Diabetic patients served at a regional level hospital: what is their clinical picture?

Pillay S,[1] MBChB, FCP(SA), Specialist Physician; **Aldous C,**[2] PhD, Senior Lecturer
Mahomed F,[3] MBChB, FCP(SA), FRCP(UK), CertEndocrinology, Specialist Physician'Endocrinologist
[1]Edendale Hospital, Department of Internal Medicine, Pietermaritzburg, KwaZulu-Natal
[2]School of Clinical Medicine, University of KwaZulu-Natal.
[3]Department of Internal Medicine, Grey's Hospital, Pietermaritzburg
Correspondence to: Somasundram Pillay, e-mail: drspillay@iafrica.com
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Abstract

Objectives: We describe the demographics, diabetic characteristics, diabetic control and complications in the diabetes service in Edendale Regional Hospital, Pietermaritzburg, in this study. Diabetes mellitus, together with its complications, is increasing at an alarming rate worldwide. Good glycaemic control translates into lower long-term complications and longer life expectancy. Previous studies performed in both the public and the private sectors have demonstrated that there is suboptimal diabetic control in South Africa.

Design: This was a retrospective database analysis. Datasheets were designed to ensure a comprehensive and standardised assessment of patients attending Edendale Hospital's diabetic clinic. Data were stored in a designed-for-purpose database.

Subjects and setting: Data from 653 first-visit diabetic patients visiting Edendale Hospital's diabetic clinic between 1 October 2012 and 30 September 2013 were collected.

Outcome measures: Glycaemic control, diabetic complications and target blood pressure were the outcome measures studied.

Results: A total of 653 first-visit patients were seen, of whom 77.03% were female and 83.40% were type 2 diabetes patients. Only 36.33% of the type 2, and 49.07% of the type 1, diabetes mellitus patients, achieved a target blood pressure of ≤ 140/80 mmHg. Only 1.23% of the type 1, and 11.18% of the type 2, diabetes mellitus patients, achieved optimal glycaemic control, defined as haemoglobin (Hb)A_{1c} ≤ 7%. The mean HbA_{1c} in the patients with type 1 diabetes mellitus was 11.82%, and 10.52% in the type 2 diabetes mellitus patients.

Conclusion: This study showed the suboptimal control of both diabetes mellitus and hypertension in the clinic, together with high rates of diabetes complications. Obesity remains a major modifiable risk factor in both type 1 and 2 diabetes patients. Blood glucose control in this resource-limited setting was similar in those patients with home blood glucose monitoring versus those without it.

Introduction

Diabetes mellitus is a global pandemic, with devastating complications.[1] Africa has not been spared, with up to 77% of diabetics being undiagnosed.[2]

Good blood sugar control translates into lower diabetic complications and longer life expectancy.[3-6] Studies from South Africa have indicated that the target glycosylated haemoglobin (Hb)A_{1c} is not being achieved at public sector diabetes clinics.[7-11] Amod and Riback demonstrated

a similar picture in the South African private healthcare sector.[12]

We attempted to improve the standard of clinical care in our clinic by designing and implementing a diabetes datasheet, administered by the clinical staff in the diabetes clinic.

It aimed to serve the following purposes:

- To ensure a standardised method of collecting patient data at the clinic, to make certain that all aspects of

patients' health care are addressed.

- To standardise diabetes management in the clinic, to ensure that patients receive comprehensive treatment.

- To serve as a clinical guide to staff when performing a comprehensive assessment of diabetic patients, to avoid elements of a medical examination inadvertently being skipped.

- To provide patients with a clinical record which serves as a communication between the regional hospital and their community clinic, thus improving communication across the patients' healthcare service and ensuring consistent treatment.

This data-capturing system was implemented in September 2012. In order to create a baseline for the assessment of our patients to guide the implementation of strategies to improve patient care going forward, the data it rendered were analysed for the period from 1 October 2012 to 30 September 2013. The level of control and the complications seen in this regional public sector diabetes clinic in Edendale Hospital, Pietermaritzburg, KwaZulu-Natal, are described in this paper. The patients seen in our clinic are predominantly black South Africans.

Common complications of diabetes, such as neuropathy, retinopathy and nephropathy, were investigated. The data was analaysed to find out whether or not there was an association between the duration of diabetes and the mean HbA_{1c} and control in the three different treatment groups viz. oral antidiabetic drugs (OADs), insulin monotherapy and a combination of OADs and insulin. Obesity is one of the major risk factors for insulin resistance and poor diabetic control, hence we examined obesity rates in this group of patients.[13,14]

Method

A new datasheet was designed and introduced into the Edendale Hospital's diabetic clinic by the clinical authors in September 2012.

Data were recorded manually onto the datasheet, and then captured by the author onto a computer programme specifically developed for this project using Visual Basic.net® and .net® technologies. Descriptive statistics applications were built into this customised programme and reports were automatically generated using crystal reports.

The following data were collected:
- *Epidemiological:* Age, gender and employment status.
- *Medical history:* Type, duration and family history of diabetes mellitus and co-morbid conditions.
- *Vital signs:* Blood pressure (BP) (mmHg), while sitting and standing using an electronic device; resting pulse, urine test (using Makromed® urine dipsticks), height (in cm), weight (in kg), body mass index (BMI) (kg/m^2), random blood glucose (mmol/l) and waist circumference (WC) (in cm).
- Physical examination findings.
- HbA_{1c} (%).
- Lifestyle and pharmacological management.

Urine dipstick proteinuria was used as a surrogate marker of nephropathy[3] as urine microalbumin dipsticks were not available at the time of the study.

To perform height, weight and BMI readings, the Adam® Equipment MDW-300L scale was used. A Accu-Chek Active® glucometer was used. BP and pulse were recorded using a Mindray® VS-800 machine. BP was recorded, as described in the 2011 South African hypertension guidelines.[15] The patient's WC was taken at the end of normal expiration with a measuring tape at a point midway between the lower ribcage and the superior iliac crest in the midaxillary line. The National Health Laboratory Service used the Bio-Rad® D-10 machine to determine the HBA_{1c} values, which were National Glycohemoglobin Standardization Program-accredited to ensure the standarisation of the HbA_{1c} values.

Results

There were 1 613 patient visits during the study period. Of these, 653 were first-patient visits, and a further 960 were repeat visits.

Epidemiology

The majority of the patients seen at the clinic were female (77.03% vs. 22.97%). Half (50.38%) of the patients were in the age range of 51-70 years. Type 2 patients predominated (83.46%), and 91.81% of the patients reported being unemployed.

Medical history

Of the 653 first-visit patients seen, 108 had type 1 diabetes and 545 type 2 diabetes. The diagnosis of type 1 and type 2 diabetes was historically based on the age of diagnosis of diabetes mellitus at this clinic. Although in retrospect, this may seem to have been a crude diagnostic effort, it was a pragmatic decision, given the poor resource setting. Type 1 diabetes mellitus was diagnosed in patients who developed diabetes mellitus before the age of 30 years, while type 2 diabetes mellitus was diagnosed in patients who developed it after 30 years of age. The mean age of diagnosis for type 1 and type 2 diabetes patients was 21.89 and 49.42 years, respectively. The majority of the patients (57.27%) had diabetes mellitus for ≤ 10 years. Just over half (56.15%) of the type 2 patients reported no family history of diabetes mellitus, while 52.78% of the type 1 patients related a positive family history thereof. The possibility of maturity-onset diabetes mellitus of the young might explain this finding.

Table I: Obesity rates according to body mass index

Body mass index (kg/m²)	Type 1 diabetes		Type 2 diabetes	
	n	%	n	%
Very severely underweight: Less than 15.0	0	0.00	38	6.97
Severely underweight: 15.0-16.0	0	0.00	0	0.00
Underweight: 16.0-18.5	1	0.93	3	0.55
Normal: 18.5-25.0	35	32.41	52	9.54
Overweight: 25.0-30.0	29	26.85	114	20.92
Obese (class 1): 30.0-35.0	21	19.44	127	23.30
Obese (class 2): 35.0-40.0	12	11.11	109	20.00
Obese (class 3): ≥ 40)	10	9.26	102	18.72
Total	**108**	**100**	**545**	**100**

Co-morbid conditions found in our patients included:
- Human immunodeficiency virus (HIV) infection (22.82%).
- Hyperlipidaemia (55.59%).
- Ischaemic heart disease (6.28%).

Vital signs

Body mass index

Obesity is defined by World Health Organization as a BMI ≥ 30 kg/m². It was noted that there was a relationship between obesity and diabetes type. Type 2 diabetes patients displayed higher rates of obesity than type 1 diabetes patients (62.02% vs. 39.81%) [odds ratio (OR) 0.41, 95% confidence interval (CI): 0.27-0.62, p-value < 0.0001], (Fisher's exact test) (Table I).

The mean HbA_{1c} in the type 1 obese patients compared to that in the non-obese patients was 11.59 ± 2.67 vs. 11.97 ± 3.35, respectively (p-value 0.557) (Wilcoxon rank-sum test).

The mean HbA_{1c} in the type 2 obese patients compared to that in the non-obese patients was 10.54 ± 3.13 vs.10.48 ± 3.56, respectively (p-value 0.90) (Wilcoxon rank-sum test).

Waist circumference

The type 1 patients had a mean WC of 84.50 cm (males) and 97.20 cm (females), while the type 2 patients had a mean WC of 103.74 cm and 109.22 cm (males and females, respectively).

Waist to height ratio

Waist to height ration (WTHR) is a better predictor of obesity and adverse cardiovascular outcomes than BMI.[16]

A value of > 0.5 has been proposed as a cut-off point for central obesity.[16] Using this value, 79.76% of female patients and 20.24% of male patients in this study were classified as obese.

Waist to height ratio versus body mass index

Approximately 10% of the patients (15.33% of the males and 8.35% of the females) had a normal BMI, but an increased WTHR.

Urine dipstick findings

Random urine dipstick readings were performed on the morning of the patient's visit to the clinic. Prior to home-based blood sugar testing devices being freely available, the testing of urine for glycosuria was advocated.[17] Glycosuria was used as an indicator of poor blood sugar control.[17]

The mean HbA_{1c} was higher in the glycosuria group. Glycosuria was present in 39.47% of the patients, and their mean HbA_{1c} was 11.57 ± standard deviation ± 3.32. The mean HbA_{1c} was 10.17 ± 3.16 (p-value 0.00) (Wilcoxon rank-sum test), (Table II) in the group without glycosuria. Eta was used to determine the strength of the association between glycosuria and HbA_{1c} (eta 0.208). This showed a medium to typical effect size. Eta squared was 0.043, indicating that the two variables share a 4.3% common variance.

Table II: Glycosuria, as an indicator of poor blood sugar control

	Number of patients (n)	Mean HbA_{1c} (%)
NAD	381	10.19
1+	26	9.71
2+	55	11.42
3+	97	11.92
4+	83	11.85
No entry	11	9.67
Total	**653**	

HbA_{1c}: haemoglobin A_{1c}, NAD: no abnormality detected

Proteinuria is associated with an increased risk of cardiovascular complications.[17] Proteinuria was present in 18.38% of the patients, and their mean HbA_{1c} was 10.33 ± 3.16. The mean HbA_{1c} was 10.82 ± 3.32 (p-value 0.110) (Mann-Whitney U test), (Table III), in the group without proteinuria. The presence of proteinuria increased with the duration of diabetes mellitus in years (Table III). The

Table III: Overt proteinuria versus glycaemic control and duration of diabetes mellitus

	n	Mean HbA_{1c} (%)	Duration of diabetes mellitus (in years)
NAD	508	10.88	8.65
1+	61	9.62	9.67
2+	41	11.18	11.10
3+	18	10.81	11.83
No entry	25	9.69	10.20
Total	**653**	**100**	

HbA_{1c}: haemoglobin A_{1c}, NAD: no abnormality detected

majority of patients with overt proteinuria and hypertension (72.12%) did not achieve their target BP (Table IV).

Blood pressure

Hypertension was the most common co-morbid condition found (83.61%).The mean sitting BP reading in this cohort of diabetic hypertensive patients was 138/83 mmHg and the mean erect BP was 140/86 mmHg. The South African

guidelines advocate target sitting BP in diabetes patients to be ≤ 140/80 mmHg.[15] Fifty-three (49.07%) of the type 1, and 198 (36.33%) of the type 2, diabetes mellitus patients, achieved the target BP.

Physical examination

Long-term diabetes complications

The mean HbA_{1c} was 11.07 ± 2.80 vs. 10.71 ± 3.32 (p-value 0.478) (Mann-Whitney U test) in patients with retinopathy, as opposed to those without retinopathy, and the average duration of diabetes mellitus in years was 10.98 ± 8.24 vs. 8.91 ± 7.75, respectively (Tables V and VI).

The mean HbA_{1c} was 10.33 ± 3.16 vs. 10.82 ± 3.32 (p-value 0.110) (Mann-Whitney U test) in patients with nephropathy, as opposed to those without it, and the average duration of diabetes mellitus in years was 10.48 ± 8.15 vs. 8.72 ± 7.68, respectively (Tables V and VI).

The mean HbA_{1c} was 10.64 ± 3.26 vs.10.80 ± 3.33 (p-value 0.584) (Mann-Whitney U test) in patients with neuropathy, as opposed those without it, and the average duration of diabetes mellitus in years was 9.18 ± 7.72 vs. 8.93 ± 7.86, respectively (Tables V and VI).

The prevalence of all forms of retinopathy was higher in type 2, versus type 1, diabetes mellitus patients (6.97% vs 3.70%), while patients with type 1 diabetes had a higher incidence of nephropathy (19.44% vs. 18.17%) (Table V).

A significant relationship was not demonstrated in this study between the average duration of diabetes and microvascular complications viz. retinopathy (OR 0.90, 95% CI: 0.48-1.70), neuropathy (OR 0.82, 95% CI: 0.60-1.13) and nephropathy (OR 0.71, 95% CI: 0.47-1.05) (Fisher's exact test), (Table VI).

The combination of orthostatic hypotension and/or resting tachycardia was used as an indication of autonomic neuropathy in this study. Close to half (45.48%) of the

Table IV: The presence of overt proteinuria and hypertension

	n	Patients with proteinuria and target BP achieved (n)	Patients with proteinuria and target BP not achieved (n)
NAD	420/508	212	208
1+	49/61	18	31
2+	39/41	6	33
3+	16/18	5	11
No entry	22/25	10	12
Total		**251**	**295**

BP: blood pressure, NAD: no abnormality detected

Table V: The prevalence of microvascular complications

Microvascular complications	Diabetes mellitus		
	Type 1	Type 2	Type 1 and 2
	n (%)	n (%)	n (%)
Diabetic retinopathy	4 (3.70)	38 (6.97)	42 (6.43)
Non-proliferative diabetic retinopathy	1 (0.93)	20 (3.67)	21 (3.22)
Proliferative diabetic retinopathy	3 (2.78)	18 (3.30)	21 (3.22)
Nephropathy	21 (19.44)	99 (18.17)	120 (18.46)
Neuropathy	49 (454.37)	246 (45.14)	295 (45.18)
Total	**108**	**545 (100)**	**653**

Table VI: Comparisons between microvascular complications and the duration of diabetes mellitus

Microvascular complications	Duration of diabetes mellitus	Total number of patients	Number of patients with complications	%
All forms of retinopathy	≤ 10 years	404	25	6.19
	10-20 years	172	9	5.23
	≥ 20 years	77	8	10.39
	Total	**653**	**42**	
Nephropathy	≤ 10 years	404	66	16.34
	10-20 years	172	37	21.51
	≥ 20 years	77	17	22.08
	Total	**653**	**120**	
Neuropathy	≤ 10 years	404	175	43.32
	10-20 years	172	91	52.91
	≥ 20 years	77	29	37.66
	Total	**653**	**295**	

Table VII: Glycaemic control achieved with various forms of pharmacological management

Diabetic patients	Medication used	n	Mean HbA$_{1c}$ (%)
Type 1	OAD monotherapy	4	9.73
	Insulin monotherapy	67	12.04
	Combination insulin and OADs	37	11.64
Total		108	
Type 2	OAD monotherapy	142	10.09
	Insulin monotherapy	118	9.91
	Combination insulin and OADs	285	10.98
Total		545	

HbA1c: haemoglobin A1c, OAD: oral antidiabetic drugs

patients had evidence of a resting tachycardia (heart rate ≥ 100 beats per minute), while 41.19% had orthostatic hypotension. Sixty-nine patients (10.41%) attending the diabetic clinic had evidence of autonomic neuropathy.

The mean HbA$_{1c}$ was 11.28 ± 3.54 vs. 10.68 ± 3.27 (p-value 0.234) (Mann-Whitney U test) in patients with autonomic neuropathy versus those without it, and the average duration of diabetes was 9.63 ± 6.82 vs. 8.99 ± 7.89 years, respectively.

Laboratory investigations

The mean HbA$_{1c}$ in type 1 and type 2 patients was 11.82% and 10.52%, respectively.

Lifestyle and pharmacological management

Exercise and diet

Exercise and diet form one of the cornerstones of lifestyle modification for the management of diabetes mellitus. The majority of patients (77.34%) reported following a diabetic diet, and 44.10% some exercise, in the form of daily occupational activities and getting to and from work.

Smoking and alcohol intake

Only a small percentage of the patients had a history of smoking (3.98%) and alcohol intake (3.52%). This is likely to have been under-reported.

Home glucose monitoring

The majority of our patients (71.21%) did not have blood glucose monitoring devices. Less than half (42.59%) of the type 1, and 26.06% of the type 2, diabetes mellitus patients, had glucometers. The mean HbA$_{1c}$ obtained in those with glucometers versus that in those without them was 10.87 ± 3.09 vs. 10.68 ± 3.38 (p-value 0.777) (Mann-Whitney U test).

Again, less than half (39.36%) of the patients on insulin therapy had glucometers, while 29.03% of the patients

on insulin therapy didn't have them. The mean HbA$_{1c}$ obtained in those with glucometers versus that in those without them the insulin therapy group was 11.40 vs. 10.04 (OR 1.10, 95% CI: 0.33-3.64, p-value 1.00) (Fisher's exact test). The patients who had received the glucometers were probably the more difficult to treat or were resistant diabetic patients, and this could explain the poor response to the use of glucometers.

Treatment groups and diabetes control

The four type 1 patients who were on OAD monotherapy were probably type 2 diabetes mellitus in childhood, misclassified as type 1 diabetes (Table VII).

Discussion

Our hypothesis was that, like the rest of South Africa,[7-12] we have suboptimal control of diabetes mellitus and a high rate of complications, and hence there is a need for an improved package of diabetes care.

Epidemiology

Most (62.78%) of our patients were aged 50 years and older. With an older population, the clinician has to take the increased pill burden into consideration, together with possible drug-drug interactions that may occur. It was noteworthy that the majority of our patients were female (77.03%). This makes is essential to introduce education on female issues, like regular Papanicolaou smears and breast examinations at our clinic. The employment history relied on self-reporting, and was probably under-reported as patients might have viewed this question as a threat to their continuing to receive government-funded financial grants.

Medical history

The majority of the type 2 patients had no family history of diabetes (56.15%). This was possibly owing to their families having little or no access to health care in the past, and therefore diabetes never having been diagnosed. A large proportion of our patients had concurrent HIV infection (22.82%), which poses certain management problems. The control obtained in this diabetic HIV-positive population will be analysed in a subsequent study.

Over half of the patients (57.27%) had diabetes mellitus for less than 10 years. It is unfortunate that the opportunity to aggressively control the diabetes early in the course of disease was missed previously.

Vital signs

BP control is essential in the management of diabetes mellitus.[6] Less than half of the patients (both type 1 and type 2) achieved optimal BP control. Statistically, better BP control was observed in the type 1 diabetes patients (OR 1.69, 95% CI: 1.10-2.17, p-value 0.017, likelihood ratio 1.35) (Fisher's exact test). This is possibly explained by the fact that the type 1 patients were younger in age.

WC measurement helps to assess the amount of visceral fat.[16] Visceral fat is more metabolically active than subcutaneous fat around the hip and thighs.[16] The International Diabetes Federation (IDF) defines central obesity as a WC ≥ 94 cm in males and 80 cm in females.[18] It was shown in a study carried out by Motala et al[19] that these cut-off values differ from the IDF values for patients of African descent. Thus, a WC of ≥ 86 cm for males and 92 cm for females was used as an indicator of central obesity in this study. What was shown in our study was that an average WC in both males and females of 103.74 cm and 109.22 cm, respectively, in the type 2 patients, exceeded the cut-off points for central obesity. This trend of central obesity was also seen in the female patients with type 1 diabetes mellitus, with a WC of 97.20 c.

Using BMI as indicator of obesity, type 2 patients in the study displayed higher rates of obesity than type 1 patients (62.02% vs. 39.81%), (Table I). When the WTHR of > 0.5 was used as an indicator for obesity, 73.04% of the type 1, and 87.01% of the type 2, diabetes mellitus patients, were classified as obese. This study demonstrated that 10% of the patients with a normal BMI had an increased WTHR. This indicates that using BMI alone as an indicator for obesity may result in actual obesity rates being under-reported. Studies have shown that type 2 patients have a higher rate of obesity than type 1 patients.[20] The rate of obesity observed in our type 1 patients (39.81%) was of great concern, and attempts need to be made to prevent and control this.

Physical examination

Our study confirmed that complications from diabetes mellitus remain high, with at least 20% of the patients having evidence of overt nephropathy, 6.43% evidence of retinopathy, and 45.18% evidence of neuropathy. It is notable that the HbA$_{1c}$ in patients with nephropathy and neuropathy was better than that in those without these complications, possibly as a result of recent improved control in these patients subsequent to diagnosis of the complications.

Laboratory investigations

This study showed no difference to previous studies with regard to the demonstration of poor diabetic control in South African clinics. Only 8 (1.23%) of the type 1, and 73 (11.18%) of the type 2, diabetes mellitus patients, achieved optimal blood sugar control (defined as an HbA$_{1c}$ < 7%). The mean HbA$_{1c}$ achieved in the type 1 patients was 11.82%, and that in the type 2 patients, 10.52%.

Control in the type 1 patients was worse than that in the type 2 patients [mean HbA$_{1c}$ of 11.82 ± 3.09 vs. 10.52 ± 3.29, respectively, (p-value < 0.001) (Mann-Whitney U test). This is especially important as the type 1 patients were younger, and poor control would increase their chance of diabetic complications.

Lifestyle and pharmacological management

This study showed that insulin therapy in type 2 patients was effective in controlling blood sugar, and may indicate that earlier insulin initiation might improve diabetes control in this setting.This suggests physician inertia, which needs to be adderssed so that insulin therapy can be introduced earleir in accordance with the Society for Endocrinology, Metabolism and Diabetes of South Africa guidelines. It is imperative that better ways of maintaining control of diabetes mellitus in our patients are sought, as these could translate into a reduction in long-term complications.[3-6] Our study has highlighted specific areas that could be targeted when starting to make improvements to the care of patients with diabetes mellitus.

We have shown that the majority of patients had no access to glucometers. Also, there was no difference in control in the group of patients with glucometers. This unexpected finding could be explained by the following:

- Language barriers.
- A poor understanding of the use of the machine by the patient and/or doctor.
- Insufficient glucosticks.
- Selection bias with regard to whom was given the glucometers.
- More emphasis needing to be placed on patient education regarding lifestyle modification and compliance with medication, especially insulin, and its method of administration.
- Medication availability, and the long wait at clinics, needing to be addressed.
- Patients' psychological attitudes to insulin commencement and administration needing to be addressed.

Limitations

The majority of patients were black South Africans, in whom the incidence of diagnosed cardiovascular disease is generally lower than that in the Indian and white populations,[21] and hence the lower incidence of cardiovascular disease in our study.

The diagnosis by the attending clinician of type 1 and type 2 diabetes may have been incorrect. This is an inherent problem in a retrospective study. Further studies on obesity in type 1 diabetes patients are recommended, in which formal criteria for the diagnosis of type 1 and type 2 diabetes should be used.

Urine microalbumin dipsticks were not available during the study period, so the prevalence of nephropathy was underestimated and represents overt nephropathy only.

Determining the prevalence of the following relied on self-reporting, and was therefore probably under-reported:

- Smoking.
- Alcohol intake.

- Symptoms of neuropathy.
- HIV infection.

Conclusion

The implementation of a comprehensive treatment protocol for each clinic visit and an accompanying datasheet in our diabetes clinic resulted in the development of a database which could be consulted to investigate specific problem areas. The examination of one year of data has indicated that there is poor control in this group of patients. The rates of complications were high after a short duration of the disease. This highlights the desperate need for a comprehensive diabetes treatment plan, similar to that used for the roll-out of HIV treatment, to address this problem.

Recommendations to improve diabetic control include better improved clinical datasheets, a multidisciplinary team approach to ensure a more comprehensive treatment approach to patients, and better patient education, so that patients can be more responsible for controlling their disease. This study should be viewed as a baseline study against which intervention studies should be compared.

References

1. Ginter E, Simko V. Diabetes type 2 pandemic in 21st century. Bratisl Lek Listy. 2010;111(3):134-137.
2. International Diabetes Federation diabetes atlas. IDF [homepage on the Internet]. 2012. Available from: http://www.idf.org/diabetesatlas
3. Nathan DM. Long term complications of diabetes mellitus. New Engl J Med. 1993;328(23)1676-1685.
4. Kidney Disease Outcomes Quality Initiative. KDOQI clinical practice guidelines and clinical practice recommendations for diabetes and chronic kidney disease. Am J Kid Dis. 2007;49(2 Suppl 2):S12-S154.
5. Diabetes Control and Complications Trail (DCCT): results of feasibility study. The DCCT research group. Diabetes Care. 1987;10(1):1-19.
6. American Diabetes Association. Implications of United Kingdom Prospective Diabetes Study. Diabetes Care. 2002;25(Suppl1):S28-S32 [homepage on the Internet]. Available from: http://care.diabetesjournals.org/content/25/suppl_1/s28.full
7. Rotchford AP, Rotchford KM. Diabetes in rural South Africa: an assessment of care and complications. S Afr Med J. 2002;92(7):536-541.
8. Erasmus RT, Blanco Blanco E, Okesina AB, et al. Assessment of glycemic control in stable type 2 black South African diabetics attending a peri-urban clinic. PostgradMed J. 1999;75(888):603-606.
9. Pinchevsky Y, Butkow N, Raal FJ, Chirwa T. The implementation of guidelines in a South African population with type 2 diabetes. JEMDSA. 2013;18(3):154-158.
10. Steyn K, Levitt D, Patel M, et al. Hypertension and Diabetes: poor care for patients at community health centres. S Afr Med J. 2008;l98(8):618-622.
11. Klisiewicz AM, Raal F. Sub-optimal management of type 2 diabetes mellitus: a local audit. JEMDSA. 2009;14(1):13-16.
12. Amod A, Riback W. Diabetes guidelines and clinical practice: is there a gap? The South African cohort of the International Diabetes Management Practices Study. JEMDSA. 2012;17(2):85-90.
13. Pi-Sunyer FX. Obesity and diabetes in blacks. Diabetes Care.1990;13(11):1144-1149.
14. Naser KA, Gruber A, Thomson GA. The emerging pandemic of obesity and diabetes. Are we doing enough   to prevent a disaster? Int J Clin Pract. 2006;60(9):1093-1097.
15. Seedat YK, Rayner BI. South African hypertension guideline 2011. S Afr Med J. 2012;102(1 Pt 2):57-84.
16. Browning LM, Hsieh SD, Ashwell M. A systematic review of waist-to-height ratio as a screening toll for the prediction of cardiovascular disease and diabetes: 0.5 could be a suitable global boundary value. Nutr Res Rev. 2010;23(2):247-269.
17. Viswanathan V, Nair MB, Suresh S, et al. An inexpensive method to diagnose incipient diabetic nephropathy in developing countries. Diabetes Care. 2005;28(5):1259-1260.
18. The IDF consensus worldwide definition of the metabolic syndrome. IDF [homepage on the Internet]. c2015. Available from: http://www.idf.org/webdata/docs/Meta_syndrome_definition.pdf
19. Motala AA, Esterhuizen T, Pirie FJ, Omar MAK. The prevalence of metabolic syndrome and determination of the optimal waist circumference cutoff points in a rural South African community. Diabetes Care. 2011;34(4):1032-1037.
20. Daousi C, Casson IF, Gill GV, et al. Prevalence of obesity in type 2 diabetes in secondary care: association with cardiovascular risk factors. Postgrad Med J. 2006;82(966):280-284.
21. Yusuf S, Reddy S, Ounpuu S, Anand S. Global burden of cardiovascular diseases. Circulation. 2001;104(23):2855-2864.