ASSESSING PREDICTORS FOR SUSTAINABLE MANAGEMENT OF TYPE 2 DIABETES USING EVIDENCE-BASED GUIDELINES IN PUBLIC PRIMARY CARE IN A PREDOMINANTLY AFRO-CARIBBEAN POPULATION

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Purpose: The purpose of our study was to assess the success in the public primary health care clinics in Barbados, a developing nation with a predominantly Afro-Caribbean population, of achieving the targets for the management of type 2 diabetes (T2D) set by local guidelines introduced in 2006. The targets are: A1C<6.5% (48 mmol/mol), blood pressure (BP) ≤130/80 mm Hg and LDL cholesterol <1.8 mmol/L.

Methods: A retrospective descriptive chart review of 499 (317 females, 182 males) T2D patients using random quota sampling.

Results: Only 41.2% (Men 48.3%, women 36.8%, *P*=.048) of the patients reached the A1C target, 39.3% (men 48.6%, women 34.0%, *P*=.002) reached BP target and 8.6% (men 10.8%, women 7.3%, *P*=.24) reached the LDL target and only 1.2% (*n*=3) attained all three targets.

Conclusion: Similar to other studies in developed and developing countries of varying ethnic composition, there was suboptimal attainment of the defined targets for all parameters and inadequate monitoring. The main predictors affecting the attainment of treatment goals were the frequency of monitoring, duration of the disease, sex and ethnicity related factors. Interestingly, the findings support a possible viewpoint that ethnicity, defined by an interplay of genetics, culture and environmental attributes, is not the single most important predictor for poor target attainment in T2D. The low attainment of the targets emphasizes the question of less rigorous and more individualized treatment to achieve better outcomes in a developing territory as recommended by the 2014 guidelines. (*Ethn Dis.* 2014;24[4]:469–474)

Key Words: Diabetes Mellitus Type 2, Standards, Primary Health Care, African Continental Ancestry Group – Caribbean

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INTRODUCTION

Barbados has a population of 273,925 (2011) which is predominantly of African descent (93%). With an estimated prevalence of diabetes of around 17% in persons aged <60 years and 21.6% in persons aged >60 years, the figures are among the highest in the Latin American and Caribbean countries.[1] Studies suggest that the prevention of macro- and microvascular complications of diabetes mellitus type 2 (T2D) require not only control of hyperglycemia but the integrated management of hypertension and dyslipidemia as well.[2–5] However the specific target or goal for these parameters is the subject of much debate.[6–8] Also, it has been reported that ethnicity has predisposed minorities to poorer attainment of the treatment goals and outcomes.[9,10] While these disparities may be related to equity and accessibility, biological factors such as having any of the major risk factors associated with the cardio-renal syndrome and salt sensitivity/low renin status in persons of African descent have been considered the main contributors to the ethnic disparities in health status.[11,12]

There is a general assumption that following evidenced-based guidelines and reaching target goals reduce the risk of the complications of T2D. Thus evidence-based guidelines are useful for regularizing optimal care and standardizing practices. The Caribbean Health Research Council (CHRC) guidelines were introduced to the polyclinics in 2006.[13] The guidelines identify targets of glycosylated hemoglobin A1C (A1C) <6.5% (48 mmol/mol), blood pressure ≤130/80 mm Hg and LDL cholesterol <1.8 mmol/L. These targets were considered to be commensurate to the evidence-based approaches to managing diabetes in the multiethnic Caribbean region.

Barbados has a state-run health care infrastructure, and care is free at the point of delivery. It is estimated that approximately half of the population use the public service.[14] Eight polyclinics serve as the primary health care delivery points of which four have a specialized clinic for patients with diabetes; however, the specialized clinics are not staffed by an endocrinologist/diabetologist.

Our study sought to assess and quantify blood glucose, blood pressure and cholesterol control in persons diagnosed with T2D who are not on insulin treatment after the introduction of the CHRC guidelines. Also, it has attempted to identify predictors for optimal monitoring and target goal attainment.

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Table 1. General characteristics of the study population, *N*=499[a]

Variable	*n*	Total	Female *n* = 317	Male *n* = 182	Sample Range Min	Sample Range Max
Age, years	499	65.4 ±12.1	65 ± 12.7	66 ± 11.2	34	95
Duration of DM, years	290	9.8 ± 6.3	10.5 ± 6.6	8.9 ± 5.6	2	30
A1C, %, mmol/mol	301	7.0 ± 1.6	7.1 ± 1.6	7.0 ± 1.7	2	12.3
		53 ± 17.5	54 ± 17.5	53 ± 18.6	-	111
Fasting BG, mmol/L	282	8.1 ± 3.2	8.1 ± 3.2	8.1 ± 1.7	2.6	19.2
LDL Cholesterol, mmol/L	374	3.0 ± 1.3	3.1 ± 2.2	2.8 ± 0.9	1	33.3
BP - systolic, mm Hg	496	133 ± 14.6	134 ± 14.8	130 ± 14.0	64	190
BP - diastolic, mm Hg	496	78 ± 9.0	78 ± 9.1	77 ± 8.8	33	105
Weight, kg	380	77.5 ± 17.2	76.5 ± 17.6	79.3 ± 16.5	40	146.5

DM, diabetes mellitus; BG, blood glucose, LDL, low-density lipoprotein; BP, blood pressure.
[a] Data are mean ± SD unless specified otherwise.

Our study sought to assess and quantify blood glucose, blood pressure and cholesterol control in persons diagnosed with T2D who are not on insulin treatment after the introduction of the CHRC guidelines.

METHODS

Our study is a descriptive retrospective chart review of patients categorized as T2D not treated with insulin who attended the 8 public polyclinics. Inclusion criteria were aged ≥25 years with a minimum of 2 visits per year during the period January 2009–December 2010. Exclusion criteria were insulin treatment and/or referral to Queen Elizabeth Hospital's endocrine/diabetes clinic (the only public specialist clinic on the island) during the study period.

Participants were selected using random quota sampling with random selection of records and replacement using the clinics' administrative patient database (based on the ICD-9-CM international classification of diseases, ninth revision, clinical modification). The patients' files are handwritten and if not found legible or not fulfilling the inclusion criteria the next file in the clinics filing system was pulled. Identifiable data of attending physicians, clinic staff, institutions and patients were omitted in order to maintain confidentiality and anonymity. Extraction of data from the selected charts was compiled in a Microsoft Access® database designed from a validated data abstraction tool.[15]

Blood pressure readings were obtained from the patients' files. Laboratory reports were used to verify A1C and LDL cholesterol results. The LDL cholesterol measurements were assessed using spectrophotometry and reagent kits (Roche Diagnostics LDL-C plus 2nd Generation, Roche Diagnostic Corporation, Indiana US) at the Queen Elizabeth Hospital Laboratory. All A1C were analyzed at the Public Health Laboratory by a PDQ system (Primus PDQ Plus, PRIMUS Corporation, Missouri USA). Data analysis was carried out using Stata Statistical Software: Release 12 (StataCorp 2011, College Station, Texas US). Pearson's linear regression was used for comparison of groups who did or did not meet the various targets. Student's *t* test was used to determine difference between means, ANOVA for factorial analysis and Chi squared test was used to establish any sex differences, the type of care provided at the clinics and target attainment. Statistical significance was set at the 95% confidence level.

The study was approved by the Institutional Review Board of the University of the West Indies and the Ministry of Health, Barbados.

RESULTS

The total study sample consisted of 499 records from the 8 polyclinics. Table 1 displays the general characteristics of the sample.

Table 2 indicates that 60.3% of the participants had A1C done during the study period. Of the monitored participants, 41.2% reached the target of A1C of less than 6.5% (48 mmol/mol); 61.1% had recorded values of ≤7.0% (53 mmol/mol). Target attainment for A1C was significantly higher for males (48.3%) than females (36.8%). There was no significant difference in the mean A1C between sexes in the groups who did attain the target (males 5.7% [39 mmol/mol], SD ± .52%, females 5.7% [39 mmol/mol], SD ± .69%, *P*=.99) and those who did not attain the target (males 8.2% [66 mmol/mol], SD ± 1.51%, females 7.9% [63 mmol/mol], SD ± 1.34%, *P*=.14). Of the participants, 94.6% had records of prescribed anti-diabetic medication.

The mean length of duration of the disease was slightly higher, although not significant, in those who attained the target than those who did not (10.8 years, SD ±7.2 vs 10.4 years SD ± 6.3;

Table 2. The number and % of patients (total, female and male) who attained targets for blood glucose, blood pressure and cholesterol[a]

Target(s)	Total Measured		Within Target		Females within Target		Males within Target		Chi Squared Test, Value
	n	%	*n*	%	*n*	%	*n*	%	
BP	496	99.4	195	39.3	107	34.0	88	48.6	.002
A1C	301	60.3	124	41.2	68	36.8	56	48.3	.048
LDL cholesterol	373	74.7	32	8.6	17	7.3	15	10.8	.240
A1C and BP	301	60.3	41	13.6	19	10.3	22	19.0	
A1C and LDL cholesterol	244	48.9	10	4.1	5	3.3	5	5.3	
BP and LDL cholesterol	373	74.7	17	4.6	7	3.0	17	7.1	
A1C, BP and LDL cholesterol	244	48.9	3	1.2	1	0.7	2	2.1	

[a] None of the sex differences reached significance.

P=.64). Mean A1C was higher in persons attending the specialized clinics however this difference was not statistically significant (*P*=.24) (Table 3).

Table 2 shows that 99.4% of the study participants had blood pressure measurements done. The overall attainment of the target blood pressure of ≤130/80 mm Hg was 39.3%. Target attainment for BP was significantly higher (*P*=.002) for males (48.6%) than females (34.0%). However there was no significant difference in the mean systolic BP between sexes in the groups who did and those who did not attain the target (*P*=.934).The prevalence of a diagnosis of hypertension was 82.2% and 77.9% of the participants were on antihypertensive medication.

Table 2 also indicates that 74.7% of the participants had LDL cholesterol measured. Of these only 8.6% were within the target goal <1.8 mmol/L. There was no statistically significant difference in target attainment between males and females (*P*=.24) nor any significant differences between the mean LDL-cholesterol in the groups (*P*=.667). 43.5% of the participants (*n*=217) were on lipid lowering medication.

Table 3 indicates that target attainment for BP and LDL were higher in the specialized clinics, but the difference in LDL was not statistically significant. The mean length of duration of the disease in all clinics was 10 years (SD ± 6).The mean length of duration of disease was significantly higher among persons attending the specialized clinics than the non-specialized clinics 10 (SD ± 7) years vs 8 years (SD ± 6; *P*=.012) (data not shown).

The difference in sex ratios of persons attending the specialized vs non-specialized diabetic clinics was not statistically different (.37 SD ± .48 vs .36 SD ± .48; *P*=.82). The mean age of persons attending the specialized clinics was slightly greater than the mean age of persons attending the non-specialized clinics 65 years (SD ± 12) vs 64 years (SD ± 12; *P*=.233) (data not shown).

Table 4 shows that there is no significant difference in target attainment between those with vs without measured A1C.

By comparing A1C, LDL, BP and weight measure values from the first year with the results from the second year, a significant increase in mean A1C from 6.6% to 7.4% (*P*<.05) was observed. However a decrease in BP was observed; mean systolic decreased from 134.2 to 130.1 mm Hg (*P*<.05) and mean diastolic from 79.0 to 76.1 mm Hg (*P*<.05). We also observed a decrease in mean weight from 76.8 to 73.0 kg (*P*<.05). A non-significant increase in mean s-LDL was observed (3.0 to 4.5, *P*=.11).

DISCUSSION

The study population was individuals with T2D not treated with insulin. This sample excluded complicated cases (ie, those needing insulin for glycemic control), which would likely be treated in the specialist tertiary health care clinic in the hospitals. Our study addressed the less complicated cases and newer onset of disease, which is usually managed in the primary care setting.

Table 3. Comparison of mean A1C, BP and LDL-cholesterol between specialized and conventional clinics

Target	Specialized Clinics		Conventional Clinics		*t*-test, *P*
	Mean (95% CI)	Target Attainment	Mean (95% CI)	Target Attainment	
A1C, %, mmol/mol	7.1%(6.9–7.4) 54(52–57)	39%(*n*=79)	6.9%(6.6–7.2) 52(49–55)	46%(*n*=65)	.24
BP - systolic	132 mm Hg(130–133)	53%(*n*=156)	135 mm Hg(133–137)	27%(*n*=51)	.007
BP - diastolic	77 mm Hg(76–78)	70%(*n*=211)	80 mm Hg(78–81)	55.6%(*n*=109)	.0003
LDL cholesterol	3.1 mmol/L(2.8–3.4)	11%(*n*=24)	3.1mmol/L(2.8–3.5)	5%(*n*=8)	.87

Table 4. Comparison of target attainment between the groups with or without A1C measurements

	With Measured A1C %		Without Measured A1C %		
Target	Mean (95% CI)	Target Attainment	Mean (95% CI)	Target Attainment	*t*-test, *P*
FBS	8.03 mmol/L(7.56–8.49)	55%(n=93)	8.22 mmol/L(7.60–8.83)	54%(n=61)	.63
BP - systolic	132 mm Hg(131–134)	49%(n=148)	134 mm Hg(132–136)	44%(n=86)	.19
BP - diastolic	78 mm Hg(77–79)	67%(n=201)	78 mm Hg(77–80)	61%(n=119)	.53
LDL cholesterol	4.6 mmol/L(2.8–6.4)	9%(n=21)	3.0 mmol/L(2.8–3.2)	9%(n=11)	.20

It is surprising that almost all in our sample had their BP measured but A1C and cholesterol were not measured as frequently.

With the exception of A1C all the other parameters we measured were within ranges observed in other studies. These studies reported A1C measurements in the range 94%–65%, for cholesterol 93%–63% and for blood pressure 97%.[16–18] The consistency of the data may support the inference that there may be similar factors impacting monitoring in the primary care system globally. Of our sample, 99.4% had their BP measured; this was associated with optimal target attainment among the patients.

Some local organizational barriers that explain the low measuring frequencies have been identified previously.[19] Regional studies have shown that interventions can be successful in increasing monitoring frequencies.[20] It is surprising that almost all in our sample had their BP measured but A1C and cholesterol were not measured as frequently. We can speculate the reason is that BP is measured by nurses and is a feasible routine procedure with the use of automated sphygmometers. The other testing requires blood samples, which is a more time-consuming and complicated process; First, the doctor has to write a requisition; Second, the patient has either the choice of a long wait on the same day to have blood sampled by a nurse or phlebotomist, or alternatively come back another day; Third, the samples are sent to an outside laboratory and results aren't likely discussed with the patient until the next visit (ie, post hoc). We can speculate that many physicians see little added benefit in doing A1C testing post hoc in some of their patients. In addition the physicians are being asked to be cost efficient and told that A1C is an 'expensive test'. It appears, from a health care system point of view, that the current practice is an inefficient use of A1C testing. Also, there has been extensive focus on blood pressure control over a longer period of time in comparison to lipid and A1C control in Barbados.

Only 41% of the participants whose A1C levels were monitored attained the CHRC target of <6.5% (48 mmol/mol). Notably, 61% of the patients who had their A1C measured reached the American Diabetes Association's target of A1C of <7.0% (53 mmol/mol), which was very similar to that of the US National Health and Nutrition Examination Survey (NHANES) 2003–2006 where the target goal was <7.0%.[21] However the results from our study are better than other published results.[2,22,23] Recently reported regionally was a 29% target attainment in Puerto Rico.[24]

Studies have shown the threshold of 7.0% (53 mmol/mol) and down to 6.5% (48 mmol/mol) was instrumental in reducing macro-vascular and micro-vascular risk respectively.[18,25] However lowering A1C below 6.5% (48 mmol/mol) may have been challenging and also may not be advantageous given the risk of hypoglycemia and other side effects.[25–30] The patients who are reaching the target for A1C are really tightly controlled since they are reaching a mean of 5.7% (39 mmol/mol) for both females and males. Some studies show evidence of a j-curve effect for cardiovascular mortality that reaches a trough around 7.5 (58 mmol/mol).[26] Hence, glucose lowering should be tailored on an individual basis;[31] using factors such as age, disease duration, life expectancy and the risk of hypoglycemia from pharmacotherapy.[3,7,32]

Some studies have shown that persons of African descent tend to have higher A1C, BP and LDL cholesterol than other racial groups.[21] While some uncertainties exist about the impact of social conditions and access to health care on these findings, biological factors such as the prevalence of cardiorenal syndrome risk factors and salt sensitivity/low renal status may also play roles in poor attainment of treatment goals and health outcomes in persons of African descent.[11,12] Interestingly, this ethnicity-related factor was not reflected in our study vs other studies with varying ethnic compositions.[2,21–24] This could suggest that perceived disparities observed in target attainment in persons with T2D may not be greatly influenced by ethnicity.

There was no statistically significant difference in the average A1C in patients attending specialized clinics or conventional clinics − 7.1% (54 mmol/mol) and 6.9% (52 mmol/mol), respectively. However, there was a significant improvement in target attainment with both systolic and diastolic blood

pressures in the specialized clinics. This difference may reflect that the specialized diabetes clinics in Barbados procure better blood pressure control than lipid and glycemic control when compared with polyclinics with non-specialized clinics. It could be due to a deeper understanding of the critical control parameters for managing T2D and faster adaptation of new knowledge by physicians in the specialized clinics. Further studies are required to explore this phenomenon.

The level of screening for A1C rose from 28% before, to 60.3% after, the introduction of the guidelines.[14] Attainment of target goal for A1C also rose from 25% to 41.2% while noting that the A1C target for the Adams and Carter study was <7.0% (53 mmol/mol) and also included patients on insulin.[14] It cannot be verified whether the increase in the proportion of individuals with T2D reaching the target reflects: 1) better control; 2) an increase in A1C screening; 3) a different population who are not on insulin treatment; or 4) different clinics. It could be a result of a different case mix, which would lead to increased diagnosis of 'milder' cases. The assessment of blood pressure is generally a routine investigation and hence a high performance (99.4%) of this measurement was recorded. The prevalence of a diagnosis of hypertension among this group was 82.2%; this represents an increase of 10% from the Adams and Carter study.[14]

The average LDL cholesterol was 3.0 mmol/L which is comparable to the 2.8 mmol/L average attained in the NHANES study.[21] The attainment of the CHRC target of <1.8 mmol/L for LDL cholesterol was very low, representing 8.6% of those monitored. In the NHANES study, where the target for LDL cholesterol was set at 2.6 mmol/L, attainment was 42%.[21] If the same target was applied to our study sample the results would be similar (39.8%) and also consistent with regional findings.[24] There was no difference between men and women in the attainment of LDL cholesterol target (P=.254), however in the NHANES study, the percentage of men achieving the target was higher than women.[21]

In our study, 39.3% reached the target for blood pressure while other studies have reported values between 46% and 66%.[17,21] One obvious reason for the low attainment being that the population in this study is Afro-Caribbean and is possibly salt sensitive.[12] Similar to the NHANES study,[22] our study showed significantly better control in men (48.6%) as opposed to women (34.0%) P=.002.

The percentage of persons who achieved the target for A1C, blood pressure and LDL cholesterol simultaneously was a low 1.2%. This is considerable lower than the 6.6% attained in Puerto Rico or the 12.2% in the NHANES study.[21,24] Quite notably, males had significantly better target attainment than females for all three treatment goals. Similar trends were observed in a multicenter study in Brazil with a varied ethnic study population.[33] The Brazilian national goals for glycemic control, blood pressure and lipid levels were rarely achieved in clinical practice, and the availability for diabetic complication screening was low. Similar to the findings of our study, Brito Gomez et al highlighted that the quality of diabetes care, in particular for women, is poor and concluded that it should be further reviewed in developing territories.[33]

LIMITATIONS

The ICD-9-CM (international classification of diseases, 9th revision, clinical modification) coding may have led to outcome misclassification, biasing the results. The population studied is not necessarily representative of people with T2D in Barbados, or even necessarily of people with T2D who primarily use a public health care system. The number of men observed in our sample raises concern; possible explanations may be that more men are using private care and/or it may be possible that they are using care intermittently, and hence did not meet our case definition. This could have caused an overestimate of the number of males reaching the recommended targets.

CONCLUSION

Effective diabetes care requires a comprehensive approach to the management of hyperglycemia, hypertension and hyperlipidemia. In our study, we found inadequate monitoring and suboptimal attainment of targets as defined by the CHRC guidelines but also found indications that treatment was being aligned to a new body of evidence. The main predictors affecting the attainment of treatment goals were: frequency of monitoring, length of duration of the disease, sex and ethnicity-related factors. These predictors for target attainment in T2D may also be consistent in other developing and developed countries with the same or varied ethnicities. The low attainment of the targets points to the need for more individualized treatment to achieve better outcomes, especially in countries with limited health resources.

Our study emphasizes the need for rigorous monitoring. Diabetes is a complex condition and the optimal treatment cannot be reached unless A1C, BP and lipids are monitored frequently. T2D management in developing and developed territories will vary based on available resources. There needs to be a realistic approach to interventions with a better understanding of the socioeconomic, cultural and demographic issues and perceptions surrounding the management of chronic diseases.

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