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Research article

Diabetes education—Cornerstone in management of diabetes mellitus in Jamaica

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Abstract: Background: Diabetes mellitus (DM) is one of the leading causes of morbidity and mortality among Caribbean populations. Ideal glycemic control can be attained when patients adhere to self-management behaviors such as consistent monitoring of blood glucose (BG) levels, staying physically active, taking medications, and eating a healthy diet. **Aim:** The present study has the following aims: (1) to assess knowledge of self-care and the initiative of type 2 diabetic patients in medication compliance, making suitable food choices, regular physical exercise and BG monitoring, (2) to evaluate diabetic patient self-management by adhering to instructions of healthcare provider in attaining outcomes such as medication adherence, appropriate food choices, prescribed physical exercise, and self-monitoring of BG levels and determination of glycated hemoglobin (HbA1c) levels at clinic visits and (3) to determine whether there are associations between BG control (glucose and HbA1 levels) and sociodemographic factors (i.e., age, education, employment status) as well as knowledge of self-care and the number of years persons had type 2 diabetes mellitus (T2DM). **Method**: The study is a cross-sectional study that utilized a quantitative methodology. The study population consisted of 101 T2DM patients. The researchers used a 12-point interviewer administered questionnaire to solicit information on socio-demographics, knowledge of self-care, and self-management of T2DM, including physical activity and selecting appropriate food choices, and evidence of glycemic control, such as HbA1c and random blood glucose (RBG) levels. Researchers analyzed the data using SPSS version 17.0 and Microsoft Excel 2007. Authors applied an analytical statistical analysis with a 95% confidence level. **Results**: The findings revealed that 90.1% of respondents indicated that they knew how to take their medications. Results also indicated that there

was no association of knowledge of self-care with the number of years persons had T2DM. Among the total respondents, 53.5% had poor compliance to prescribed medication, and women were 1.2 times more likely not to comply with medication. In addition, 65.3% of respondents reported poor compliance with physical exercise and 81.2% of respondents indicated poor compliance in self-monitoring BG. **Conclusion**: The findings from this study reveal that the majority of patients with T2DM knew how to take their medications. However, compliance with physical exercise and self-monitoring BG were less than satisfactory. Didactic interventions focusing on the acquisition of knowledge and information will empower patients and improve their self-care and management.

Keywords: diabetes mellitus; education; glucose; management; medication; behavior; patients

Abbreviations: DM: Diabetes mellitus; BG: Blood glucose; T2DM: Type 2 diabetes mellitus; RBG: Random blood glucose; DSME/S: Diabetes self-management education and support; HbA1c: Glycated hemoglobin; SGBM: Self glucose blood monitoring

1. Introduction

Jamaica is an island in the Caribbean region with a population of 2,734,092 [1]. With the increasing point prevalence of DM in the Caribbean and Jamaica in particular, it became necessary to employ strategies for the prevention and management of this disease. According to Ferguson et al. the overall prevalence of DM in the Caribbean is about 9.0% [2] and accounts for 13.8% of all deaths amongst adults in the region [3]. The Jamaica Health and Lifestyle Surveys [JHLS] 2000 and 2008 revealed that the prevalence of DM among Jamaicans was 7.2% and 7.6%, respectively [4].

Diabetes mellitus is a chronic disease that requires the person with the illness to make daily self-management decisions that inform their best care practices [5]. Diabetes self-management education and support (DSME/S) is fundamental in helping people with DM to navigate these decisions and activities and has been shown to improve health outcomes [6].

The Caribbean region does not have diabetes educators as a part of the primary healthcare system. Therefore, in 1997, the Diabetes Association of Jamaica (DAJ) developed The Peer Facilitators Diabetes Training Programme. The training was conducted for six hours with selected persons from the community, including community health workers. Health care areas covered during the training included diabetes self-management, the importance of BG monitoring, meal planning, physical activity, and foot care.

In Jamaica, the St. James Public Health Services, mediated through its 23 health centres, provides preventative and curative health care primarily for approximately 39% of the total populace of the Western Region. This paper reports the research conducted in the primary health care within the parish of St. James, Jamaica and examined aspects of the DSME/S system including knowledge of self-care and self-management with particular focus on medication adherence, engaging in regular physical activities, selecting appropriate food choices, self-monitoring of BG levels, and evaluation of any association between knowledge of self-care and the number of years persons had DM.

The aims of this study were: (i) to assess knowledge of self-care, medication compliance, regular physical exercise and BG monitoring among T2DM patients, (ii) to evaluate self-management of T2DM patients by adhering to instructions of healthcare provider in attaining outcomes such self-

monitoring of BG levels and determination of HbA1c levels at clinic visits and (iii) to determine whether there are associations between BG control parameters, sociodemographic factors (i.e., age, education, employment status), knowledge of self-care and the number of years persons who present with T2DM.

2. Materials and methods

2.1. Study design and population (sample size)

A description of the study was previously published which has the demographic characteristics of the participants [7]. This is a cross-sectional study with population comprising of T2DM patients attending medical clinics within St. James, Jamaica. These patients had been entered in the chronic disease register after being diagnosed with T2DM ($N = 437$ persons as at January 2012). Using the University of Florida IFAS PEOD6 document [8], the authors calculated a sample size of 212 persons [Formula: $n = N/1+N (e)^2$, where n = sample, N = population size, e = level of precision, 0.05, CI = 95%]. The authors then calculated distribution by health centres manually.

2.2. Sampling, inclusion and exclusion criteria

Researchers used convenience sampling to recruit the persons for this study versus the systematic random sampling previously proposed. This was based on the clinic attendance rate of patients and the time frame for conducting the research. Patients were referred for inclusion, after being assessed and confirmed as having T2DM. Patient referral was followed up with docket reviews by the researcher to ensure patients met the inclusion criteria. Additionally, the authors attempted to contact patients listed in the diabetes register to ascertain scheduled clinic appointments.

The inclusion criteria for the patients in the study were: being previously diagnosed with T2DM, attending a health centre or medical clinic for a year, attending the clinic on the day of visit by the researcher, and residing in St. James. The exclusion criteria were: being diagnosed with hypertension, being newly diagnosed with DM, and having only two docket entries from the medical clinic.

2.3. Data collection, questionnaire and ethical approval

The researchers collected the data over a three-month period, from February to April 2012, through the use of interviews and docket reviews of patients recorded in the chronic disease register. The researchers used a 12-point interviewer-administered questionnaire shown in supplementary to solicit information including socio-demographics and medical history. Additionally, researchers allowed for qualitative inputs by asking for comments from the respondents regarding the assessments.

The 12-point questionnaire covers areas such as (i) medical history including how long the patients had T2DM, any other known medical condition, medications and knowledge thereof, (ii) knowledge of self-care and patient management including medication compliance, appropriate food choices, exercise compliance, BG monitoring practices and regular examination of feet or foot care, and (iii) laboratory data including RBG and HbA1c levels at index visits or at 3, 6 or nine months. Patients were asked to evaluate the level of difficulty in carrying out specific tasks aimed at managing

DM, so as to ascertain self-management skills and self-efficacy based on prior advice or instructions given by a healthcare worker.

This instrument was adopted from Heisler et al. (2002) [9]. Prior to data collection, the researchers requested permission via email from the authors to use the instrument. The study team trained a research assistant in administration of questionnaires, the authors evaluated the research assistant's work during the training session and the initial phase of data collection to ensure reliability and validity of data.

Cronbach's alpha is a measure of the reliability of the 12-part questionnaire used in the study. It was used to calculate the sample size needed to obtain a confidence interval of 95%. The authors ran Cronbach's Alpha on the sample used for the study at a confidence interval of 95%, which indicated a value of 0.624. The overall Cronbach's alpha value of 0.624 demonstrates the construct reliability and values larger than 0.50 specifies that the construct has acceptable of all internal consistency [10].

Additionally, the authors obtained approval for the study from the Ethics Committee of the Western Regional Health Authority [WRHA], which required modification of the initial proposal as the researcher sought funding assistance from the WRHA. The authors maintained ethical observance in conducting the interviews, seeking consent, and conducting as docket searches.

2.4. Study outcomes

The primary health outcome is knowledge of self-care which refers to the patient's own initiative in medication adherence or compliance, displaying appropriate eating behaviors (reduced intake of sweet and sugary foods inclusive of juice drinks and monitoring the amount of food eaten), engaging in regular physical activity (30 minutes at least 3 days per week), regular glucose monitoring (twice at least 3 days per week) and regular examination of feet or foot care (conducted daily).

The secondary health outcome is patient self-management skills which refer to closely following instructions of healthcare workers in order to accomplish positive health outcomes, with specific emphasis on taking medication prescribed, making appropriate food choices, participating in the prescribed physical activity, self-monitoring of BG levels and HbA1c levels determined at clinic visit as well as foot care.

2.5. Statistical analysis

The authors analyzed the data using SPSS version 17.0 and Microsoft Excel 2007.

Descriptive statistics were applied to knowledge of health care variables (such as medication, appropriate food choice knowledge and frequency of exercise knowledge and practice), frequency of HbA1c determination and comparison of duration of diagnosis with HbA1c testing.

The statistical analysis involved the use of Spearman Rank Order correlation to explore potential associations between exposures, and the primary and secondary outcomes. The study determine whether there is an association between BG control (glucose and HbA1c) and sociodemographic factors (i.e., age, education, employment status) as well as knowledge of self-care and the number of years persons had T2DM.

Univariate analyses were used to evaluate associations between variables such demographic characteristics, compliance to medication and number of years having DM with health outcomes. The

differences between the continuous variables were identified by the Mann-Whitney U test, with P < 0.05 statistically significant.

3. Results

3.1. Knowledge and self-care

Researchers asked the respondents to evaluate their knowledge of diabetes self-care. Ninety-point one percent (90.1%) of respondents indicated that they knew how to take their medications "very well" (Table 1). Among these respondents, 46.2% indicated that they could name "all their medications", 41.7% were able to name "some of their medications", and 12.1% were not able to name their medication. Taking medication "*as prescribed*" was the most frequent comment that was given (88.1%).

When asked about how to make food choices to prevent increased BG, 52.5% responded "very well" (Table 1), of which 39.6% indicated that they interacted with nutrition personnel and understood the information shared (either "all the time", "most times", or "sometimes"). Forty-eight-point five percent (48.5%) of respondents knew how often glucose monitoring should be done "very well". Among those who reported knowing how often to monitor their BG, 63.2% indicated that they checked their glucose daily (two to three times per day). When the authors asked respondents about the frequency of exercise, 63.4% indicated knowing when to exercise "very well" (Table 1), of which 53.1% indicated "daily", while 14% stated "*15 to 30 minutes daily*".

Of the 101 respondents, 69.3% indicated knowing "very well" what to do for symptoms of hypoglycemia (Table 1), with almost 100% (98.5%) stating "*have something sweet*". In response to being asked about the target for glucose control, approximately 50% (48.5%) of respondents indicating knowing "very well" the recommended values (Table 1), with 79.6% of said respondents stating values of less than or equal to five to seven mmol/L as the recommendation for control.

There was no association between age and the knowledge of self-care variables. However, there was an even distribution of those who knew how to take their medications "very well" (20 to 49 years = 49.5%, 50 years and older = 50.5%). This was similar for those who knew how to make appropriate food choices. More persons who knew the frequency of glucose testing "very well" were in the age group 20 to 49 years (59.2%). Additionally, there was an even distribution for those who knew the frequency of exercise as well as those who knew the controlled glucose metabolic rate (GMR) (20 to 49 years = 51.6%, 50 years and older = 48.4%), while more persons in the age group 20 to 49 years (55.6%) knew what to do for hypoglycemia.

There was no association with knowledge of self-care and the number of years persons had T2DM. However, when compared with the other groups, more persons who had T2DM for 10 years or more knew how to take their medications "very well" (34.0%), how to monitor their BG (36.7%), how to make appropriate food choices (35.8%), and how to exercise as recommended (34.4%). Additionally, more persons who had T2DM for four to six years knew how often to do self-blood glucose monitoring (34.7%) and what to do for symptoms of hypoglycemia (37.1%).

Table 1. Knowledge of self-care variables.

Variables	Frequency (N)	Percentage (%)
Medication Knowledge		
Very Well	91	90.1
Not So well	2	2.0
Need more Help	5	5.0
N/A	3	3.0
Total	101	100.0
Appropriate Food Choice Knowledge		
Very Well	53	52.5
Not So well	15	14.9
Need more Help	33	32.7
Total	101	100.0
Frequency of GMR Testing		
Very Well	49	48.5
Not So well	11	10.9
Need more Help	41	40.6
Total	101	100.0
Frequency of Exercise Knowledge		
Very Well	64	63.4
Not So well	17	16.8
Need more Help	20	19.8
Total	101	100.0
Managing Hypoglycemia		
Very Well	70	69.3
Not So well	16	15.8
Need more Help	15	14.9
Total	101	100.0
Blood Glucose Target		
Very Well	49	48.5
Not So well	20	19.8
Need more Help	32	31.7
Total	101	100.0

3.2. Patient self-management

Patients were asked to evaluate the level of difficulty in carrying out specific tasks aimed at managing diabetes, so as to ascertain self-management skills and self-efficacy based on prior advice or instructions given by a healthcare worker. Compliance was determined by the patient's ability to complete the task as "exactly correct".

3.2.1. Task 1—Medication compliance

Among all respondents, 53.5% had poor compliance to prescribed medication, with the highest frequency being among persons diagnosed with T2DM for 10 years or more (38.9%); however, there was no statistical association between being diagnosed with T2DM for 10 years or more and poor compliance. The most frequent comment given for not complying was "*tired of taking medications*" (34.6%). When researchers examined the odds ratio, women were 1.2 times more likely not to comply with medication.

A comparison between those who knew the name of "all" their medications and those who knew how to take their medications showed that 53.3% of respondents had satisfactory compliance. The researchers re-coded the data and carried out Mann Whitney tests, which revealed a statistical association between being able to name the medication and compliance ($U = 411.5$, $p = 0.005$). Additionally, the authors found a statistical association between medication knowledge and compliance or adherence ($U = 248.0$, $p = 0.008$).

Among the persons who did not complete the task, 55.4% had "immediate social support systems"; additionally, there was no statistical association.

3.2.2. Task 2—Exercise 30 minutes at least 3 days per week

Sixty-five-point three percent (65.3%) of respondents reported poor compliance to exercising as recommended, with the most frequent responses for not complying being "*no time*", "*lazy*", and "*work is a factor*". When compared with knowing the recommendation for physical activity/exercise, less than 50% (45.4%) were compliant. There was an association between knowing what to do and the ability to carry out the task ($U = 839.5$, $p = 0.003$). Additionally, persons with T2DM for one to three years were better able to carry out the recommended physical activity (54.5%). Of the respondents who found it difficult to do the prescribed task, 62.1% had "immediate social support systems", although there was no statistical association between these variables.

3.2.3. Task 3—Appropriate food choices

There was reduced intake of high-fat foods and sweet, sugary foods, including of juice drinks and monitoring the amount of food eaten, including high-fibre foods and having one to three servings of fruit and vegetables at least three times per week or as prescribed by a nutrition professional.

Among all respondents, 71.3% reported poor compliance with making appropriate food choices to prevent an increase in BG, with the highest frequency being among persons diagnosed with T2DM for 10 years or more (39.4%). The most-recurring responses for not complying were "*cost*", "*eat everything*", "*eat what I have*", and "*based on availability*". When compared with knowledge level, there was almost an equal distribution between those who complied with the required task and those who did not (43.4% and 52.8% respectively; $U = 977.0$, $p = 0.016$). Both those who had difficulty and those who were able to complete the task had similar "immediate support systems" (63.6% and 65.5%, respectively).

3.2.4. Task 4—Self glucose blood monitoring (SGBM)

When asked about self-glucose monitoring patterns, 81.2% of respondents indicated poor compliance, with "*no machine*" and "*test only at clinic*" being the most frequent reasons given for not complying (57.4%). When compared with "immediate social support systems", they found that 69.6% of those who found it difficult to complete the task had such support system.

3.2.5. Task 5—Foot care

Eighty-three-point two percent (83.2%) of respondents expressed that they got checking feet for sores and cuts "exactly correct" with 83.1% reporting "*daily inspection*". In addition, 64.3% of those respondents had "immediate social support systems".

3.3. Laboratory results

3.3.1. Random blood glucose (RBG)

At the index visit, the mean RBG was 12.08 ± 5.7 mmol/L, with only 20.8% of respondents measured as controlled (RBG < 7 mmol/L). When the researchers completed docket searches for previous clinic visits (at three to four months), the mean RBG was 10.7 ± 4.9 mmol/L, with 22.8% of respondents having values greater than 7 mmol/L. On the other hand, at six to eight months, the mean RBG was 10.9 ± 5.5 mmol/L, with 19.8% of respondents being controlled. Additionally, the mean RBG when dockets at nine to 12 months, was 11.07 ± 5.7 mmol/L, with 13.9% of respondents being controlled. It should be noted that values were not available for the clinic visits as established by the researcher.

The study determined whether there was an association between sociodemographic factors (i.e., age, education, employment status) and glucose control. The results showed an association between level of education and RBG at six to eight months and nine to 12-month visit ($r = -0.238$, $p = 0.031$; $r = -0.0269$, $p = 0.015$, respectively).

When researchers compared with the number of years persons had T2DM, persons having the illness for one to three years had better control at index visit, at three to four months visits, and at nine to 12 month visits (31.8%, 50%, and 41.2%, respectively). On the other hand, 39.3 % of those with T2DM for four to six years had better control at six to eight months.

3.3.2. HbA1c

Researchers carried out docket review of the results of HbA1c. Table 2 provides frequency of the data. The majority of the participants did not have the HbA1c test performed over the period 6–36 months and for those who had a result it was above the normal reference interval of 4.4–6.4% (Table 2). Comparison between the number of years for being diagnosed with T2DM and the frequency with which HbA1c testing was done is shown in Table 3. The HbA1c testing of T2DM patients across the different time intervals that reflects the duration.

Table 2. Frequency of HbA1c.

Variables	Frequency (N)	Percentage (%)
HbA1c done in past 6 months		
No	86	85.1
Yes, >7%	9	8.9
Yes, 7–9%	5	5.0
Yes, >10%	1	1.0
Total	101	100.0
HbA1c done in past 12 months		
No	97	96.0
Yes, >7%	0	0.0
Yes, 7–9%	4	4.0
Yes, >10%	0	0.0
Total	101	100.0
HbA1c done in past 18 months		
No	96	95.0
Yes, >7%	0	0.0
Yes, 7–9%	1	0.0
Yes, >10%	4	4.0
Total	101	100.0
HbA1c done in past 24 months		
No	80	79.2
Yes, >7%	5	5.0
Yes, 7–9%	11	10.8
Yes, >10%	5	5.0
Total	101	100.0
HbA1c done in past 36 months		
No	92	91.0
Yes, >7%	5	5.0
Yes, 7–9%	2	2.0
Yes, >10%	2	2.0
Total	101	100.0

Table 3. Comparing duration of diagnosis with HbA1c testing.

Variables	Diabetes Diagnosis	1 to 3 years	4 to 6 years	7 to 9 years	≥10 years
HbA1c done in past 6 months	No	17 (16.8)	26 (25.7)	10 (9.9)	33 (32.6)
	Yes, ≤7%	4 (3.9)	3 (2.9)	1 (0.9)	1 (0.9)
	Yes, 7–9%	0 (0.0)	2 (1.9)	1 (0.9)	2 (1.9)
	Yes, >10%	1 (0.9)	0 (0.0)	0 (0.0)	0 (0.0)
	Total	**22**	**31**	**12**	**36**
HbA1c done in past 12 months	No	22 (21.7)	28 (27.7)	12 (11.8)	35 (34.6)
	Yes, ≤7%	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Yes, 7–9%	0 (0.0)	3 (2.9)	0 (0.0)	1 (0.9)
	Yes, >10%	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Total	**22**	**31**	**12**	**36**
HbA1c done in past 18 months	No	22 (21.7)	31 (30.6)	12 (11.8)	31 (30.6)
	Yes, ≤7%	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Yes, 7–9%	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.9)
	Yes, >10%	0 (0.0)	0 (0.0)	0 (0.0)	4 (3.9)
	Total	**22**	**31**	**12**	**36**
HbA1c done in past 24 months	No	21 (20.7)	23 (22.7)	8 (7.9)	28 (27.7)
	Yes, ≤7%	0 (0.0)	3 (2.9)	0 (0.0)	2 (1.9)
	Yes, 7–9%	0 (0.0)	4 (3.9)	4 (3.9)	3 (2.9)
	Yes, >10%	1 (0.9)	1 (0.9)	0 (0.0)	3 (2.9)
	Total	**22**	**31**	**12**	**36**
HbA1c done in past 36 months	No	21	25	11	35
	Yes, ≤7%	0 (0.0)	4 (3.9)	1 (0.9)	0 (0.0)
	Yes, 7–9%	1 (0.9)	1 (0.9)	0 (0.0)	0 (0.0)
	Yes, >10%	0 (0.0)	1 (0.9)	0 (0.0)	1 (0.9)
	Total	**22**	**31**	**12**	**36**

4. Discussion

A health professional typically provided initial DSME, whereas community-based resources provides ongoing support. DSME/S programs were designed to address the patient's health beliefs, cultural needs, current knowledge, physical limitations, emotional concerns, family support, financial status, medical history, health literacy, numeracy, and other factors that influence each person's ability to meet the challenges of self-management.

The relatively good knowledge of self-care reported in this study could be partly attributed to the participation of the peer facilitators who reinforced the information delivered by the health professionals because the general population prefers to communicate in the local dialect, called Patois. Health care professionals find great difficulty in translating health-related information into the general population. In fact, they may find it even unprofessional to do so. It was, therefore, not entirely surprising that peer facilitators impacted this cohort.

Another important factor that may have contributed to the appreciable knowledge of self-care reported is the cultural base of the DSME. Caribbean cultural practices greatly impact the health of the region. The Peer Facilitators Program reflected the needs specific to the cultural practices and cultural context. Educators likewise recognize that the way a person learns and how information is utilized depends heavily on prior life experiences and support networks; and that each of these elements is shaped by culture [11]. This is more than a finite knowledge of cultural values, beliefs, customs, language, thoughts, and actions. The more engaged individuals with T2DM and their support members are involved in their healthcare, the more likely they are to achieve desired outcomes and improve their quality of life. Cultural definitions germane to the understanding of cultural sensitivity and DM may be found in an understanding and application of the following: cultural sensitivity, cultural competence, ethnicity, and racial identity [12]. The fact that the health information delivered was based on ethnic/cultural, norms, values, social beliefs, historical, and environmental factors unique to the study population was significant. In addition, the health workers' ethnic and racial identities were similar to those under their care. This included their physical traits, cultural/religious background, and nationality [13].

Although there was very good knowledge of self-care, poor compliance was observed in taking prescribed medication, exercise, diet, and self-monitoring of BG. Similar findings have been reported in other international studies [14,15]. Invariably, the reasons proffered are grounded in socio-demographic and cultural barriers, such as poor access to medication, high cost, patient satisfaction with their medical care, patient provider relationship, degree of symptoms, and unequal distribution of health providers between urban and rural areas, which has restricted self-care activities in developing countries such as Jamaica [16–20]. Additionally, it appears that some patients may experience difficulty in understanding and following the basics of diabetes self-care activities. When adhering to self-care activities, patients are sometimes expected to make what would in many cases be a medical decision, and many patients are not comfortable or able to make such complex assessments. An important lesson that is emerging is the need of regular follow-up. This can never be underestimated in a chronic illness such as DM, and therefore, regular follow-up should be looked upon as an integral component of its long-term management.

The relatively good compliance seen in foot care is not entirely surprising. It is the result of an aggressive foot care campaign after the publication of a paper by Hennis et al. [21], in which the Caribbean was portrayed as the amputation capital of the world. The Caribbean climate favors use of casual footwear or walking around barefoot outdoors, as confirmed by other workers [22].

Realizing that these were among the leading causes of lower limb amputations, the education blitz sort to address these along with others. This included encouraging subjects to wear proper, fitting shoes that were comfortable. As such, shoes would best be purchased mid-morning when the feet are in-between sizes. Feet are smallest on waking in the morning and largest at the end of the day.

It was also important that the shoes allow for circulation of air. The former would best be worn with cotton socks or stockings. Foot care was also emphasized. The need to wash feet with soap and water followed by proper drying could not be overstated. Also, daily foot examination should be priority and regularly practiced. Subjects were greatly discouraged from pricking blisters or cutting corns and calluses. They were also forbidden from using corn cures, paints, plasters, or iodine in treating these foot lesions. The didactic education sessions were reinforced by the use of DVDs, videos, and graphic charts with good effect in the waiting areas of clinics.

It was not surprising that the RBG was out of range for a significant number of the subjects in this study. Blood glucose is greatly influenced by lifestyle. The poor adherence to dietary advice and an exercise regimen by the majority of patients can explain the RBG that was observed. The presence of glycosuria showed a remarkably similar trend to the RBG, which is not entirely surprising. However, one must interpret this data with some caution. It is a well-established fact in clinical medicine that glycosuria usually occurs at blood levels exceeding 10 mmol/L. Blood levels seldom exceed the renal threshold during the day. Then glycosuria often, but not always, indicates hyperglycemia. A low glomerular filtration rate with normal tubular function could result in higher concentrations of glucose being completely reabsorbed, and so glycosuria may not occur even at fairly high blood sugar. Conversely, defective proximal tubal could result in glycosuria at BG levels below the renal threshold.

The data on HbA1c were very revealing. In the past, HbA1c was either unavailable, inaccessible, and /or unaffordable. This was especially true in the more rural areas of the country, like Western Jamaica, which is distant from the Kingston Metropolis. However, these realities are changing since the World Health Organization Consultation concluded that HbA1c can be used as a diagnostic test for DM, provided that: stringent quality assurance tests are in place and assays are standardized to criteria aligned to the international reference values: and there are no conditions present which preclude its accurate measurement [23]. The Ministry of Health of Jamaica, through the National Health Fund, has now undertaken to cover the cost of HbA1c along with other blood investigations associated with the management of chronic diseases. As a result, private and government-run laboratories are now able to conduct these assays. Patients can have their HbA1c done free of cost, and attending health care professionals are more inclined to recommend this investigation. The published outcome of this study will help greatly in cementing this practice which will redound to the highest good of the population.

5. Conclusions

The findings from this study showed satisfactory compliance with medication as most of the T2DM patients knew how to take their diabetic treatment, and had knowledge of diabetes self-care in terms of regular monitoring of BG. However, there was poor compliance with regular physical exercise and making appropriate food choices in order to control BG. The expansion of DSMES services and greater provision of human and financial resources will empower T2DM patients to make better self-management decisions which could improve their health outcomes.

6. Future perspective

This is one of the few studies in Jamaica and other Caribbean countries that examines knowledge, self-care and management of T2DM patients, and related disease outcomes. In order to improve the health outcomes of the participants in this study and their outcomes the DSMES program should be expanded to rural areas in the country and the provision of the services to a greater number of T2DM patients. Basic DSME training courses should be made available at a subsidized cost to healthcare professionals involved in the care of T2DM patients who will be empower these individuals to make more informed self-management decisions, and improved health literacy and behavior. With DSME services more widely available and tailored to meet individual patient needs, the well-being, quality of life and clinical outcomes of these T2DM patients will be significantly improved. This will result in

significant reduction in morbidity and mortality of T2DM patients in Jamaica, most of whom are of African descent.

Acknowledgement

Conflict of interest

All the authors declare that there are not biomedical financial interests or potential conflicts of interest in writing this manuscript.

References

1. Statistical Institute of Jamaica (STATIN) Demographic statistics; 2019. ISSN: 0799-1118. https://statinja.gov.jm/Demo_SocialStats/PopulationStats.aspx
2. Ferguson T, Tulloch-Reid M, Wilks R (2010) The epidemiology of diabetes mellitus in Jamaica and the Caribbean: a historical review. *West Indian Med J* 59: 259–264.
3. International_Diabetes_Federation (2019) IDF Diabetes Atlas. In: International Diabetes Federation. 9th ed. 2019. Available from: https://www.diabetesatlas.org/en/resources/
4. Wilks R, Younger N, Tulloch-Reid M, et al. (2008) Jamaica health and lifestyle survey 2007–8; Technical Report. Available from: https://www.paho.org/hq/dmdocuments/2012/Jamaica-Health-LifeStyle-Report-2007.pdf
5. Weaver RG, Hemmelgarn BR, Rabi DM, et al. (2014) Association between participation in a brief diabetes education programme and glycaemic control in adults with newly diagnosed diabetes. *Diabet Med* 31: 1610–1614.
6. Brunisholz KD, Brio TP, Hamilton S, et al. (2014) Diabetes self-management education improves quality of care and clinical outcomes determined by a diabetes bundle measure. *J Multidiscip Healthc* 7: 533–542.
7. Barrett-Brown P, McGrowder D, Ragoobirsingh D (2019) The level of satisfaction of diabetic patients with healthcare personnel attending outpatient health clinics in Jamaica. *Int J Diabetes Clin Res* 6: 101.
8. Israel G (2012) Sampling issues: nonresponse. Program Evaluation and Organizational Development, IFAS, University of Florida. PEOD-9. Available from: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.599.3380&rep=rep1&type=pdf
9. Heisler M, Bouknight RR, Hayward R, et al. (2002) The relative importance of physician communication, participatory decision making and patient understanding in diabetes self-management. *J Gen Intern Med* 17: 243–252.
10. Taber KS (2018) The use of Cronbach's Alpha when developing and reporting research instruments in science education. *Res Sci Educ* 48: 1273–1296.
11. Caballero AE (2018) The "A to Z" of managing type 2 diabetes in culturally diverse populations. *Front Endocrinol* 9: 479.

12. American Association of Diabetes Educators (2012) Cultural sensitivity and diabetes education. *Diabetes Educ* 38: 137–141.

13. American Association of Diabetes Educators (2015) Cultural Considerations in Diabetes Education, AADE Practice Synopsis, July 28, 2015. Available from: https://www.diabeteseducator.org/docs/default-source/default-document-library/cultural-considerations-in-diabetes-management.pdf?sfvrsn=0

14. Bonger Z, Shiferaw S, Tariku E (2018) Adherence to diabetic self-care practices and its associated factors among patients with type 2 diabetes in Addis Ababa, Ethiopia. *Patient Prefer Adherence* 12: 963–970.

15. Mogre V, Abanga ZO, Tzelepis F, et al. (2017) Adherence to and factors associated with self-care behaviours in type 2 diabetes patients in Ghana. *BMC Endocr Disord* 17: 20.

16. Hildebrand JA, Billimek J, Lee JA, et al. (2020) Effect of diabetes self-management education on glycemic control in Latino adults with type 2 diabetes: a systematic review and meta-analysis. *Patient Educ Couns* 103: 266–275.

17. Basu S, Garg S, Sharma N, et al. (2020) The determinants of out-of-pocket health-care expenses for diabetes mellitus patients in India: an examination of a tertiary care government hospital in Delhi. *Perspect Clin Res* 11: 86–91.

18. Grant P (2013) Management of diabetes in resource-poor settings. *Clin Med* 13: 27–31.

19. Linetzky B, Jiang D, Funnell MM, et al. (2017) Exploring the role of the patient-physician relationship on insulin adherence and clinical outcomes in type 2 diabetes: insights from the MOSAIc study. *J Diabetes* 9: 596–605.

20. Horii T, Iwasawa M, Kabeya Y, et al. (2019) Polypharmacy and oral antidiabetic treatment for type 2 diabetes characterised by drug class and patient characteristics: a Japanese database analysis. *Sci Rep* 9: 1–6.

21. Hennis AJ, Fraser HS, Jonnalagadda R, et al. (2004) Explanations for the high risk of diabetes-related amputation in a Caribbean population of black African descent and potential for prevention. *Diabetes Care* 27: 2636–2641.

22. Gulliford MC, Mahabir D (2002) Diabetic foot disease and foot care in a Caribbean community. *Diabetes Res Clin Prac* 56: 35–40.

23. International Expert Committee (2009) International Expert Committee report on the role of A1C assay in the diagnosis of diabetes. *Diabetes Care* 32: 1327–1334.