortin Health Centre and for the purpose of this study was considered as supplemental care and it will be compared to La Brea Health Centre an example of a centre receiving usual care.

Individuals Attending the Health Centres

The structure at both of the centres are similar and attendees range from neonates to the geriatric population, inclusive of antenatal individuals. The catchment areas of the centres are comprised mainly of individuals of African, Indian or mixed descent, with those of African and Indian descent accounting for the majority of patients in similar proportions. Many household incomes are dependent on the industrial and construction industries although some have maintained agriculture which was the traditional source of income. All patients with a diagnosis of a chronic illness are placed in the chronic disease clinic and are reviewed every 3 to 4 months.

Inclusion and Exclusion Criteria

Inclusion criteria consisted of those individuals 18 years and over who would have attended clinic on 3 or more occasions in the 12 months prior to administration of the survey. This time frame allowed for individuals to have attended clinic and to have received advice on several aspects of diabetes care, including diet. Potential participants who had dementia were excluded as they would not have been able to give accurate information. Also excluded, were those who refused to give consent and those who received regular dietary advice independently from that provided at the clinic. Participants were recruited over a 4 month period from the Chronic Disease Clinics of both health centres.

Sampling

The study participants were recruited by convenient consecutive sampling. Individuals with type 2 diabetes mellitus attending the chronic disease clinics were identified as they arrived to clinic in a sequential order. They were informed of the study and if they gave consent, the survey was administered. This method facilitated the ease of collection of data over a short period of time. The sample frame included all individuals with type 2 diabetes mellitus attending the chronic disease clinic at both health centres. A sample size (288) was calculated for each centre using: $n = Z^2 P(1-P)/d^2$, where Z is a 95% confidence interval (1.96), P is the prevalence of non-adherent individuals (75%) and D is precision (5%).

Instrument Design and Testing

A de novo survey was formulated after reviewing the literature and a survey used in another study, namely, *Identification of Barriers to Appropriate Dietary Behavior in Low-Income Patients with Type 2 Diabetes Mellitus* by Marcy et al. [19] It was administered to a cross-section of patients with type 2 diabetes mellitus at each centre, with those at Point Fortin labelled as the supplemental care group and those at La Brea the usual care group. It included several categories which sought to address the various factors noted in previous studies and populations that impacted on food choices. It also allowed the researcher to determine what could be the greatest challenge to eating healthy, the centre of loci of individuals and their readiness for change of behaviour, if a need to change was identified.

The first section delved into the demographics and socioeconomic status of individuals, followed by a section which attempted to ascertain their knowledge of and attitudes towards diabetes. This section looked specifically at their understanding of what diabetes was and their view on management and benefits associated with management using dietary measures. The penultimate section looked at their actual eating practices which sought to assess the regularity of meals, the frequency of use of fast foods and sweetened drinks, as well as the use of salt, high fiber foods, fruit and vegetables. The final section covered barriers or factors affecting food choices as well as behavioural change.

A registered dietitian's expertise was also recruited to review the survey and she indicated that it covered the topic adequately. A pilot survey **[Appendix V]** was administered to 6 individuals who attended the Point Fortin centre and changes that aided in the comprehension of the survey were made based on the patients' reported experience. Example, "adhere to" was replaced with "stick to". The completed survey instrument can be found in **[Appendix VI]**. Research assistants were trained at both centres and the questionnaire was administered to each participant by an assistant. This ensured that even individuals with literacy problems were included, limiting selection bias, as well as provide extra information to aid in understanding items on the questionnaire.

Analysis of the information collected, was done using the Statistical Package for the Social Sciences (SPSS). Using the items in the "practices" section of the questionnaire, participants were identified as displaying the preferred dietary practice if they:

- Had regularly timed, appropriate meals and snacks most days or every day
- Skipped meals infrequently
- Used sweetened beverages infrequently
- Ate fast foods infrequently
- Did not add salt when cooking
- Included high fiber foods in diet
- Consumed 3-5 servings of fruits and vegetables most days

It was either they had the preferred practice or not. The data was then transformed so that participants could be grouped as having 3 or less of the preferred practices, 4 preferred practices, 5 preferred practices, 6 preferred practices or all 7 of the preferred practices. Chi-square was used to analyze associations and binary logistic regression was used to determine which factors were predictors of preferred practices if necessary. Other tests like comparison of means and correlation were done when required.

Ethical Considerations

Permission and ethical clearance to carry out this research was obtained prior to data collection from both the Ethics Committee of the Medical Sciences Faculty of The University of the West Indies, St. Augustine and the Ethics Committee of The South-West Regional Health Authority. In keeping with standards for medical research, informed consent was obtained from each individual participating in this study. There was no coercion and each participant was ensured that no penalty would be incurred for refusal to participate. These

measures protected their autonomy. Anonymity was maintained by omitting identifying information like name and place of residence from the actual survey form. At the end of each clinic session, surveys were collected and kept under lock and key. In addition, information was only shared with the principal investigator and co-investigator and the research assistants who administered the survey were coached not to divulge any information. The above actions ensured that a high level of confidentiality was upheld.

Results

The questionnaire was offered to a total of 471 patients, with a total of 355 completing it. Of the completed surveys, 5 were discarded during the analysis process as they had incomplete responses. Therefore, a total of 350 surveys were analyzed inclusive of both centres.

Table 1. Distribution of Surveys and the Response rate at the Centres

Centre	Survey Offered	Survey Completed	Response Rate	*Defaulted Clinic	!Survey Opportunity	Default Rate
La Brea	186	145	78.0%	85	271	31.4%
Point Fortin	285	210	73.7%	74	359	20.6%
Total	471	355	75.4%	159	630	25.2%

*Individuals who did not keep their scheduled clinic appointment

! Total possible number of individuals with type 2 diabetes mellitus that should have attended clinic during the study period

The sample was predominantly of East Indian and of African descent. Women comprised approximately two thirds of the sample and men the other third of participants, with a mean age of 62.5 years. HbA1c values were obtained for 148 (42.3%) of the participants and the mean 8.3%.

Table 2. Patient Demographics

DEMOGRAPHICS	Total	Point Fortin	La Brea
Ethnicity, N (%) African East Indian Mixed	 157 (44.9) 158 (45.1) 35 (10.0)	 117 (56.0) 68 (32.5) 24 (11.5)	 40 (28.4) 90 (63.8) 11 (7.8)
Gender, N (%) Male Female	 120 (34.3) 230 (65.7)	 64 (30.6) 145 (69.4)	 56 (39.7) 85 (60.3)
Mean Age, years (standard deviation)	62.5 (11.6)	63.4	61.2
Mean Haemoglobin A1c, % (standard deviation)	8.3 (5.4)	8.5	7.9
Education, N (%) Primary Secondary Tertiary	 222 (63.4) 96 (27.4) 20 (5.7)	 128 (61.2) 59 (28.2) 14 (6.7)	 94 (66.7) 37 (26.2) 6 (4.3)

Other	12 (3.4)	8 (3.8)	4 (2.8)

There were similarities in demographics at both centres.

The knowledge of participants about the benefits of diet in the management of diabetes mellitus was generally high at both of the centres. This is shown in the table below.

Table 3. Comparison of Knowledge of Diet and its Benefits at both Centres

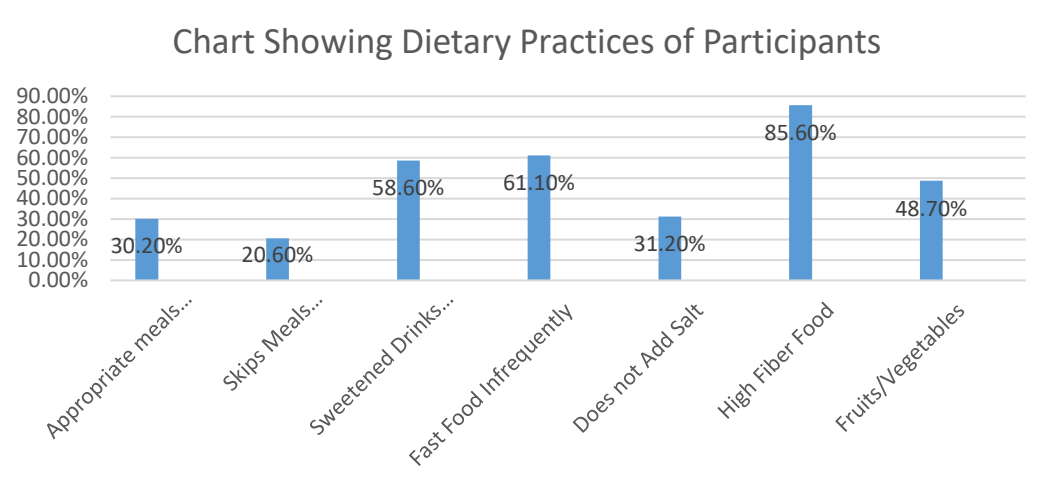
Knowledge about Diet	Point Fortin N (%)	La Brea N (%)
Diet is very important	197 (94.7)	134 (95.7)
Use of less medications	183 (87.6)	123 (87.2)
Leads to weight loss	184 (88.0)	125 (88.7)
Avoids hypoglycemia	175 (83.7)	104 (73.8)
Avoids hyperglycemia	178 (85.2)	104 (73.8)
Affects Htn/Choles	174 (83.3)	78 (55.3)

Results of Preferred Dietary Practices

The dietary practices of the sample was assessed by using the preferred practice facts as described in the methodology. The results showed that 30.2% of individuals had the suggested number of meals and snacks per day, 20.6% skipped meals infrequently, 58.6% used sweetened beverages infrequently, 61.1% had infrequent intake of fast food, 31.2% did not add salt when cooking, 85.6%

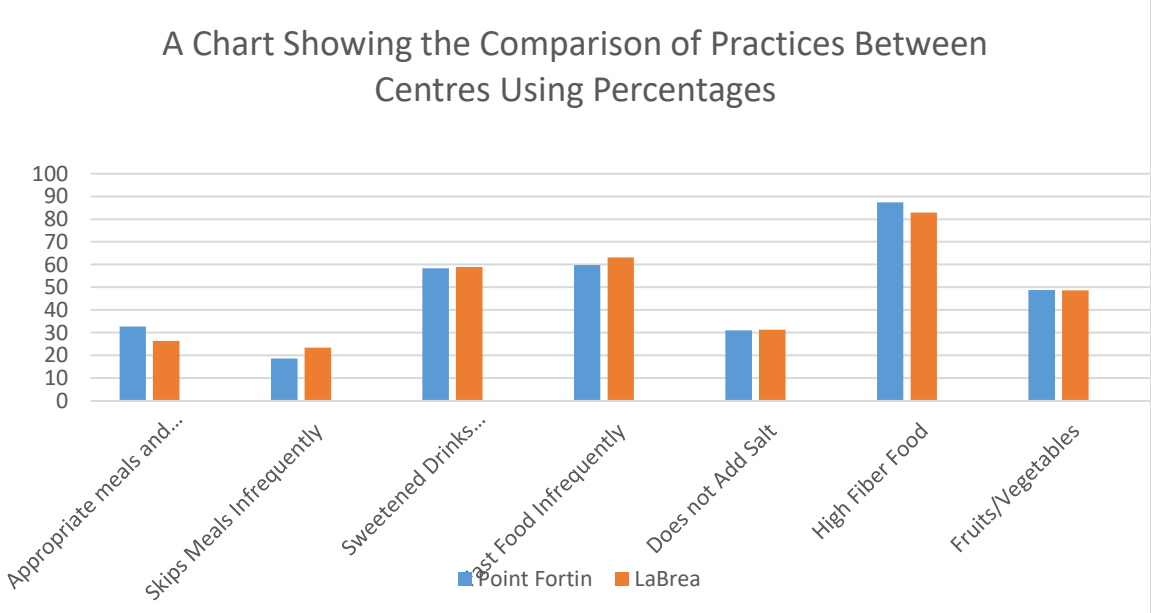
included high fiber foods in their diet and 48.7% used 3-5 servings of fruits and vegetables at least five days each week.

Chart 1. Percentage of Participants with the Preferred Dietary Practices



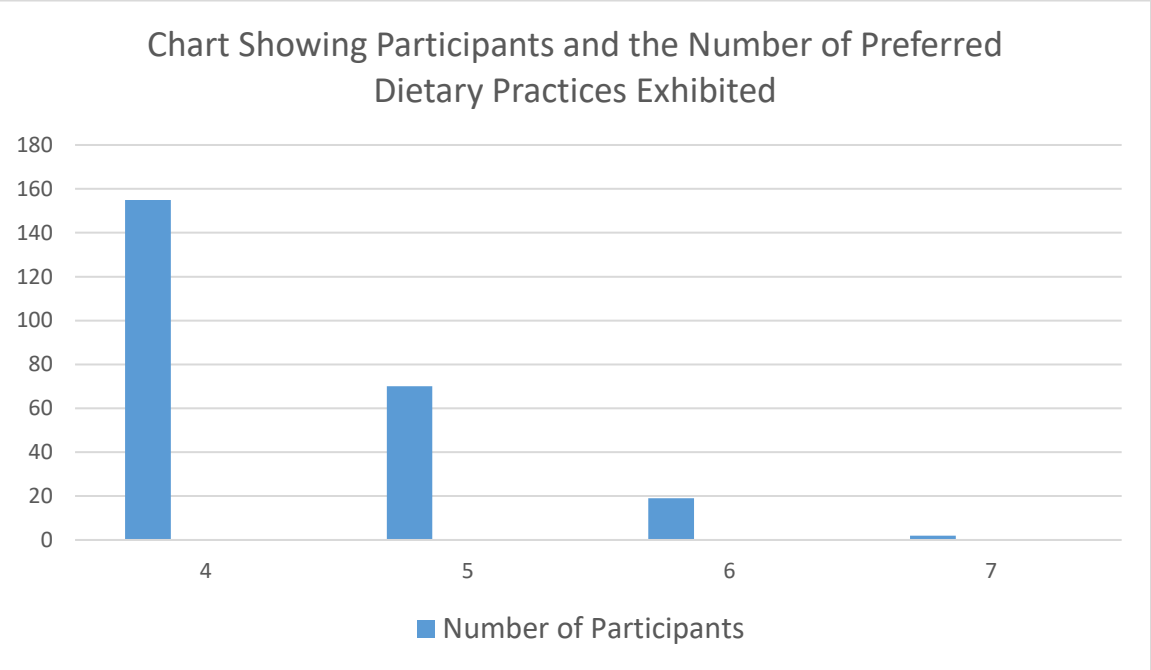
The percentage of patients with the preferred dietary practices were similar for both health centres.

Chart 2. Percentage of Preferred Practices at Both Health Centres



Dietary practices were further assessed to determine what percentage of participants exhibited either 4, 5, 6 or all 7 of the preferred practices itemized in the questionnaire. These values were chosen as they represented an individual practicing a majority of the preferred practices.

Chart 3. Participants and the Number of Preferred Practices



The results indicated that 46.4% had at least 4, 21% practiced at least 5, 5.7% practiced at least 6 and 0.6% practiced all 7 of the preferred dietary choices. There was no association found with gender, ethnicity, marital status, education or the amount of money spent on food when analyzed against the above number of preferred practices.

Table 4. The Relationship between Gender and the Number of Preferred Practices

Number of Preferred Practices (N)	Male (total males = 113)	Female (total females = 221)	*P Value
4 (155)	54 (47.8%)	101 (45.7%)	0.729
5 (70)	24 (21.2%)	46 (20.8%)	0.928
6 (19)	6 (5.3%)	13 (5.9%)	0.816
7 (2)	0 (0%)	2 (0.9%)	0.310

*Chi-square

Table 5. The Relationship between Ethnicity and the Number of Preferred Practices

Number of Preferred Practices (N)	African (total = 150)	Indian (total = 149)	Mixed (total = 35)	*P Value
4 (155)	72 (48.0%)	66 (44.3%)	17 (48.6%)	0.784
5 (70)	31 (20.7%)	30 (20.1%)	9 (25.7%)	0.761
6 (19)	10 (6.7%)	9 (6.0%)	0 (0%)	0.307
7 (2)	1 (0.7%)	0 (0%)	1 (2.9%)	0.142

*Chi-square

Table 6. The Relationship between Marital Status and the Number of Preferred Practices

Number of Preferred Practices (N)	Single (total = 95)	Married/Common Law (total = 176)	Other (total = 63)	*P Value
4 (155)	39 (41.1%)	89 (50.6%)	27 (42.9%)	0.267
5 (70)	20 (21.1%)	39 (22.2%)	11 (17.5%)	0.734
6 (19)	7 (7.4%)	9 (5.1%)	3 (4.8%)	0.713
7 (2)	0 (0%)	1 (0.6%)	1 (1.6%)	0.447

*Chi-square

Table 7. The Relationship between Education and the Number of Preferred Practices

Number of Preferred Practices (N)	Primary (total = 211)	Secondary (total = 92)	Tertiary (total = 20)	Other (total = 11)	*P Value
4 (155)	94 (44.5%)	42 (45.7%)	13 (65.0%)	6 (54.5%)	0.336
5 (70)	39 (18.5%)	23 (25.0%)	5 (25.0%)	3 (27.3%)	0.542
6 (19)	8 (3.8%)	8 (8.7%)	2 (10.5%)	1 (9.1%)	0.287
7 (2)	1 (0.5%)	0 (0%)	1 (5%)	0 (0%)	0.282

*Chi-square

Table 8. The Relationship between Money Spent on Food and the Number of Preferred Practices

Number of Preferred Practices (N)	<$500 (total = 20)	$500-$1000 (total = 102)	$1000-$2000 (total = 123)	>$2000 (total = 84)	*P Value
4 (152)	13 (65.0%)	43 (42.2%)	57 (46.3%)	39 (46.4%)	0.318
5 (70)	3 (15.0%)	19 (18.6%)	30 (24.4%)	18 (21.4%)	0.657
6 (19)	1 (5.0%)	2 (2.0%)	12 (9.8%)	4 (4.8%)	0.082
7 (2)	0 (0%)	1 (1.0%)	0 (0%)	1 (1.2%)	0.511

*Chi-square

Of the 42.3% of participants with an available HbA1c, 50.7% of them had an ideal HbA1c, which for the purpose of this research was a value of 7 or less. Chi-square testing was performed to analyze any associations between having a preferred practice and an ideal HbA1c.

Table 9. A Comparison between each Preferred Practice and an Ideal HbA1c

Preferred Practice (N)	Ideal HbA1c (total = 75)	Non-ideal HbA1c (total = 73)	*P Value
Appropriate Meals and Snacks (49)	25 (33.3%)	24 (32.9%)	0.953
Skips Meals Infrequently (28)	14 (18.7%)	14 (19.2%)	0.937
Sweetened Beverages Infrequently (91)	52 (69.3%)	39 (53.4%)	0.047
Fast Foods Infrequently (88)	50 (66.7%)	38 (52.1%)	0.070
Does not Add Salt (43)	19 (25.3%)	24 (32.9%)	0.312
Use High Fiber Foods (125)	63 (84.0%)	62 (86.1%)	0.720
Fruits/Vegetables (68)	33 (44.0%)	35 (47.9%)	0.630

*Chi-square

Table 10. Association between Ideal HbA1c and the Number of Preferred Practices Exhibited

Number of Preferred Practices (N)	Ideal HbA1c (total = 75)	Non-ideal HbA1c (total = 70)	*P Value
4 (65)	37 (49.3%)	28 (40.0%)	0.259
5 (31)	17 (22.7%)	14 (20.0%)	0.696
6 (9)	2 (2.7%)	7 (10.0%)	0.061
7 (2)	-	-	

*Chi-square; (Nil HbA1c values available for individuals with 7 practices)

The above table shows the results of an analysis done to determine any association between exhibiting a greater number of preferred practices and having an ideal HbA1c. There was no association found for any of them. Of note, neither of the 2 participants who were practicing all of the preferred practices had a documented HbA1c.

Patients were asked whether or not they thought they had a good diet to assess their individual perception to their diet. A majority of 71.9% responded in the affirmative. Chi-square analysis was done to evaluate for any significant association with their perception of having a good diet and having a majority of the preferred practices.

Chart 4. Depiction of Patients who Perceived that Their Diet was Good

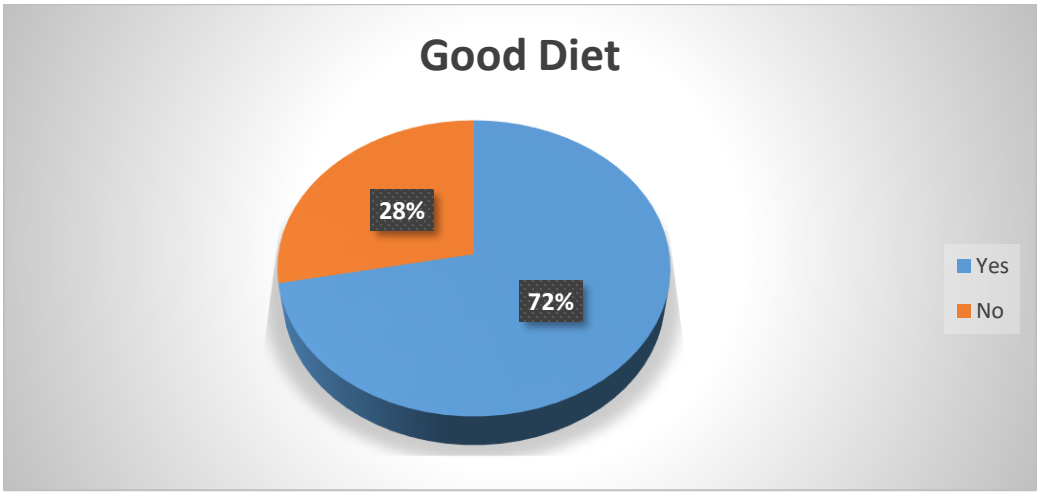


Table 11. Association of Perception of Good Diet and Having a Majority of Preferred Practices

Preferred Practice (N)	Good Diet (total = 239)	Not a Good Diet (total = 90)	*P Value
4 (152)	129 (54.0%)	23 (25.6%)	<0.0005
5 (70)	61 (25.5%)	9 (10.0%)	0.002
6 (19)	17 (7.2%)	2 (2.2%)	0.087
7 (2)	2 (0.8%)	0 (0.0%)	0.384

A positive association was identified between patient perception of a good diet and those having 4 or 5 of the preferred practices but none was noted for those with 6 or 7 of the preferred practices.

Participants were also asked whether or not they had control over their food choices as a means of assessing their locus of control. Chi-square analysis was applied to look for associations between the indication of having control over choices and having a majority of preferred practices.

Chart 5. Participants Indicating Having Control over Their Food Choices

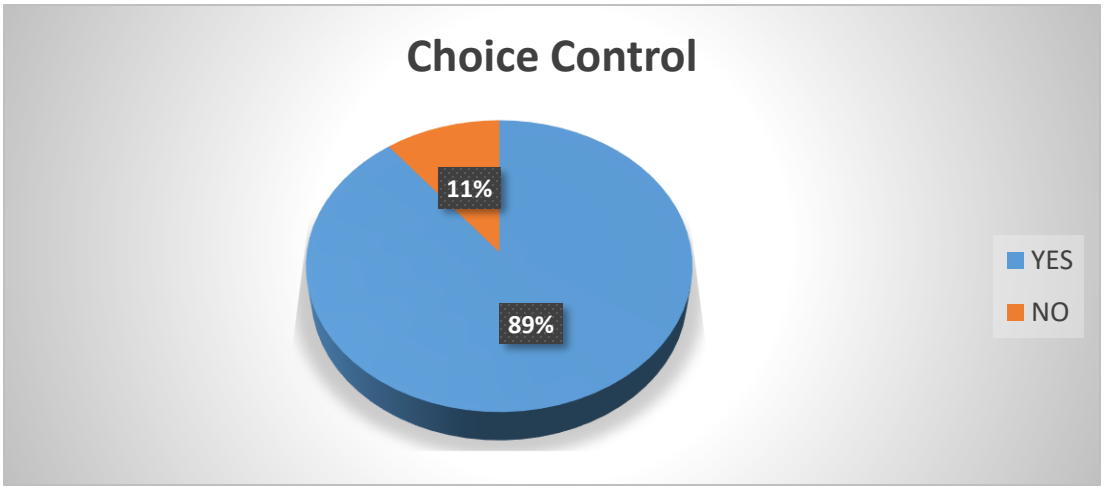


Table 12. Association between Having Choice Control and a Majority of Preferred Practices

Preferred Practice (N)	Choice Control (total = 299)	No Choice Control (total = 35)	*P Value
4 (155)	144 (48.2%)	11 (31.4%)	0.015
5 (70)	66 (22.1%)	4 (11.4%)	0.076
6 (19)	17 (5.7%)	2 (5.7%)	0.981
7 (2)	2 (0.7%)	0 (0.0%)	0.671

*Chi-square

Most patients (89.4%) indicated that they had control over their food choices but a significant association was only found for those with 4 of the preferred practices. Reasons listed for not having choice control included, finances (2%), difficulty resisting unhealthy foods (3.7%), availability (1.1%), time (0.6%) and being dependent on family (3.1%).

Participants were presented with a list of barriers to having an appropriate diet and asked to identify which ones pertained to them. They were also given an opportunity to state what they thought was their greatest obstacle to eating healthy. They results are shown in the following tables.

Results of Barriers to Appropriate Dietary Choices

Chart 6. Participants' Responses to Provided List of Barriers

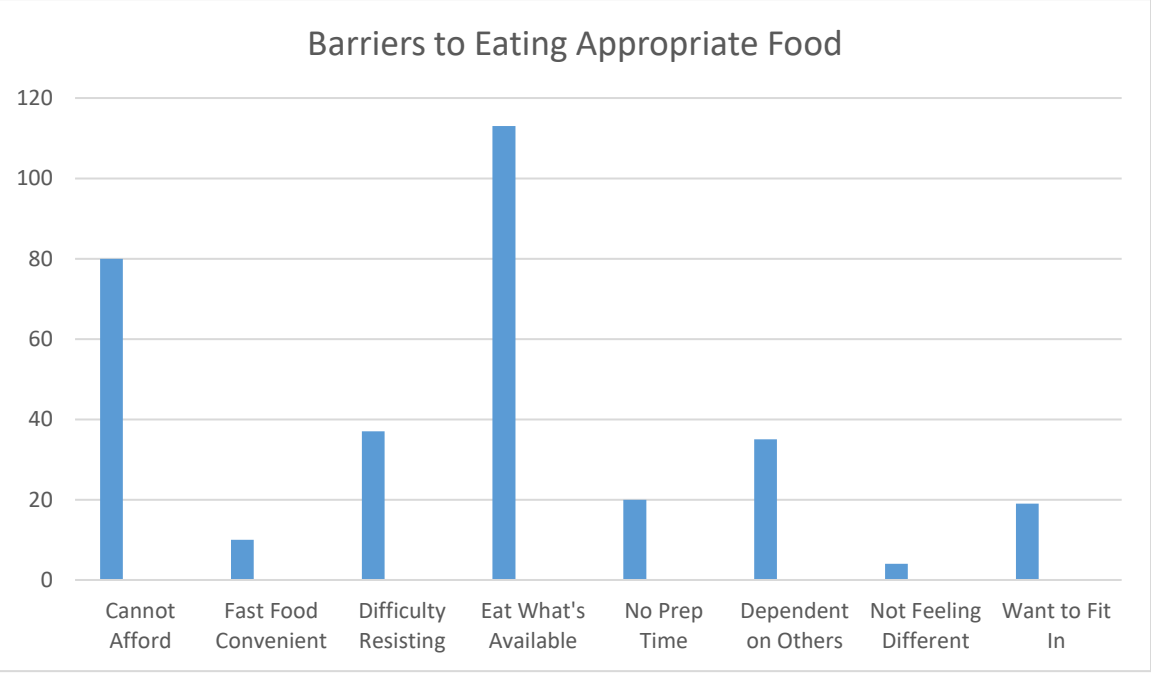
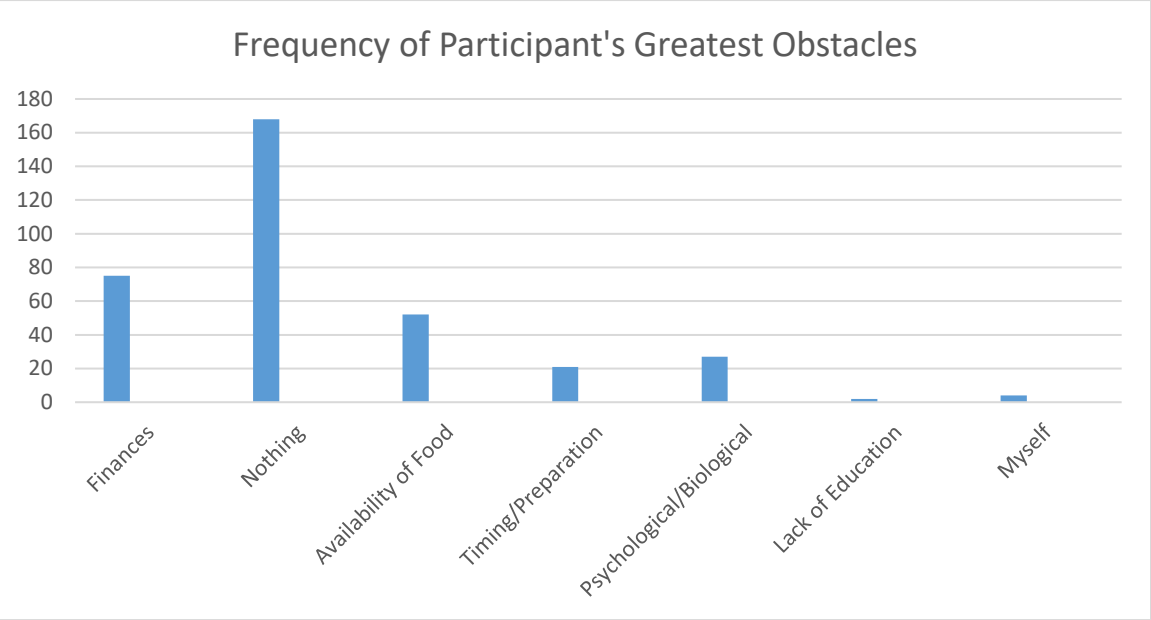


Chart 7. Greatest Obstacles Perceived by Participants



For individuals who had 3 or less of the preferred practices (minority of preferred practices), which represented 53.6% of the sample population, chi-square testing was performed to look for any associations with given barriers.

Table 13. Association between Barriers and having a Minority of preferred Practices

Barrier (N)	Majority of Preferred Practices (total = 155)	Minority of Preferred Practices (total 179)	*P Value
Cannot Afford (75)	31 (20.0%)	44 (24.6%)	0.317
Fast Food Convenient (9)	0 (0.0%)	9 (5.0%)	0.001
Difficulty Resisting Unhealthy Foods (37)	13 (8.4%)	24 (13.4%)	0.145
Eat What's Available (104)	29 (18.7%)	75 (41.9%)	0.000

No Time to Prepare (20)	3 (1.9%)	17 (9.5%)	0.004
Dependent on Others (34)	16 (10.3%)	18 (10.1%)	0.936
Does Not Want to Feel Different (3)	1 (0.6%)	2 (1.1%)	0.644
Wants to Fit In (19)	9 (5.8%)	10 (5.6%)	0.931

*Chi-square

There was a strong significant association with fast foods being convenient, eating whatever is available and having no time to prepare meals.

The perception of the occurrence of stress was assessed and its association to having a minority of preferred dietary practices analyzed. 14% of individuals felt stressed often, 47% admitted to feeling stressed sometimes and 39% were seldom stressed. There was no association to the number of preferred practices for those who responded.

Chart 8. Occurrence of Stress

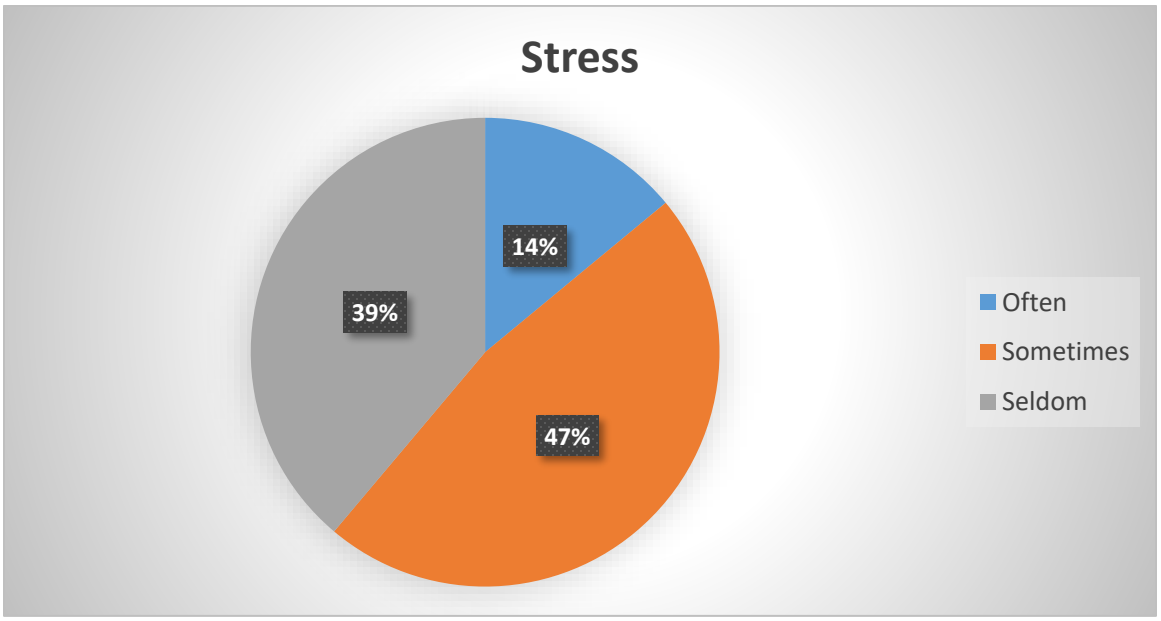


Table 14. Association between Stress and Preferred Practices

Preferred Practices (N)	Often Stressed (total = 45)	Sometimes (total = 156)	Seldom (total = 133)	*P Value
Majority (155)	20 (44.4)	69 (44.2%)	66 (49.6%)	0.406
Minority (179)	25 (55.6%)	87 (55.8%)	67 (50.4%)	0.406

A similar assessment was also done for use of comfort foods.

Chart 9. To Show the Use of Comfort Foods

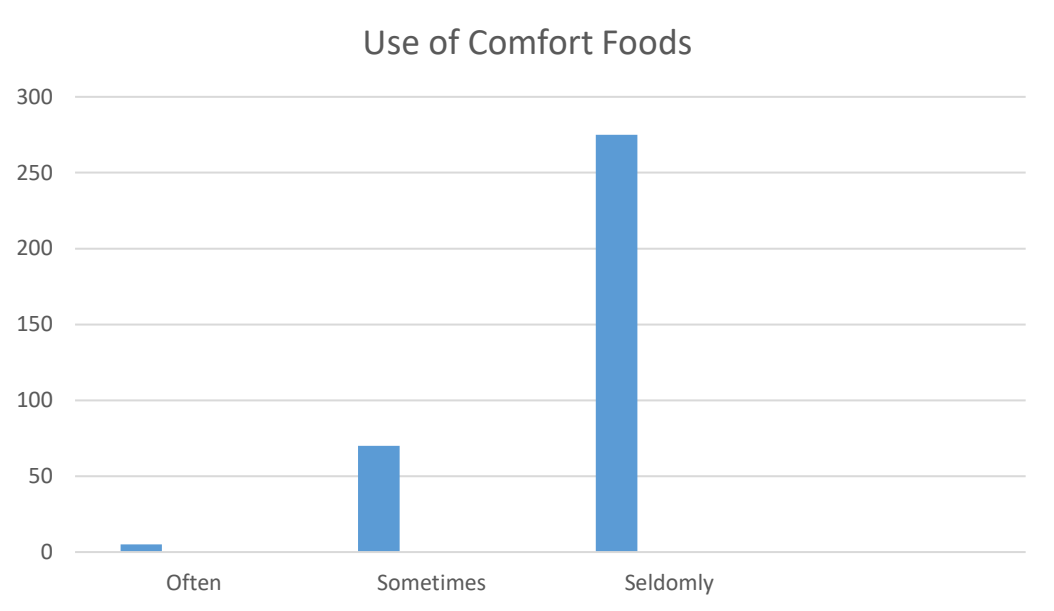


Table 15. Association with Comfort Foods and Having a Minority of Preferred Practices

Preferred Practices (N)	Often (total = 4)	Sometimes (total = 67)	Seldom (total = 263)	*P Value
Minority (179)	1 (25.0%)	47 (70.1%)	131 (49.8%)	0.030

There was a significant association with seldom use of comfort foods and practicing a minority of preferred practices.

Cronbach's alpha

- Barriers to eating healthy scale consisted of 8 items (alpha = 0.268)
- Preferred practices checklist consisted of 7 items (alpha = 0.127)

Finally, for those patients who did not think that they had a good diet, their willingness to change was assessed. Of the 97 patients who said that they did not have a good diet, 90 (92.8%) said that they needed to change their diet, 64 indicated that they intended to make a change within the next 6 months (contemplation stage of the transtheoretical model for behaviour change), 67 had thought about how they would make changes (preparation stage of the transtheoretical model of behaviour change) and 66 had already started making small changes (action stage of model). Overall, all of the patients who indicated they needed to change their diet believed that changes would lead to a healthier life.

Discussion

Diabetes mellitus has been placed in a pivotal position worldwide especially with the release of the World Health Organization's "Global Report on Diabetes" on April 6, 2016 and their slogan for World Health Day "Halt the rise: Beat Diabetes". Emphasis was placed on lifestyle factors, including diet, and

governments were encouraged to prioritize their actions to prevent obesity, promote breast feeding and consumption of healthy food, whilst discouraging consumption of sugar soda [26].

The timing of this research was therefore opportune. The results highlighted that adherence levels was suboptimal with only 2 participants practicing all seven of the preferred practices highlighted in the study. This result was conflicting as there was a high level of knowledge about dietary benefits noted at both health centres and not many participants indicated a lack of education as their greatest obstacle to eating healthy. When the preferred practices were analyzed individually, only 3 out of 7 were being practiced by more than 50% of participants, suggesting that having a good knowledge base was not a major factor affecting dietary choices and this is supported by the literature which states that providing information for patients is not the only predictor of food choices and diet related behaviours [18]. Although a comparison of preferred practices between the two centres was not done statistically, as sample sizes at each centre were dissimilar, a bar graph plotted, showed that the dietary practices at both centres were very similar for all of them. These results imply that intervention by a primary care physician did not have an impact on dietary decisions in this setting. This may be an indication that large group sessions, interspersed throughout the year are not effective in influencing behavioural change in making appropriate food choices. It may also mean that participants at the usual care centre were exposed to supplemental care that the researcher was not aware of. In studies reviewed, dietary intervention was usually individualized, led by a

registered dietitian and done more frequently over a shorter period of time. Franz et al. compared usual nutrition care consisting of only one visit with a more intensive nutrition intervention, which included at least three visits with a dietitian. The results concluded that with more intensive nutrition intervention, changes in lifestyle can lead to significant improvements in glucose control [13]. Analysis concluded that there was a significant relationship between an individual's perception of having a good diet and actually having the preferred dietary choices when the exhibited at least 4 or 5 of them ($p<0.0005$ and $p= 0.002$ respectively). This is important as it indicates that individuals do have some capability of self-evaluation. Evaluating the HbA1c level in individuals with diabetes is the gold standard for assessing blood glucose control. The ideal HBA1c level for this research was achieved by 50.7% of those participants with available values and there was no significant association with having a majority of preferred practices. There was also no significant relationship found between an ideal HbA1c and each of the preferred practices except for infrequent use of sweetened beverages ($p=0.047$). The overall significance of these results are unclear as less than half of the sample had available HbA1c values. Factors that could affect HbA1c levels like exercise, haemoglobinopathies and chronic kidney disease were not controlled for in this study, also limiting the significance of its value.

Gender, ethnicity, marital status, level of education or the amount of money spent on food did not have significant associations with those individuals who had at least 4 or more of the preferred practices. This is unlike some studies where poor

access to healthful food seem to be associated with residents of low-income neighbourhoods.

Significant barriers to healthy eating were identified as fast food being convenient, eating whatever is available and lack of preparation time for participants with 3 or less of the preferred practices. These barriers are unlike those noted in other studies assessing barriers. S. Vijan et al. found that expense, portion size and support from family or other family issues were the top three barriers identified[21]. Similarly, Todd Marcy cited cost of food as a major barrier which was preceded by stress causing over-eating and unhealthy food choices and difficulty resisting temptation to eat unhealthy food[20]. In this study there was no significant relationship found with stress, finances or comfort foods and preferred practices.

Eighty-nine point four percent (89.4%) of participants indicated that they had control over their food choices which suggest a strong internal locus of control for the sample.

Cronbach's alpha for barriers to eating healthy was 0.268 which indicates a low level of internal consistency between barriers. More comprehensive solutions may have been provided by including several focus group interviews which, if executed well, could result in more in-depth discussion about the above issues and non-verbal behavioural cues could also be assessed.

Cronbach's alpha was also used to measure the internal consistency of the practices used to assess for preferred practice. Cronbach's alpha was 0.127 which

indicated a low level of internal consistency for the parameters used to assess practice. The low level of internal consistency for practice parameters likely had a negative impact on how practices were assessed and by extension, the calculation of adherence. Having the de novo survey reviewed by a registered dietitian and undertaking pre-testing of the survey were done in an effort to ensure that the survey was relevant, yet, easily understood by the average patient. After the pilot of the survey, minimal changes were made which did not result in any real changes to the items used to assess practice or barriers. For example, “stick to” was used instead of “adhere to”. Having the open question “what do you consider your greatest obstacle to eating healthy?” was inserted to give participants the opportunity to state their own opinions. Cronbach’s alpha was not calculated after piloting the survey, otherwise changes could have been made to improve the internal consistency of practices and barriers.

Finally, willingness to change one’s behaviour was evaluated. Of the 97 patients who noted that they did not have a good diet, almost all wanted to change their diet and thought it would lead to a healthier life. Whether they were pre-contemplation, contemplation or preparation, at least two thirds of the 97 were incorporated at the different stages of change mentioned above. Getting patients to change behaviour and maintain the change is known to be challenging but different techniques can be employed to foster behaviour change including family, community and national support.

Impact of Study

This study was able to show that adherence to preferred practice for the sample population is low as well as highlight contrasting factors as major barriers unlike those seen previously in other studies assessing barriers to healthy eating. It also implied that the current structure for dietary health in the health centres is failing the majority of patients accessing its service. Increasing the number of sessions with a dietitian over a shorter time frame may be a viable solution. More public health initiatives directed towards healthy eating may need to be implemented to encourage and reinforce good dietary choices. For example, in Mexico, which has the highest prevalence of diabetes among the Organization for Economic Cooperation and Development (OECD) member countries and the highest per capita consumption of soft drinks worldwide, a nationwide tax on drinks containing added sugar was implemented in January 2014, that increased their price by over 10% [26]. While it is too early to draw far-reaching conclusions, one analysis estimated that the increase in price was associated with an 11.6% decrease in the quantity consumed [26]. A similar tax was implemented by the Barbadian government in June 2015. Policies similar to this may help to address the barrier of individuals with diabetes not wanting to feel left out as well as encourage food outlets to be more health conscious. Further research, utilizing focus groups may help the researcher to understand why patients eat whatever is available. For example, is this practice related to cost of food items or the ability to access food when it is needed?

Limitations

This research project was inexpensive and allowed valuable data to be collected over a relatively short period of time. However, there are some limitations that should be considered. First, this survey was conducted in patients who attended public health centres and is therefore not an adequate representation of a true cross-section of all patients with diabetes living the identified areas. In Point Fortin alone, they are several private general practices as well as two medical centres that cater to the employees and family members of the Petrotrin and Trinmar companies. Second, it provides a 'snap shot' of the problem as it is carried out at one point in time over a short period and factors may vary even in the same individual over a prolonged period of time. Thirdly, consecutive convenient sampling was utilized after randomized sampling was unsuccessful. This sampling method facilitated the ease of collection of data over a short period of time but it is susceptible to selection bias and sampling error which can limit the strength of the results obtained. Random sampling would have limited these errors and was initially utilized to select participants. The medical notes of all patients with type 2 diabetes were identified prior to their clinic date and numbers were assigned. A random numbers table was used to select notes of potential participants. This method was unsuccessful in this research setting because many of the selected individuals did not give consent and others did not attend clinic on their scheduled day. It would have prolonged data collection time beyond the 3 to 4 month cycle of the clinics for chronic disease which could lead to some individuals being inadvertently administered the survey more than once. This

limits the applicability of results to forming conclusions of the entire population as it does not allow for true a representation of the population. Individuals who did give consent for administration of the survey or those who did not come to clinic may be different from those who attended clinic and completed the survey. Collecting the demographic information like gender and age, for those who did not complete the survey regardless of the reason would have allowed for comparison to determine if there really was a difference. These factors affect the generalizability of findings and limit how information acquired can be applied to the population. The Hawthorne Effect may have impacted on this study as well, as patients may have been eager to give "good" answers because they knew that they were being documented. Research assistants were utilized to administer the survey instead of doctors to limit this bias and to assist participants in completing surveys.

Statistical analysis for any difference in preferred practice between the two health centres could not be done as there were dissimilar sample sizes at each centre. Analysis of childhood foods was omitted because it was not adequately addressed in the survey. This factor may have provided further information as to why participants make the dietary choices they do.

Conclusion

The barriers identified to eating healthy were 'eating whatever was available', 'fast food being convenient' and 'not wanting to feel different from others'. The

research shows that the provision of dietary health is inadequate as evident by the low number of patients following all of the preferred practices. There was no apparent difference in dietary health found between patients receiving usual care and supplemental care which alludes to the fact that group intervention lead by a primary care physician may not be significant. Further assessment using focus groups could help to get a broader understanding of factors affecting choices as this would allow for free and open discussion.

References

1. World Health Organization. Diabetes Fact Sheet. World Health Organization, 2016 March [cited 2016 Mar 8]. Available from http://www.who.int/mediacentre/factsheets/fs312/en/

2. Caribbean Health Research Council, Pan American Health Organization. Managing Diabetes in Primary Care in the Caribbean. Caribbean Health Research Council, 2006 [cited 2014 Jan 20]

3. Johns Hopkins Medicine International. New and Comprehensive Study of Diabetes Care in Trinidad and Tobago. Trinidad and Tobago: Johns Hopkins Medicine; 2012 Mar [cited 2014 Jan 20]. Available from http://www.hopkinsmedicine.org/news/media/releases/new_and_comprehensive_study of_diabetes_care_in_trinidad_and_tobago_released

4. Gulliford MC, Ariyanayagam-Baksh SM, Bickram L, Picou D, Mahabir D. Counting the Cost of Diabetic Hospital Admissions From a multi-ethnic population in Trinidad. Diabet Med. 1995; 12 (12): 1077-85 [cited 2014 Jan 23]. Available from http://www.ncbi.nlm.nih.gov/pubmed/8750217

5. Mahabir D, Gulliford MC. Changing Patterns of Primary Care for Diabetes in Trinidad and Tobago over 10 years. Diabetic Medicine 2005; 22 (5): 619-624 [cited 2014 Jan 23]. Available from http://www.ncbi.nlm.nih.gov/pubmed/15842518

6. Nicholls K. The Diabetes Epidemic in Trinidad and Tobago: Attacking a Burdensome Disease with Conventional Weapons. 2010 [cited 2014 Apr 4]. Available from: http://www.rcsocialjusticett.org/downloads/diabetic_epidemic.pdf

7. Diabetes in the UK 2012. Key statistics on diabetes [cited 2013 Nov 2]. Available from: http://www.diabetes.org.uk/Documents/Reports/Diabetes-in-the-UK-2012.pdf

8. American Diabetes Association. Nutrition Recommendations and Interventions for Diabetes. Diabetes Care. 2008, Jan; volume 3 supplement 1: S61-S78 [cited 2014 Apr 23]. Available from http://care.diabetesjournals.org/content/31/Supplement_1/S61.full.pdf+html

9. Evert A. et al. Nutrition Therapy Recommendations for the Management of Adults With Diabetes. Diabetes Care. 2013, Nov; volume 36 [cited 2016 Mar 10]. Available from: http://care.diabetesjournals.org/content/36/11/3821.pdf+html

10. Horton E, Silberman C, Davis K, Berria R. Weight Loss, Glycemic Control, and Changes in Cardiovascular Biomarkers in Patients With Type 2 Diabetes Receiving Incretin Therapies or Insulin in a Large Cohort Database. Diabetes Care. 2010, Aug; volume 33, number 8 [cited 2016 Mar 10]. Available from: http://care.diabetesjournals.org/content/33/8/1759.full.pdf+html

11. Johns Hopkins Medicine International. News Publication: Study Reveals Significant Gaps in Patient Self-Management of Diabetes in Trinidad and Tobago. Trinidad and Tobago: Johns Hopkins Medicine; 2013 Feb 28 [cited 2014 Jan 24]. Available from: http://www.hopkinsmedicine.org/news/media/releases/study reveals significant gaps in patient self management of diabetes in trinidad and tobago

12. World Health Organization. Adherence to Long Term Therapies Evidence for Action. World Health Organization; 2003. Chapter X, Diabetes; p. 74 [cited 2014 Jul 6]. Available from: http://whqlibdoc.who.int/publications/2003/9241545992.pdf

13. Pastors J, Warshaw H, Daly A, Marion F, Kulkarni K. The Evidence for the Effectiveness of Medical Nutrition Therapy in Diabetes Management. Diabetes Care. 2002, Mar; volume 25: 608-613 [cited 2014 Mar 28]. Available from: http://care.diabetesjournals.org/content/25/3/608.full.pdf

14. Brown SA, Upchurch S, Anding R, Winter M, Ramirez G. Promoting weight loss in type II diabetes. Diabetes Care. 1996, Jun; 19(6):6 13-24 [cited 2016 Mar 26]. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8725861

15. Georgoulis M, Kontogianni M, Yiannakouris. Mediterranean Diet and Diabetes: Prevention and Treatment. Nutrients. 2014, Apr; 6(4): 1406-1423 [cited 2016 Mar 28]. Available from: doi 10.3390/nu6041406

16. Bulwer B. Your Doctor Can't Make You Healthy. Boston: Lay Publications;2003. Chapter 7, Food and Choices… The "Dynamix" of Why We Eat What We Eat; p. 253-259

17. Overview of Determinants of Food Choice and Dietary Change: Implications for Nutrition Education. United States: Jones and Bartlett Publishers. Chapter 2 [cited 2014 Apr 26]. Available from: http://samples.jbpub.com/9780763775087/75087_ch02_Contento.pdf

18. Larson N, Story M, Nelson M. Neighborhood Environments Disparities in Access to Healthy Foods in the U.S. Am J Prev Med. 2009; 36(1) [cited 2014 Apr 28]. Available from: http://www.ajpmonline.org/article/S0749-3797(08)00838-6/abstract

19. Marcy T, Britton M, Harrison D. Identification of Barriers to Appropriate Dietary Behavior in Low-Income Patients with Type 2 Diabetes Mellitus. Diabetes Ther. 2011; 2 (1):9-19 [cited 2014 Jan 28]. Available from: doi: 10.1007/s13300-010-0012-6

20. Vijan S et al. Barriers to following dietary recommendations in Type 2 diabetes. Diabetes UK. *Diabetic Medicine*. 2004; 2: 32-38 [cited 2016 Mar 29]. Available from: doi: 10.1111/j.1464-5491.2004.01342.x

21. All-Inclusive Project Development Services. Borough of Point Fortin Final Draft Municipal Development Plan. Point Fortin Borough Corporation. 2010 July [cited 2014 Apr 29]. Available from: http://www.localgov.gov.tt/~/media/Resource%20Library/Spatial%20Development%20Plans%20Per%20Corporation/Point%20Fortin%20Borough%20Spatial%20Development%20Plan.ashx

22. Ministry of Planning and Sustainable Development Central Statistical Office. Trinidad and Tobago 2011 Population and Housing Census Demographic Report. Government of the Republic of Trinidad and Tobago: The Central Statistical Office [cited 2014 Feb 5]. Available from: https://guardian.co.tt/sites/default/files/story/2011_DemographicReport.pdf

23. Mathison C. History of Point Fortin. Point Fortin Borough Corporation. Government of the Republic of Trinidad and Tobago [cited 2016 Mar 17]. Available from: http://pointfortinborough.com/home/history-of-point-fortin

24. Historical Development of La Brea District and Environs. Alutrint Social Impact Assessment Study. Trinidad, 2005 [cited 2016 Mar 17]. Available from: http://www.ema.co.tt/docs/public/alutrint final sia report.pdf

25. World Health Organization. Global Report on Diabetes. World Health Organization; 2016. Part 2, Preventing Diabetes; p. 39 [cited 2016 Apr 13]. Available from:

http://apps.who.int/iris/bitstream/10665/204871/1/9789241565257_eng.pdf

26. NGSP. Factors that Interfere with HbA1c Test Results. NGSP, 2010 [cited 2016 July 14]. Available from: http://www.ngsp.org/factors.asp

Appendix I. Summary of Evidence for Nutrition Therapy in Diabetes in Randomized Controlled Trials [13]

Researchers	Study length	No. of subjects	Outcome
UKPDS Group, 1990	3 months	3042 newly diagnosed patients with type 2 diabetes	In 2595 patients who received intensive nutrition therapy (447 were primary diet failures), HbA1c decreased 1.9% (8.9 to 7%) Average weight loss of ~ 5 kg
Franz et al., 1995	6 months	179 persons with type 2 diabetes; 62 in comparison group; duration of diabetes: 4 years	HbA1c at 6 months decreased 0.9% (8.3 to 7.4%) with nutrition practice guidelines care; HbA1c decreased 0.7% (8.3 to 7.6%) with basic nutrition care; HbA1c was unchanged in the comparison group with no nutrition intervention (8.2 to 8.4%)
MNT in combination with DSMT. Glasgow et al., 1992	6 months	162 type 2 diabetic patients over the age of 60 years	HbA1c decreased from 7.4 to 6.4% in control-intervention crossover group while the intervention-control crossover group had a rebound effect; intervention group had a multidisciplinary team with an RD who provided MNT

Appendix II. Interventional Studies Exploring the Effects of the Mediterranean Diet on Type 2 Diabetes Mellitus Patients' Glucose Homeostasis Indices [15]

Researchers	Research Design	Results
Esposito et al. 2009	4-year randomized controlled clinical trial: 215 overweight adults with newly-diagnosed T2DM who were not receiving anti-hyperglycemic drug therapy and had HbA1c levels <11% were assigned to either a low carbohydrate Mediterranean diet (LCMD) or a low-fat diet (LFD) based on the 2000 AHA guidelines	44% of patients in the LCMD group and 70% in the LFD group required treatment ($p<0.001$). Improvements were greater in the LCMD group for glucose, HOMA-IR and HbA1c levels. The proportion of participants who met ADA goals for HbA1c was greater in the LCMD group.
Elhayany et al. 2010	12-month RCT: 259 overweight adults with T2DM were assigned to one of three diets: a LCMD, a traditional MD (TMD) or LFD based on the 2003 ADA guidelines	Glucose, HOMA-IR and HbA1c decreased while insulin levels increased in all three groups. Changes in glucose, insulin and HOMA-IR levels were similar among groups. The reduction in HbA1c levels was significantly greater for patients allocated to the LCMD and the TMD groups, compared with the patients on the LFD ($p=0.021$)
Itsiopoulos et al. 2011	Randomized cross-over interventional study: 27 T2DM subjects were assigned to either an ad libitum MD or their usual diet for 12 weeks and then cross over to the alternate diet	The ad libitum MD led to a significantly greater decrease in HbA1c, compared with the usual diet ($p = 0.012$).

Appendix III: Table Showing registered Food Establishments in the Point Fortin Borough

Type of Food	Number of Providers
Bakery Treats	5
Roti	6
Chinese food	5
Restaurant	3
Creole food	4
Barbecue	3
Mixed	10

Appendix V: Pilot Survey

Demographics

1. How old are you?
   □ 18-35 years □ 36-55 years □ 56-75 years □> 75 years

2. What is your gender?
   □ Female □ Male

3. What is your ethnicity?
   □ African □ Indian □ Mixed □ Other _____

4. What is your marital status?
   □ Single □ Married/ Common Law □ Other _____

5. What is your highest level of education?
   □ Primary □ Secondary □ Tertiary
   □ Other

6. What is the average monthly amount of money spent on food for the family?
   □ $500- $1000 □ $1000- $2000 □>$2000

7. Number of members in your household.
   □ 1-3 □ 4-8 □>8

8. How long have you had type 2 diabetes mellitus?
   □ 1-5 years □ 6- 10 years □> 10 years

9. Do other members of your household have diabetes?
   □ Yes □ No

10. If yes to the above, please specify how many. _____

Knowledge and Attitudes

1. What type of illness is diabetes?
   □ Infectious □ Chronic □ Transient

2. Can diabetes be cured?
   □ Yes □ No

3. Which of the following are used in the treatment of diabetes? (You can select more than one)

   □Exercise □ Smoking
   □Diet □ Medications
   □Radiotherapy □ Electroconvulsive therapy

4. I feel comfortable giving basic advice about diabetes to others.
   □ Yes □ No

5. How important is diet in the management of diabetes?
   □ Very important □Somewhat important □ Unimportant

6. Do you think that using an appropriate diet can:
   a. Decrease the amount of medications required to control blood sugars?
   □ Agree □ Neutral □ Disagree

   b. Lead to weight loss?
   □ Agree □ Neutral □ Disagree

   c. Avoid episodes of hypoglycemia (low blood sugars)?
   □ Agree □ Neutral □ Disagree

   d. Avoid episodes of hyperglycemia (high blood sugars)?

□ Agree □ Neutral □ Disagree

e. Affect other conditions, like hypertension and high cholesterol, which are associated with diabetes?

□ Agree □ Neutral □ Disagree

Practices

1. I have breakfast, lunch and dinner with a snack between breakfast and lunch and between lunch and dinner.
   □ Every day □ Most days □ Sometimes □ Infrequently

2. I skip meals or change the timing of my meals.
   □ Every day □ Most days □ Sometimes □ Infrequently

3. I use sweetened beverages.
   □ Every day □ Most days □ Sometimes □ Infrequently

4. I eat fast foods.
   □ Every day □ Most days □ Sometimes □ Infrequently

5. I add salt to food when I am cooking.
   □ Yes □ No

6. I include high fiber foods in my diet.
   □ Yes □ No

7. How many servings of fruit and vegetables do you consume most days (at least 5 days each week)?
   □ 3- 5 □ 2 □ 1 □ 0

Barriers

1. I am unable to adhere to my diet because (select one or more of the following)
   □ I cannot afford the correct foods □ I do not have time to prepare food
   □It is more convenient to buy fast food □ I am dependent on others for food
   □ Resisting sugary foods is difficult □I do not want to feel different
   □ I eat whatever is available □ Social events make it easy to eat unhealthily

2. I usually eat foods that I would have eaten as a child and a teenager.
   □ Often □ Sometimes □ Seldomly

3. I use 'comfort foods' when I am feeling stressed.
   □ Often □ Sometimes □ Seldomly

4. I feel stressed
   □ Often □ Sometimes □ Seldomly

5. Indicate how true the following statements are using a rating scale of 1 to 10, with a score of 10 meaning 'very true'.
   a. I do not want to give up the foods I like. ___
   b. I do not think that diet is important to the care of my condition. ___
   c. I would risk the complications of high blood sugars before giving up the foods I like. ___
   d. I do not have any control over my diabetes. ___

6. What do you consider your greatest obstacle to eating healthy?

   _____

Appendix VI: Survey Instrument

Demographics

1. What is your date of birth?

   _____

2. What is your gender?
   □ Female □ Male

3. What is your ethnicity?
   □ African □ Indian □ Mixed □ Other _____

4. What is your marital status?
   □ Single □ Married/ Common Law □ Other _____

5. What is your highest level of education?
   □ Primary □ Secondary □ Tertiary □ Other

6. What is the average monthly amount of money spent on food for the family?
   □ $500- $1000 □ $1000- $2000 □>$2000

7. Number of members in your household.
   □ 1-3 □ 4-8 □>8

8. How long have you had type 2 diabetes mellitus?
   □ 1-5 years □ 6- 10 years □> 10 years

9. Do other members of your family have diabetes?
   □ Yes □ No

10. If yes to the above, please specify how many._____

Knowledge and Attitudes

1. What type of illness is diabetes?
   □ Infectious □ Chronic □ Transient

2. Can diabetes be cured?
   □ Yes □ No

3. Which of the following are used in the treatment of diabetes? (You can select more than one)
   □Exercise □ Smoking
   □Diet □ Medications
   □Radiotherapy □ Electroconvulsive therapy

4. I feel comfortable giving basic advice about diabetes to others.
   □ Yes □ No

5. How important is diet in the management of diabetes?
   □ Very important □Somewhat important □ Unimportant

6. Do you think that using an appropriate diet can:

   a. Decrease the amount of medications required to control blood sugars?

   □ Agree □ Neutral □ Disagree

   b. Lead to weight loss?

   □ Agree □ Neutral □ Disagree

   c. Avoid episodes of hypoglycemia (low blood sugars)?

   □ Agree □ Neutral □ Disagree

   d. Avoid episodes of hyperglycemia (high blood sugars)?

   □ Agree □ Neutral □ Disagree

   e. Affect other conditions, like hypertension and high cholesterol, which are associated with diabetes?

   □ Agree □ Neutral □ Disagree

Practices

1. I have breakfast, lunch and dinner with a snack between breakfast and lunch and between lunch and dinner.

□Every day □ Most days □ Sometimes □ Infrequently

2. I skip meals or change the timing of my meals.

□ Every day □ Most days □ Sometimes □ Infrequently

3. I use sweetened beverages.

□ Every day □ Most days □ Sometimes □ Infrequently

4. I eat fast foods.

□ Every day □ Most days □ Sometimes □ Infrequently

5. I add salt to food when I am cooking.

□ Yes □ No

6. I include high fiber foods in my diet.

□ Yes □ No

7. How many servings of fruit and vegetables do you consume most days (at least 5 days each week)?

□ 3- 5 □ 2 □ 1 □ 0

Barriers

1. I am unable to adhere or stick to my diet because (select one or more of the following)

□ I cannot afford healthier foods □ I do not have time to prepare food

□ It is more convenient to buy fast food □ I am dependent on others for food

□ Resisting sugary foods is difficult □ I do not want to feel different

□ I eat whatever is available □ I want to fit in at social events

2. I usually eat foods that I would have eaten as a child and a teenager.

□ Often □ Sometimes □ Seldomly

3. I use ‘comfort foods’ when I am feeling stressed.
   □ Often □ Sometimes □ Seldomly

4. I feel stressed
   □ Often □ Sometimes □ Seldomly

5. Indicate which of the following statements are true or false for you.
   a. I do not want to give up the foods I like. ___
   b. I do not think that diet is important in the care of my condition. ___
   c. I would risk the complications of high blood sugars before giving up the foods I like. ___
   d. I do not have any control over my diabetes. ___

6. What do you consider your greatest obstacle to eating healthy?

   _____
   _____
   _____
   _____

7. Do you think that you control your food choices? □ Yes □ No

8. If your answer is no, explain why.

   _____
   _____

9. Do you think you have a good diet? □ Yes □ No

10. If your answer is no, do you think you need to change your diet? □ Yes □ No

11. If your answer to the previous question is yes, do you intend to make a change within the next 6 months? □ Yes □ No
12. Have you thought about how you will make the changes to your diet? □ Yes □ No

13. Have you started making small changes already? □ Yes □ No

14. Do you believe that the changes will lead to a healthier life? □ Yes □ No

Appendix IV: The Plate Model

Daily Meals

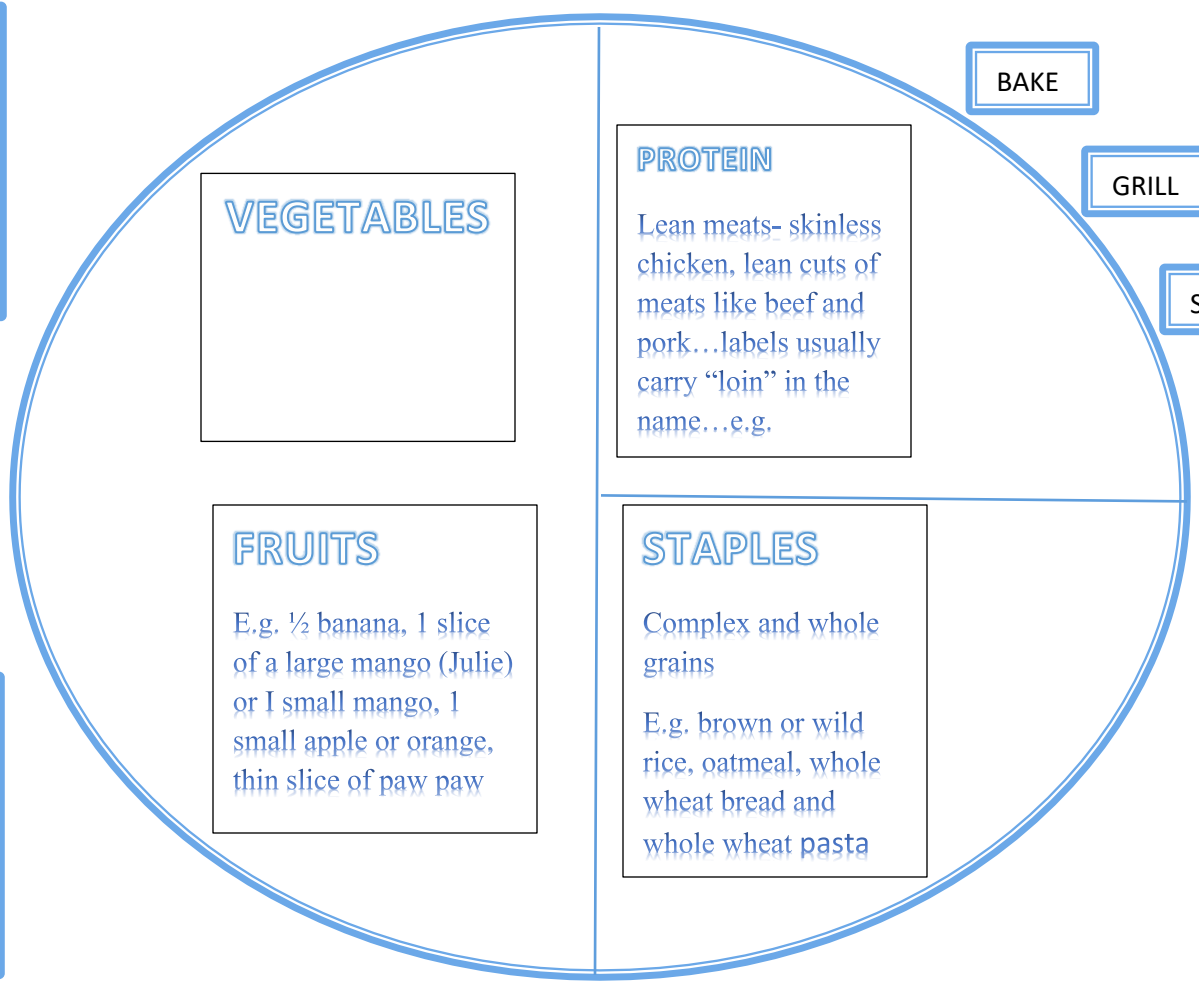
BREAKFAST

Snack

LUNCH

Snack

DINNER



BAKE

GRILL

STEAM

Small portions of:

Fats from plants (avoid intense heat)

Dairy (e.g. low fat milk)

Drink at least 8 glasses of water daily

E.g. a glass before and after each meal and a glass with each snack

Avoid 'sweet drinks' and limit juice to one glass daily

Appropriate Snacks

E.g. Nuts, fruits, vegetables, whole grain snacks