

An investigation into diabetic patients' knowledge of diabetes and its ocular complications in the Western Cape

PC Clarke-Farr*, MM Nel** and AC Wilkinson***

* Department of Ophthalmic Sciences, Faculty of Health and Wellness Sciences, Cape Peninsula University of Technology, PO Box 652, Cape Town, 8000 South Africa

** Office of the Dean - Head: Educational Development, Faculty of Health Sciences, University of the Free State, PO Box 339, Bloemfontein, 9300 South Africa

*** Centre for Higher Education Studies, University of the Free State, PO Box 339 Bloemfontein, 9300 South Africa

*<clarkefarrp@cput.ac.za>

**<gndkmmn.MD@mail.uovs.ac.za>

***<wilkinac.RD@mail.uovs.ac.za>

Abstract

This paper presents the findings of a study which evaluated the knowledge of a sample of diabetic patients about their disease and its ocular complications. A comprehensive questionnaire was provided to diabetic patients in the Cape Town metropolitan district and its surrounds. Specifically, the questionnaire aimed to determine the patient's knowledge of diabetes, their knowledge of the ocular complications of diabetes, the options for its management and treatment as well as a section considering other general information relating to diabetes and its ocular complications. Their subject knowledge about diabetes and its ocular complications was relatively limited as only 42% of respondents knew about the existence of two types of diabetes. Twenty nine percent of respondents believed that diabetes would not affect their eyes. Although 76% of the patients felt it very important to measure

their blood sugar and 80% rated blood sugar control as very important, only 37% of the respondents measured their blood sugar on a daily basis. A particular concern was that although 96% of the respondents felt that it was important to have their eyes checked regularly, only 30% of the respondents stated that they had actually had their eyes checked every year. The results of this investigation support the need for diabetic patients to receive better patient education about diabetes and its ocular complications. Furthermore, attention needs to be paid to expanding patient access to diabetic screenings and ocular examinations in order to manage this condition effectively.

Keywords

Community health centres, blood sugar, diabetes mellitus, diabetes education, diabetic retinopathy, diet, health care worker, insulin, ocular complications of diabetes.

* PhD (UFS)

** PhD (UFS)

*** PhD (UFS)

Introduction

According to Feman¹, diabetes mellitus is a chronic disorder characterised by hyperglycemia and major abnormalities of carbohydrate, fat and protein metabolism. Diabetes is accompanied by a marked propensity to develop relatively specific forms of renal, ocular, neurological and premature cardiovascular diseases. Dobbins² similarly defines diabetes as “a chronic disorder characterised by a deficiency of insulin secretion and/or insulin effect, which causes hyperglycemia, disturbances of carbohydrate, fat and protein metabolism, and a constellation of chronic complications.” It is this inability to metabolise carbohydrates, fats and proteins that leads to chronic and acute complications associated with the disease.

Diabetes mellitus can be classified according to two main categories, namely Type I and Type II. This classification is also indicative of the pathophysiological development of the disease. Type I or insulin-dependent diabetes mellitus occurs mainly in children and young adults and the onset is usually sudden³. The deficiency or absence of insulin is due to the destruction of β-islet cells, and although the causes for Type I diabetes are unknown, there is frequently a familial tendency which suggests that there is a genetic involvement.

Type II or non-insulin-dependent diabetes mellitus is the most common form of diabetes³ accounting for about 90% of all cases. Most patients who develop this form of diabetes are either overweight or obese adults. Insulin secretion may be below or above normal and the deficiency of glucose inside body cells may occur when there is hyperglycaemia and a high insulin level. A further additional category of diabetes is termed secondary diabetes. This form usually occurs as a result of a prior condition, for instance acute and chronic pancreatitis or even through the effects of certain drugs, such as corticosteroids. Other hormonal disturbances, or even pregnancy - producing gestational diabetes, are possible contributing factors³.

The diagnostic criteria for diabetes in the South African context have been determined by the South African Department of Health⁴ as part of its National Programme for Control and Management of Diabetes Type II. The criteria

includes symptoms of diabetes plus random glucose levels greater than 11.1 mMol/l, or symptoms of diabetes plus fasting glucose greater than 7.1 mMol/l (plasma) or greater than 6.1 mMol/l (whole or capillary blood).

Global epidemiology of diabetes

According to the International Diabetes Federation⁵, an estimated 151 million people between the ages of 20-79 have diabetes and this figure is on the increase. Table 1 reflects the prevalence of diabetes globally, as well as in Africa, and classifies the prevalence of diabetes by age group, type and location. It appears that the current prevalence of diabetes in Africa is lower than the global average. However, in Africa and, in particular South Africa, the prevalence of diabetes is on the rise⁶.

Table 1: The epidemiology of diabetes mellitus		
Diabetes Mellitus (DM) for the 20-79 year age group		
Region	No. of people with DM (000's)	Prevalence %
Global	150 916.3	4.6
Africa	2532.9	1.2
Type 1 Diabetes Mellitus (DM) for all age groups		
Global	4867.04	0.09
Africa	101.57	0.02
Source: International Diabetes Federation (2001:11)		

Epidemiology of diabetes in South Africa

Although statistics available from the South African Department of Health⁷ do not distinguish between Type I and Type II diabetes, the stated prevalence of 3.2% and 2.4% for the Western Cape and South Africa respectively, are nevertheless indicative of a very serious public health issue. The figures are also much higher than the average prevalence values for Africa as a whole, which reflects the view that diabetes, particularly Type II diabetes, is largely a disease of lifestyle both in terms of poor dietary habits and insufficient exercise. *The National Guidelines for the Prevention of Blindness in South Africa*⁶ quotes an even higher prevalence of diabetes in South Africa. The stated prevalence of diabetes in South Africa among Indians is estimated to be 11-13%, while among black Africans it is 5% and increasing. According to the guidelines⁶, approximately 90% of diabetes

that occurs in South Africa is Type II, and in these cases retinopathy may well exist before the diabetes is eventually diagnosed. In South Africa, diabetic retinopathy accounts for 8% of blindness which is also on the increase⁶. The prevalence of blindness due to diabetic retinopathy in any particular health region may however, vary, and would also possibly depend on the demography of the region. Large-scale studies on the prevalence rates of diabetic retinopathy in the Western Cape Province or in South Africa have as yet not been conducted.

Risk factors for developing diabetes mellitus

Fantus, Delovitch and Dupré⁸ consider that no known modifiable risk factors exist for acquiring Type I diabetes in children and the youth. Non-modifiable risk factors include race and ethnic background, age and genetic susceptibility. Non-modifiable risk factors for Type II diabetes are similar to Type I, that being age and family history⁹. Potentially modifiable risk factors include upper-segment body fat distribution and physical inactivity. Studies by Levitt *et al.*⁹ further concluded that waist circumference for visceral fat was a more important determinant of Type II diabetes than obesity *per se*.

In terms of diabetic retinopathy, the following risk factors have been identified by various authors as possibly having an influence on the incidence and progression of diabetic retinopathy: male sex^{10, 11}; race^{8, 12} (indirect risk factor); genetic factors¹; duration of diabetes^{1, 10, 13, 14}; older age^{1, 11}; hyperglycaemia and poor glycaemic control^{1, 15, 11}; proteinuria and renal disease^{1, 16}; as well as pregnancy^{1, 17}.

Ocular complications of diabetes

The ocular changes that may arise due to diabetes mellitus affect almost every aspect of the eye. The most significant of these include refractive changes, cataracts, rubeosis irides, ocular hypertension and glaucoma, and diabetic retinopathy with all its manifestations and complications¹⁸.

Methodology

The purpose of this study was to determine exactly what diabetic patients knew about diabetes, its complications and how to treat and manage the condition. The preparation for the

research involved a comprehensive literature review of diabetes and its ocular complications which established the background for the research, and thereafter formed the basis for the development of the questionnaire for the diabetic patients.

The diabetic patient record card and questionnaires were developed first by formulating a patient history/record card. Subsequently four broad areas of investigation were identified based on information obtained through the comprehensive literature review. Considering that the aim of the questionnaire was to determine the diabetic patients' knowledge about their condition and its potential effects on the eyes, questions were developed to determine their knowledge in the following areas: the disease of diabetes; the ocular complications of diabetes; the management and treatment options for diabetes; and other additional information relating to diabetes.

The questionnaires were available in the three most commonly-spoken languages of the patients attending the community health clinics, namely Afrikaans, isiXhosa and English. The questionnaires were also specifically coded during their development to ensure that upon completion, the data could be analysed in terms of both qualitative and quantitative statistics. Section 1 of the questionnaire dealt with the various issues pertaining to the patient's *Knowledge of diabetes*. Section 2 of the questionnaire dealt with the areas pertaining to the patient's *Knowledge of the ocular complications of diabetes*. Section 3 of the questionnaire dealt with aspects pertaining to the patient's *Knowledge of the management and treatment options of diabetes*. Section 4 of the questionnaire dealt with other *Additional information* related to the patient's knowledge of diabetes. The questionnaire survey with the diabetic patients was preceded by a pilot study that was initially conducted with a small group of 10 diabetic patients in order to critically evaluate and finalise the patient questionnaire.

Permission to conduct the research was obtained from the Chief Director: District Health Services in the Western Cape Department of Health. Furthermore, all diabetic patients provided written informed consent to participate in the study prior to the commencement of the

research. They also gave permission for their details and results to be used for the statistical analysis of the findings.

Sample selection

The target population included diabetic patients in the Western Cape Province of South Africa, specifically Cape Town and the surrounding districts. The survey population consisted of diabetic patients from community health centres and clinics as well as diabetic patients attending the Cape Peninsula University of Technology Eye Care Clinic who had been requested to participate in the research. The sample size consisted of a total of 98 diabetic patients. There were no inclusion or exclusion criteria other than that the patient should be diabetic (already receiving medication and treatment) and willing to participate in the study.

Data analysis

The data obtained from the questionnaires was captured and analysed descriptively and statistically using Microsoft Excel according to the coding system set up for the questionnaire. The number of respondents, the frequency and the percentage of the respondents was calculated for each question or statement. A qualitative analysis of the diabetic questionnaires was performed through prior coding of individual open-ended questions as well as both a quantitative and a qualitative analysis of the data derived from the closed-response questions in the questionnaires. The responses to the open-ended questions were analysed per section in order to identify themes or common traits that became evident in the answers provided.

Results

The full questionnaire and table of results is not included in this article for the sake of brevity but is available upon request.

Demographic information of the diabetic patients

A total of 98 patients participated in the questionnaire survey. With regard to ethnicity, 7% of patients stated their racial classification was black, 3% white and 90% coloured. 28% of the respondents were male and 72% were

female. The largest age group of respondents (39%) were in the 60-69-year age group. This was followed by 30% in the 50-59-year age group. 14% fell into the 40-49-year age group followed by 4% in the 30-39-year age group. Only 2% and 1% of the respondents fell into the 20-29-year and 80-89-year age groups respectively. The largest category of the respondents (32%) stated that they were pensioners. 23% were housewives and 21% indicated some other type of employment. 11% were unemployed and 9% did not state their working/employment status. 2% of the respondents stated that they were domestic workers and 1% was retired. The overwhelming majority (80%) of the diabetic patient respondents stated that they were Afrikaans-speaking, followed by English (13%) and isiXhosa (7%).

Diabetic patients' knowledge of diabetes

This part of the questionnaire dealt with the diabetic patients' knowledge of the various aspects pertaining to the disease of diabetes. As far as the patients' knowledge of the number of different types of diabetes was concerned, only 42% stated that they knew about the existence of two types of diabetes. 24% of the patients stated that they had insulin-dependent diabetes, 61% stated that they had the non-insulin-dependent type of diabetes and a total of 15% either did not know what type of diabetes they had or did not answer the question.

Fifty-seven percent believed that diabetes was hereditary whilst 28% did not. Interestingly, only 24% of the diabetic patients believed their waist size could be used as a means to predict their risk of developing diabetes, whilst 32% did not believe this and 44% of the patients either did not know or did not answer the question. 49% of the respondents also believed that pregnancy might affect diabetes and its complications, yet 34% of the patients were unaware of this aspect.

On the question regarding the ways that problems arising from diabetes may be reduced, 79% of the patients felt that a healthy diet and lifestyle were very important. Only 3% felt that this was not important, and 2% felt that this was only slightly important. A total of 80% of the respondents felt that the age of diagnosis was an important factor or a very important factor

when considering the problems that might arise from diabetes. This was supported by their choice of statements, as 35% felt that the duration of diabetes was important and 41% felt that the duration of diabetes was very important.

Sixteen percent of the respondents felt that having good control of their blood sugar was important and 80% believed this was very important (Figure 1). 19% thought that having their blood pressure checked and controlled was important and 74% of the respondents believed that this was very important. An additional lifestyle question asked the respondents about their thoughts on smoking: 12% considered that it was important not to smoke and 83% believed that this was very important.

Diabetic patients' knowledge of the ocular complications of diabetes

This aspect of the questionnaire considered the diabetic patients' knowledge of the ocular complications of diabetes and how diabetes might affect their own eyes. A total of 89% of the patients agreed or strongly agreed that diabetes might affect the way that people may see. When considering whether diabetes could affect the way their eyes healed if they became injured, 37% agreed and 43% strongly agreed.

An important question related to the patients' knowledge of whether diabetes could cause cataracts. 13% disagreed or strongly disagreed with this statement and 5% did not know. 41%, however, agreed and 41% strongly agreed with this statement. A total of 88% agreed or strongly agreed that diabetes may cause pressure changes in the eyes leading to glaucoma. Perhaps the most critical question of this section dealt with the patients' knowledge of whether diabetes causes bleeding and damage inside the eyes. 33% agreed and 43% strongly agreed with this statement. However, a significant total of 24% of the respondents either disagreed or did not answer the question.

The final question of this section questioned whether they believed that diabetes will not affect their eyes. 45% strongly disagreed with this statement and 26% disagreed (Figure 2). However, a total of 29% either did not answer the question or felt

that diabetes would not affect their eyes. Of this total 18% strongly agreed that diabetes would not affect their eyes. This significant proportion of patients indicates the need for further education of such patients about diabetes and its ocular complications.

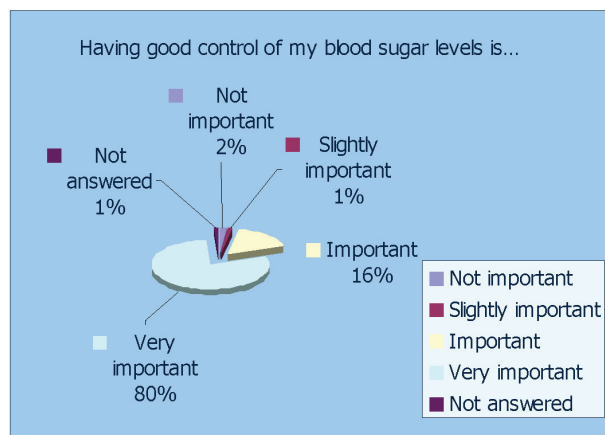


Figure 1. Diabetic patients' perceived importance of blood sugar control.

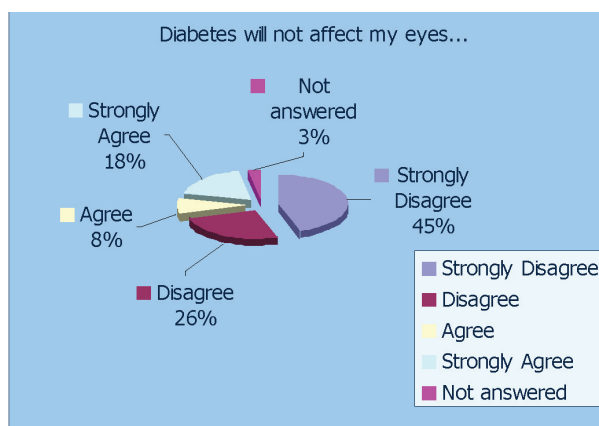


Figure 2. Patient views on the effects of diabetes on the eyes.

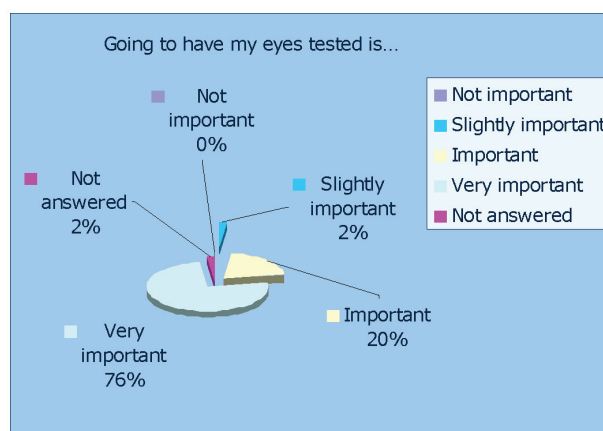


Figure 3. Patients' perceived importance of undergoing eye examinations.

Diabetic patients' knowledge of the management and treatment options for diabetes

In this section the participants were asked to rate the relative importance of various statements in relation to best controlling their diabetes. The first seven questions in the questionnaire dealt with how the participants rated the relative importance of the various statements. The following eight questions dealt with how the patients actually followed the various management and treatment regimens in their day-to-day activities.

With the exception of only 2%, all respondents felt that following a healthy diet was important in controlling diabetes. Of these respondents, 17% felt that it was simply important, but the overwhelming majority 81% felt that following a healthy diet was very important. All of the patients felt that measuring their blood sugar was important, whilst 22% and 76% stated that measuring blood sugar was important and very important respectively. On the question of exercise, 34% felt that regular exercise was important in controlling diabetes and 62% felt that exercise was very important.

In terms of maintaining an ideal body weight, 32% believed that it was important to maintain an appropriate body weight and 63% felt that this was very important. 87% of the respondents believed that taking their medication exactly as prescribed was very important and 81% felt that it was very important to go for regular medical check-ups at the clinic or doctor. Similarly, with regard to eye examinations, 76% of the respondents considered that going to have their eyes tested was very important and 20% felt this to be simply important (Figure 3). None of the patients thought that going for regular medical check-ups or eye tests was unimportant.

When questioned about how the patients followed the various management and treatment regimens on a real-life day-to-day basis 77% stated that they followed a healthy diet specifically designed for diabetes, but 18% stated that they did not follow such a diet. 5% chose not to answer this question. Significantly, 60% stated that they did not measure their blood sugar on a daily basis with only 37% of the respondents stating that they did (Figure 4). This does not correlate with the patients' overall rating of the importance of measuring their blood sugar, in which case a total

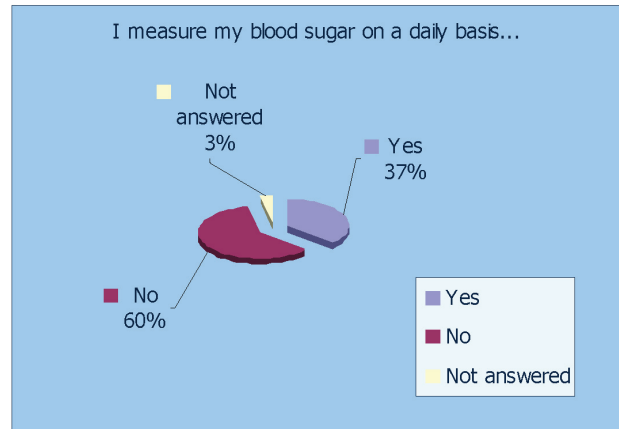


Figure 4. Patient measurement of blood sugar on a daily basis

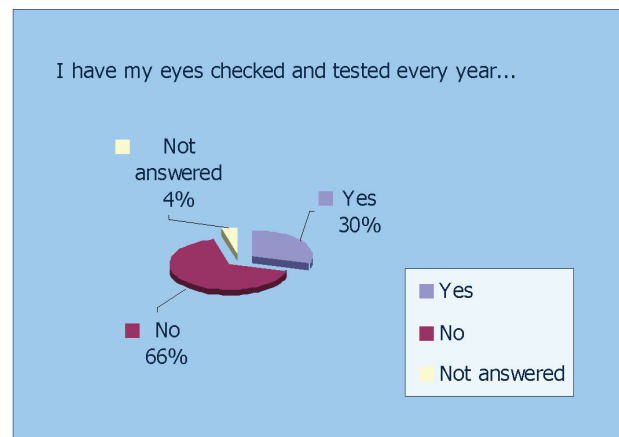


Figure 5. Regularity of diabetic patient eye examinations.

of 98% patients stated that measuring their blood sugar was important or very important.

On the question of exercise, an equal response was reflected with 47% of the patients stating that they exercised for at least an hour three times a week and 48% stating that they did not. 57% of the respondents believed that their body weight was about right for effective diabetes control, but a significant 38% did not feel their body weight was appropriate. Almost all the patients (94%) stated that they took their diabetes medication exactly as prescribed. Only 5% of the respondents chose not to answer the questions regarding exercise, body weight or the taking of their diabetes medication.

The majority of the patients (78%) stated that they went for medical check-ups once a month, which correlates closely with the 81% of patients' rated importance of going for regular check-ups. Although 98% of the patients felt that controlling their diabetes would help to prevent eye complications, the majority 66%

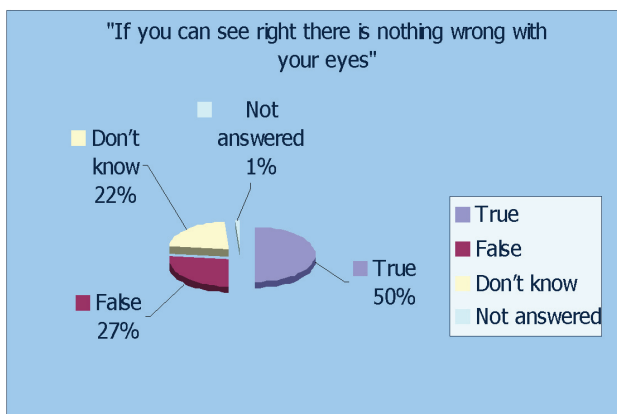


Figure 6. Patient views of vision and the effects of diabetes on the eye.

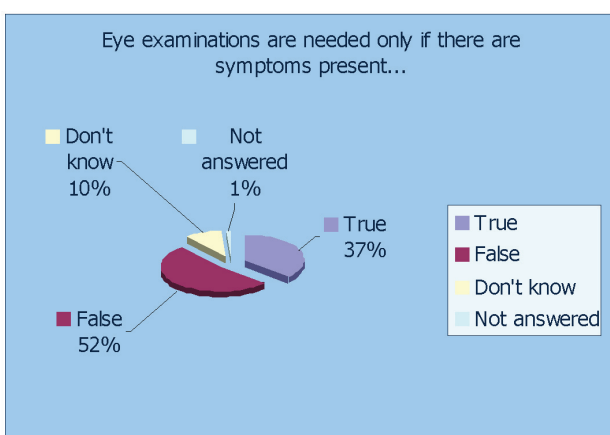


Figure 7. Patient views on ocular symptoms and the need for eye examinations.

stated that they did not have their eyes checked every year (Figure 5). Only 30% stated that they had actually had their eyes checked every year, compared to the 96% who had earlier stated that it was important to have their eyes checked regularly. This is a critical aspect to note in this research, as irreversible diabetic eye problems may occur without the patient being aware of them, thus emphasising the importance of having the eyes examined at an early stage for the complications of diabetes.

Additional information from diabetic patients

The last section referred to common misconceptions with regard to diabetes and its management. The respondents were also requested to state their opinion on the various ways in which diabetes might affect their own eyes.

A common misconception among diabetic patients was that, if their vision is good and

they could see clearly then there was nothing wrong with their eyes. A substantial 50% of the patients believed the statement that “If you can see right, there’s nothing wrong with your eyes” to be true (Figure 6). This is an important finding and one that should be addressed in a patient education programme. Only 27% of the respondents felt that this statement was untrue and 22% did not know if the statement was true or not.

On the question of whether diabetic eye disease can develop even if the diabetes is under control, 60% of the respondents felt that this was true. However, 27% did not know if this statement was true or not and 12% believed it to be false. With regard to the fact that diabetic patients should undergo annual comprehensive eye examinations with dilated pupils, 79% of the patients thought this was true, yet 20% of the patients either did not know or thought this to be false. Importantly, 89% of the patients believed that, if detected early, diabetic eye disease can be treated and vision preserved, yet in the previous section of the questionnaire only 30% stated that they had their eyes checked and tested every year.

Critically, only 52% of the patients felt that the statement “Eye examinations are needed only if there are symptoms present” was false (Figure 7). 37% thought this was in fact true and 10% did not know. Again this was highlighted by the fact that only 30% of the respondents stated that they had their eyes checked annually. A significant 74% of the respondents believed that controlling blood sugar levels eliminates the risk of visual loss, with 17% not knowing if this was in fact true. Finally, 84% of the patients felt that early diagnosis and prompt treatment could protect against vision loss, with 14% not knowing this.

Discussion

The results of these findings indicate that although the patients have a basic level of understanding of diabetes and its potential ocular complications, their daily management

of the condition is not adhered to optimally. Furthermore, the essential need for undergoing comprehensive eye examinations is not well-understood or acted upon by the patients and this is a critical area that needs to be addressed if the sight-threatening complications of diabetes are to be reduced or eliminated in these patients. The results and findings of the diabetic patients' questionnaires have implications for any attempted interventions. The results reflect deficiencies in the patients' knowledge regarding the different types of diabetes and the type that they themselves suffered from. Aspects such as the importance of diet/nutrition, body weight, and blood pressure control as preventative measures will require emphasis.

The patients' knowledge of the ocular complications of diabetes was also deficient. Interventions aimed at improving diabetes knowledge should emphasise the education of patients about the sight-threatening complications that may arise. Furthermore, the findings reflect the belief among a number of patients that diabetes will not affect their eyes and it is essential that this misconception be addressed. In order to reduce the severity and prevalence of ocular complications, diabetic patients must be informed about the need to undergo regular comprehensive eye examinations to detect any signs of diabetic retinopathy before vision might be affected. Reduced vision must not be used as criteria for when eye examinations should commence.

In terms of the diabetic patients' knowledge of the management and treatment options, patients would need to be educated in terms of a healthy diet; measuring of blood sugar; regular exercise; maintenance of an appropriate body weight and the undergoing of regular eye and medical examinations. The most critical finding that must be addressed is that, even though patients realise that vision can be preserved and diabetic eye disease can be well treated if detected early, this belief must be put into practice and effective and sustainable eye care in the public health sector must be accessible.

Diabetic retinopathy as an indicator of systemic disease and mortality

A critical aspect of this research is supported by the evidence that proliferative diabetic retinopathy is an accurate indicator for the patient's systemic disease risk and mortality. Statistics provided by Feman¹ indicate that younger-onset (Type I) diabetic patients with proliferative retinopathy were found to have a poorer six year survival (66.2%) compared with those with moderately severe (82.5%), mild (91.4%) or no retinopathy (95.9%). Similarly, older-onset (Type II) patients with proliferative retinopathy were found to have a poorer survival rate (31.8%) compared with those with moderately severe non-proliferative (41.4%), mild non-proliferative (52.2%), or no retinopathy at all (61.3%).

Due to the fact that proliferative retinopathy is a significant predictor of poorer survival because of its strong association with risk factors for systemic conditions, it is therefore imperative that screening for retinopathy takes places as early as possible and in a proper systematic way in alignment with National Health and Prevention of Blindness Policies. Diabetic patients with proliferative retinopathy should furthermore be referred for comprehensive medical examinations to detect early renal disease, elevated blood pressure and/or cardiovascular effect, in order to intervene and minimise their progress and effects.

Socio-economic aspects of diabetes

A study, which has particular relevance to this research, was published by Wändell and Gåfvels¹⁹ who found a definite association between lower educational levels and higher diabetes morbidity. They concluded that socio-economic factors affect both the prevalence of known diabetes and its complications among middle-aged patients with Type II diabetes. Therefore, they suggested that more effort should be made at the regional and national level in countries in order to prevent obesity and diabetes development, especially among

socially deprived populations.

Research by Björk²⁰ attempted to estimate the cost of diabetes and diabetes care. He suggested that diabetes ought to be one of the major concerns of Ministers of Health especially in developing countries. Björk²⁰ reiterated that the most important socio-economic aspect of dealing with diabetes relates to introducing and improving treatment if the costs to the patients, their families and their country's health system are to be reduced. This would lead to improved health status and quality of life among the population.

The socio-economic implications of diabetic blindness include both social and financial constraints, while employment opportunities for the visually disabled are limited. According to the World Health Organization²¹ (WHO) diabetic retinopathy is cited as the most common cause of vision loss in the working population. Sight-threatening retinal complications can be effectively prevented by adequate control of diabetes and thorough ophthalmoscopic examination and treatment when required. It was demonstrated by the WHO²¹ that health programmes aimed at motivating diabetic patients to undergo periodic eye examinations have proven to be cost-effective and a health investment to society as well.

Education concerning diabetes and its ocular complications

The importance of patient education and health care worker education on diabetes, and its potential ocular complications form the fundamental cornerstone of this research. The International Diabetes Federation²² (IDF) in its International Curriculum for Diabetes Health Professional Education states that "...diabetes educators are an integral part of the diabetes management team...(they) enable people with diabetes to manage their diabetes-related health...to allow them to make choices and take actions based on informed judgment and to enhance the quality of life...". The importance of education is also reflected in the

Position Statements of the Australian Diabetes Society Retinopathy Sub-committee²³ when it states that "...it is recognised that visual loss from retinopathy can be reduced further by education of the professional, the patient and the public".

Conclusions and recommendations

The results of this study should be considered within the context of certain limitations. The knowledge and educational status of the diabetic patients was based on 98 patients selected from the community health centres and clinics of the Western Cape region of South Africa. Although this may not apply to diabetic patients across South Africa as a whole, nonetheless these results provide for a broad overview of the various areas of knowledge and education that needs to be addressed in terms of diabetes and its ocular complications.

It is recommended that diabetic patients receive further attention aimed at improving their knowledge of diabetes and its complications so as to ensure better compliance with their prescribed treatment regimens. It is also recommended that the findings of the study form the basis of an education programme for health care workers dealing with diabetic patients, so that they are better equipped to manage and educate the patients about their disease and its ocular complications. Furthermore, optometry should be closely involved with the screening and management of diabetic patients as well as in educating both the patients and the nurses/health care workers dealing with them.

Bold steps must now be taken and clear leadership must be demonstrated when addressing the public health and eye care issues in South Africa. There is clearly potential for great success to be achieved in the provision of "eye care for all", but only if the necessary support and will is demonstrated. Education must therefore play a key role in all aspects pertaining to eye care; first for the diabetic patients, second for the health care workers dealing

with the patients and, finally, for the academic institutions that would be required to provide such education and training. Only when all three of these aspects are addressed will we be able to reduce the incidence of preventable diabetic blindness in South Africa.

Acknowledgements

I thank the University of the Free State for their support of the research as well as the patients who participated in the study. I would also like to thank the staff of the CPUT eye clinic who facilitated the patients and questionnaires required for the research.

References

1. Feman SS. *Ocular Problems in Diabetes Mellitus*. USA: Blackwell Scientific Publications, 1992.
2. Dobbins R. Type 2 Diabetes Mellitus: New Hope for Prevention. (Unpublished Lecture Notes.) University of Texas, Southwestern Medical Center, 1999.
3. Waugh A. and Grant A. Ross and Wilson. *Anatomy and Physiology in Health and Illness*. Ninth Edition. Philadelphia, USA: Elsevier Science Limited, 2001.
4. RSA DoH (Republic of South Africa. Department of Health). *National programme for control and management of Diabetes Type 2 at primary level*. Published by the South African Communication Service. Parow: Government Printer, 1998.
5. International Diabetes Federation (IDF). *Diabetes Atlas 2000 Executive Summary*. Belgium: International Diabetes Federation, 2001.
6. RSA DoH (Republic of South Africa. Department of Health). *National Guidelines: Prevention of Blindness in South Africa*. Pretoria: Department of Health, 2002.
7. RSA DoH (Republic of South Africa. Department of Health). *Demographic and Health Survey Preliminary Report*. Published by the DoH. Pretoria: Department of Health, 1999.
8. Fantus IJ, Delovitch TH and Dupré J. Prevention of diabetes mellitus: goal for the twenty-first century, part two. *Diabetes Care* 1997 **21** 184-206.
9. Levitt NS, Steyn K, Lambert EV, Reagon G, Lombard CJ, Fourie JM, Rossouw K and Hoffman M. Modifiable risk factors for Type 2 diabetes mellitus in a peri-urban community in South Africa. *Diabetic Medicine* 1999 **16** 946-950.
10. Klein R, Klein BEK, Moss SE, Davis MD and DeMets DL. The Wisconsin Epidemiologic Study of Diabetic Retinopathy, II: prevalence and risk of diabetic retinopathy when age at diagnosis is less than 30 years. *Archives of Ophthalmology* 1984 **102** 520-526.
11. Stratton IM, Kohner EM, Aldington SJ, Turner RC, Holman RR, Manley SE and Matthews DR. UKPDS 50: risk factors for incidence and progression of retinopathy in Type II diabetes over 6 years from diagnosis. *Diabetologia* 2001 **44**(2) 156-163.
12. Motola AA, Pirie FJ, Gouws E, Amod A and Omar MAK. High incidence of Type 2 diabetes mellitus in South African Indians: a 10-year follow-up study. *Diabetic Medicine* 2003 **20** 23-30.
13. Kanski JJ. *Clinical Ophthalmology: A Systematic Approach*. Fourth Edition. Boston, USA: Butterworth-Heinemann, 1999.
14. Mitchell P and Moffit P. Update and implications from the Newcastle diabetic retinopathy study. *Australian Journal of Ophthalmology* 1990 **18** 13-17.
15. DCCT (Diabetes Control and Complications Trial) Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *New England Journal of Medicine* 1993 **329** 977-986.
16. Borch-Johnsen K and Kreiner S. Proteinuria: value as a predictor of cardiovascular mortality in insulin dependent diabetes mellitus. *British Medical Journal* 1987 **294** 1651-1654.
17. Klein BEK, Moss SE and Klein R. Effects of pregnancy on progression of diabetic retinopathy. *Diabetes Care* 1990 **13** 34-40.
18. Kanski JJ. *Clinical Ophthalmology: A Systematic Approach*. Fifth Edition. London, UK: Butterworth-Heinemann, 2003.
19. Wändell PE and Gäfvels C. Patients with type 2 diabetes aged 35-64 years at four primary health care centres in Stockholm County, Sweden: Prevalence and complications in relation to gender and socio-economic status. *Diabetes Research and Clinical Practice* 2004 **63** 195-203.
20. Björk S. The cost of diabetes and diabetes care. *Diabetes Research and Clinical Practice* 2001 **54** 13-18.
21. WHO (World Health Organization). *Blindness and Visual Disability. Part IV: Socioeconomic Aspects*. Fact Sheet N 145. Geneva: World Health Organization, 1997.
22. IDF International Diabetes Federation. *Diabetes Education: A Right for All*. (IDF Position Statement) January 2004. URL: <http://www.idf.org/home/index.cfm?node=1093>
23. Australian Diabetes Society Retinopathy Sub-committee. ADS Position Statements: *Diabetes and the eye*. Melbourne: Diabetes Australia, 1996.