Prevalence and Determinants of Diabetic Retinopathy and Cataracts in West African Type 2 Diabetes Patients

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Objective: To quantify the prevalence of, and risk factors for, diabetic retinopathy and cataracts in patients with type 2 diabetes, and their spouse controls, enrolled from 5 centers in 2 West African countries (Ghana and Nigeria).

Method: The analysis cohort was made up of 840 subjects with type 2 diabetes, and their 191 unaffected spouse controls, who were enrolled and examined in Lagos, Enugu, and Ibadan, in Nigeria, and in Accra and Kumasi, in Ghana. A diagnosis of diabetic retinopathy was made only where a participant had a minimum of one microaneurysm in any field, as well as exhibiting hemorrhages (dot, blot, or flame shaped), and maculopathy (with or without clinically significant edema).

Results: Average duration of diabetes was 7.0 years, and mean age at diagnosis was 46.5 years. Prevalence of diabetic retinopathy was 17.9%. Cataracts were present in 44.9% of the patients with type 2 diabetes, and in 18.3% of spouse controls. The risk of developing retinopathy increased more than 3-fold for patients at the highest fasting plasma glucose (FPG) level (OR=3.4; 95% CI, 1.8–6.3), compared to patients at the lowest FPG level. The odds ratios for persons with diabetes for 10 years or more, compared to persons with diabetes for less than 5 years, was 7.3 (95% CI, 4.3–12.3) for retinopathy, and 2.6 (95% CI, 1.5–4.5) for cataracts.

Conclusions: Cataracts were a more important cause of vision impairment than was diabetic retinopathy in this cohort. The prevalence of cataracts in patients with diabetes was more than twice that of their spouse controls, indicating that type 2 diabetes is an important risk factor for cataract formation. Individuals who developed type 2 diabetes at an earlier age were more likely to develop both diabetic retinopathy and cataracts. A strong positive association was observed between FPG level, duration of diabetes, and risk of retinopathy and cataracts. The low prevalence of retinopathy and cataracts observed within the first 5 years of diagnosis of diabetes in this cohort, suggests that intensive blood glucose control may reduce the risk of the development and progression of retinopathy and cataracts. In this regard, early eye examination, preferably at first presentation of elevated blood glucose, is highly recommended. (*Ethn Dis*. 2003; 13[suppl2]:S2-110–S2-117)

Key Words: Type 2 Diabetes, Retinopathy, Cataracts, West Africa

Introduction

Diabetic retinopathy is the leading cause of blindness in adults between the ages of 20 and 65 in industrialized countries.[1,2] The condition probably begins early in diabetes, approximately 4 to 7 years prior to clinical diagnosis. This is particularly the case with type 1 diabetes, where it is unusual to see retinal lesions in patients who have the disease for less than 5 years.[3–5] However, findings from the Wisconsin Epidemiology Study, which utilized retinal photography, indicated that 23% of patients had retinopathy with diabetes of less than 2 years duration.[6] At the time of diagnosis, about 21%–29% of patients with type 2 diabetes in the United States and Europe have retinopathy.[3,4,7] Nearly 50% of all patients with diabetes will develop some form of diabetic retinopathy, and 65% to 74% of those who have diabetes for 10 years or longer will show clinical evidence of diabetic retinopathy.[4,7,8] In type 1 diabetes, diabetic retinopathy occurs in 90% of patients who have had the disease for 10 years or longer.[8]

Though diabetic retinopathy progresses predictably, in some patients, it advances rapidly and inexorably toward vision loss, even with early detection, follow-up, and adequate treatment, while the condition remains unchanged for many years in other patients. The reasons for the observed differential progress toward development of retinopathy are not clear. Puberty and cataract surgery can accelerate all of the retinal changes in diabetes, and pregnancy makes diabetic retinopathy particularly aggressive.[9–12] Gender does not appear to significantly affect the prevalence, incidence, or rate of progression of diabetic retinopathy in older-onset people; however, the frequency of proliferative retinopathy is higher among younger-onset males, compared to females.[6,13–15] The impact of obesity, a major risk fac-

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tor for the development of type 2 diabetes, on the prevalence or severity of diabetic retinopathy, has not been well established.[16–20]

The prevalence of retinopathy in patients with type 2 diabetes demonstrates wide variations between countries: in Europe, it ranges from 17% in Switzerland, 39% in Sweden, to approximately 52% in the United Kingdom.[21,22] Diabetic retinopathy is probably the result of microvascular dysfunction induced by hyperglycemia. Several studies have demonstrated that poor diabetes control predisposes individuals to and is detrimental to diabetic retinopathy.[6,23,24] The expected high level of poor diabetes control in Africa could make diabetic retinopathy a major problem in diabetes care.

DIABETIC RETINOPATHY IN AFRICA

Though diabetic retinopathy is a leading cause of blindness in industrialized countries, in sub-Saharan countries, other causes of blindness, such as vitamin A deficiency, trachoma, and onchocerciasis, decrease the proportional contributions of diabetic retinopathy as a cause of loss of sight.[25] However, the increasing prevalence of diabetes worldwide, especially in developing countries,[26] combined with the worsening healthcare situation in sub-Saharan Africa, may elevate the already high rate of all-cause blindness.

Reports about the specific contributions of type 2 diabetes to blindness in Africa are limited. Similarly, reports from Africa on the prevalence of diabetic retinopathy are limited, due to inadequate screening, lack of adequate screening technology, and the high rate of mortality. Available reports come mainly from small scale studies that often include patients with type 1 or type 2 diabetes. These factors probably explain the wide range (9%–55%) of the prevalence of diabetic retinopathy among Africans with access to health care in urban areas.[27–39] In this study, we used standardized screening methods in 5 urban and suburban centers across 2 West African countries, excluding, to the extent possible, patients with type 1 diabetes.

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RESEARCH DESIGN AND METHODS

Our cohort was made up of siblings (840 individuals) with type 2 diabetes, and their unaffected spouse controls (N=191), who were enrolled and examined in 5 sites in 2 West African countries (Lagos, Enugu, and Ibadan, in Nigeria, and Accra, and Kumasi in Ghana). This investigation is part of an ongoing research effort, the Africa America Diabetes Mellitus (AADM) Study, the goal of which is to identify susceptibility genes for type 2 diabetes in West Africans. The details and rationale of the sampling approach have been described elsewhere.[40] Briefly, with informed consent, detailed epidemiological, family, and medical, information was obtained from eligible participants. Blood samples were also obtained from each participant for biochemical measurements, including glucose, and C-peptide, and in order to detect autoantibodies to glutamic acid decarboxylase (GAD).

Diagnosis of type 2 diabetes was based on criteria established by the American Diabetes Association Expert Committee[41]: exhibiting either a fasting plasma glucose (FPG) concentration of ≥126 mg/dL (7.0 mmol/L) on more than one occasion, or a 2-hour post load value ≥200 mg/dL (11.1 mmol/L) on more than one occasion, and/or pharmacological treatment of diabetes, with adequate justification from medical records. Elevation of FPG concentration was the preferred criterion; OGTT confirmation was required in patients with FPG below 126 mg/dL who had other clinical evidence suggestive of diabetes. Detection of auto-antibodies to GAD, a level of fasting C-peptide <0.03 mmol/L, and absent history of type 1 diabetes (ie, age below 25 years, insulin dependence, and repeated episodes of ketoacidosis), were used to exclude probable cases of type 1 diabetes. Non-diabetic spouse controls (FPG <110 mg/dL or 2-hour post load value <140 mg/dL) were also enrolled.

Eye Examination

Eye examination was part of a comprehensive physical examination of each participant in the study. Each participant had the following ocular examinations: visual acuity; ocular alignment and motility; pupil reactivity and function; visual fields; intraocular pressure; slit lamp examination of the cornea, iris, lens and vitreous; and dilated fundus examination.

Due to the large number of participants and limited resources, retinal photography was excluded as a diagnostic tool. Previous experiences of the ophthalmologists in the 5 centers demonstrate a better than 80% concurrence between their clinical and photographic assessment of the presence and absence of lesions associated with diabetic retinopathy. To assure reproducibility of the assessment and classification of ocular complications between the 5 centers, the absence and/or presence of hemorrhages, microaneurysms, cotton wool

Table 1. Distribution of study participants by center, country and type 2 diabetes status: The Africa America Diabetes Mellitus (AADM) Study

	Centers	Cases	Controls
Nigeria:	Lagos (% males)	186 (51%)	45 (29%)
	Ibadan	149 (57%)	27 (22%)
	Enugu	167 (50%)	43 (28%)
Ghana:	Accra (% males)	166 (33%)	32 (47%)
	Kumasi	172 (23%)	44 (64%)
Total		840 (43%)	191 (39%)

spots, neovascularization, cataracts, retinal detachment, maculopathy, and glaucoma, in each subject's eyes was recorded, along with other ocular abnormalities. A diagnosis of diabetic retinopathy was made only where a participant had a minimum of one microaneurysm in any field, in addition to exhibiting hemorrhages (dot, blot, or flame shaped) and maculopathy (with or without clinically significant edema). For the same reason of reproducibility, no attempts were made to classify retinopathy into the conventional stages of nonproliferative and proliferative maculopathy, with or without edema.

Statistical Analysis

All statistical analyses were performed using the SAS statistical package (Cary, NC). Frequency differences were evaluated by the chi-square (χ^2) procedure. Differences in group means were tested using the *t* test. Statistical significance occurred if a computed 2-tailed probability value was less than 5% ($P < .05$). Logistic regression was used to evaluate excess risk for selected variables, including FPG level, duration of diabetes, blood pressure level, age, and sex.

RESULTS

The distribution of participants by center is shown in Table 1. The goal of the AADM parent study was to enroll 160 volunteers with type 2 diabetes, along with 40 spouse controls, at each center, for a total of 800 cases and 200 controls. At the time of preparation of this report, 840 cases were enrolled (surpassing the study goal), along with 191 spouse controls. With slight variation, the distributions of cases and controls were similar across the 5 centers.

Selected characteristics of the cohort by type 2 diabetes status are shown in Table 2. The distribution of men and women was similar for cases and controls ($P=.34$), and, on average, the controls were 4 years younger than the cases (49.4 vs 53.5 years, respectively; $P < .0001$). Approximately 50% of the cases had exhibited type 2 diabetes for 5 years or less. The average duration of type 2 diabetes was 7.0 years (ranging from 0 to 46 years), and the average age at diagnosis was 46.5 years (ranging from 20 to 79 years). Mean FPG was 197.8 ± 91.2 mg/dL for cases, and 94.0 ± 18.3 mg/dL for the controls. The mean C-peptide value was 1.3 ± 0.75 mmol/L for cases, and 1.23 ± 0.80 mmol/L for the controls. A large proportion of cases (73%) had fasting blood glucose levels greater than the diagnostic value of 126 mg/dL.

Mean body mass index (BMI) was 25.0 ± 4.3 kg/m^2 for men, and 27.5 ± 5.8 kg/m^2 for women. Remarkably, the mean BMI of cases did not differ significantly from that of controls, presumably reflecting the effect of the same family household environment ("eating from the same pot"), since the controls were spouses of the cases. About 40% of both cases and controls had BMI values greater than 27, making this cohort significantly heavier than the general population of Nigeria and Ghana.

More than half (53%) of the patients with type 2 diabetes were also hypertensive, compared to 37% among the controls; hypertension was defined as systolic blood pressure (BP)=140 mm Hg and/or diastolic BP=90 mm Hg, or taking concomitant anti-hyper-

Table 2. Selected characteristics of West African diabetic patients and control participants: The AADM study

Variables	Male (Mean ± SD)	Female (Mean ± SD)	*P* Value
	CASE		
Age	53.9 ± 10.6	53.2 ± 10.9	.3201
Waist-hip ratio	0.94 ± 0.07	0.90 ± 0.07	<.0001
Body mass index	24.8 ± 4.1	27.3 ± 5.4	<.0001
Insulin	19.6 ± 7.2	23.0 ± 30.9	.1386
C-peptide	1.13 ± 0.74	1.36 ± 0.78	.0002
Leptin	4.7 ± 5.6	24.5 ± 20.7	<.0001
Glucose	195.0 ± 94.3	199.7 ± 86.3	.5086
Systolic BP	135.4 ± 22.0	138.1 ± 25.2	.0959
Diastolic BP	83.5 ± 12.0	83.27 ± 13.2	.7800
	CONTROL		
Age	56.0 ± 11.6	45.2 ± 9.6	<.0001
Waist-hip ratio	0.91 ± 0.10	0.86 ± 0.07	.0008
Body mass index	25.0 ± 4.3	27.6 ± 6.1	.0009
Insulin	13.0 ± 11.1	18.3 ± 16.4	.0405
C-peptide	1.18 ± 0.79	1.28 ± 0.82	.5260
Leptin	7.9 ± 11.9	32.7 ± 26.4	<.0001
Glucose	94.7 ± 11.2	93.8 ± 21.3	.7648
Systolic BP	136.6 ± 22.2	127.3 ± 21.3	.0050
Diastolic BP	85.2 ± 11.7	80.8 ± 12.9	.0185

Table 3. Distribution of diabetic retinopathy and cataracts by centers for cases and controls: The AADM Study

	Lagos	Ibadan	Enugu	Accra	Kumasi	Total
Diabetic retinopathy (*N*=823)	44 (24%)	31 (20.9%)	25 (16%)	39 (23.5%)	8 (4.7%)	147 (17.9%)
Males	22 (23.9%)	14 (16.7%)	13 (16.7%)	12 (15.4%)	2 (5.1%)	63 (18.1%)
Females	22 (24.2%)	17 (26.6%)	12 (15.4%)	27 (24.3%)	6 (4.5%)	84 (17.7%)
Cataracts						
Cases (*N*=831)	103 (55.4%)	68 (46.3%)	62 (37.3%)	90 (54.2%)	50 (29.2%)	373 (44.9%)
Males (*N*=352)	48 (51.1%)	46 (55.4%)	32 (39.5%)	29 (52.7%)	12 (30.8%)	167 (47.4%)
Females (*N*=479)	55 (59.8%)	22 (34.4%)	30 (37.5%)	61 (55.0%)	38 (28.8%)	206 (43.0%)
Controls (N=191)*	9 (20.0%)	4 (14.8%)	4 (9.3%)	7 (21.9%)	11 (25.0%)	35 (18.3%)

* Too few subjects to display detailed male/female distribution.

tensive medication. While about 60% of the hypertensive type 2 diabetes patients were on anti-hypertensive therapy, only 27% of the hypertensive controls were on anti-hypertensive therapy.

As shown in Table 3, the prevalence of diabetic retinopathy was 17.9% across the 5 centers. Men had a slightly higher rate (18.1%) compared to women (17.7%); however, this difference did not have statistical significance. Among subjects with diabetic retinopathy, 59% had the disease for 10 years or more, 24% for 5–9.9 years, and 17% for less than 5 years. Our data suggest that the left eye was more frequently affected by diabetic retinopathy, although this discordance did not reach statistical significance. In contrast, both eyes were equally affected by cataracts in cases and controls, in both genders, and across all the age groups, in all 5 centers.

The prevalence of cataracts was 44.9% among patients with type 2 diabetes, compared to 18.3% among their spouse controls, across the 5 centers (Table 3). No significant difference was observed between men (47.4.5%) and women (43.0%) in their rates of having cataracts. Lagos and Accra, the largest urban centers in the 2 countries, had the highest percentage of patients affected by diabetic retinopathy (24%). Similarly, the Lagos and Accra centers had the highest prevalence rate of cataracts (over 50%), with the city of Ibadan, the next largest urban center, following closely, with a prevalence rate of 46.3%. The urban and rural comparison was less consistent for the controls, probably due to small numbers.

As shown in Table 4, diabetic retinopathy and cataracts occurred more frequently in patients who were older than 65 years. There was a steady increase in the prevalence of retinopathy and cataract with age. The observed increase in the prevalence of these 2 conditions was more dramatic for cataracts, however. For example, the prevalence of cataracts in the >65-years age group was more than 10 times that of those in the 20–45-year age group (8.5% vs 84.8%, respectively). The impact of age on the prevalence of cataracts was also strong among the control subjects.

The 2 most important risk factors for diabetic retinopathy in this cohort were duration of diabetes, and FPG level (Tables 5 and 6). Using logistic regression analysis, and the internal distribution of FPG levels, we grouped diabetes subjects into 3 groups (Q1=40–104.9 mg/dL; Q2=105–243.9 mg/dL, and Q3=244 mg/dL). We observed a statistically significant association between glucose levels and both retinopathy and cataracts (Table 5). In comparison to the patients in the group with lowest FPG level, the risk of developing retinopathy was more than twice as high (OR=2.1; 95% CI, 1.2–3.8) for patients in the intermediate group, and more than 3 times as high for patients in the group with the highest FPG level (OR=3.4; 95% CI, 1.8–6.3).

Similarly, we observed a clear trend between retinopathy, cataracts, and duration of diabetes (Table 6). The OR comparing persons having diabetes for 10 years or more, to those having diabetes for less than 5 years, was 7.3 (95% CI, 4.3–12.3) for retinopathy and 2.6 (95% CI, 1.7–4.0) for cataracts. Patients having diabetes from 5 to 9.9 years had intermediate rates (OR=2.6 for retinopathy and 1.6 for cataracts).

Table 4. Distribution of diabetic retinopathy and cataracts by age groups and gender for persons with type 2 diabetes: The AADM Study

Age Groups	Diabetic Retinopathy				Cataracts			
	N	Males	Females	Total	*N*	Males	Females	Total
20–45	201	7 (9.6%)	17 (13.3%)	24 (11.9%)	201	5 (6.8%)	12 (9.4%)	17 (8.5%)
46–65	513	43 (18.9%)	56 (19.6%)	99 (19.3%)	518	121 (53.1%)	140 (49.1%)	261 (50.4%)
>65	108	13 (27.1%)	11 (17.7%)	24 (21.8%)	112	41 (82.0%)	54 (87.1%)	95 (84.8%)
Total	823	63 (18.1%)	84 (17.7%)	147 (17.9%)	831	167 (47.4%)	206 (43.0%)	373 (44.9%)

Table 5. Distribution of odds ratios (OR) evaluating the association between the prevalence of retinopathy, cataracts, and fasting blood glucose level (FBG): The AADM Study

Diseases	# of Persons	FBG mg/dl	OR (95% CI)*
Retinopathy	184	40–104.9	1.0 (reference)
	373	105–243.9	2.1 (1.2–3.8)
	190	=244	3.4 (1.8–6.3)
Cataracts	183	40–104.9	1.0 (reference)
	377	105–243.9	1.0 (0.7–1.6)
	193	=244	1.9 (1.2–3.1)

* Odds ratios were adjusted for age, sex, and BMI.

More than 50% of persons having type 2 diabetes for 20 years exhibited retinopathy, and nearly 70% had cataracts.

DISCUSSION

Using a standardized protocol in a multi-center study of the genetics of type 2 diabetes in West Africans, we observed the prevalences of diabetic retinopathy and cataracts to be 17.9%, and 44.9%, respectively. The prevalence of cataracts was estimated as 18.3% among the spouse controls. Despite a poor glycemic control rate (more than 73% of patients had FPG levels >126 mg/dL), the prevalence rate for diabetic retinopathy fell within the lower range of reported estimates (9%–55%) for Africa.[27–39]

In a study of 302 diabetic hospital patients in Ethiopia, Seyoum et al reported an overall prevalence of 37.8% for diabetic retinopathy.[41] Nwosu et al found a prevalence of 30% for visual impairment in their study of 100 consecutive diabetes patients examined in a teaching hospital in Nigeria.[42] In a South African rural district, diabetic retinopathy of any grade was found in 40.3% of patients, and due to the severity of the condition, laser photocoagulation was warranted in 11.1% of the cases.[43] However, in a larger study of 1,386 consecutively registered Ethiopians with type 2 diabetes, Lester et al reported a prevalence of 15% for diabetic retinopathy, which is closer to the prevalence observed in this West African cohort.[38]

The wide range in prevalence estimates across Africa is due to several reasons, including the use of hospital-based, as opposed to population-based, patients. It is reasonable to expect that studies based on hospital records will have a preponderance of people with advanced, and/or severe, disease; therefore, the rate of complications due to type 2 diabetes will be over-represented. Due to the scope and design of this study, which enrolled known, as well as new, cases of type 2 diabetes, the estimated prevalence rate of diabetic retinopathy may be more representative of the general population in sub-Saharan Africa.

Despite a poor glycemic control rate (more than 73% of patients had FPG levels >126 mg/dL), the prevalence rate for diabetic retinopathy fell within the lower range of reported estimates (9%–55%) for Africa.[27–39]

The major risk factors for diabetic retinopathy identified in this study included sex, age, age at diagnosis, level of glycemic control (FPG level), and duration of diabetes. Level of blood pressure exerted a small and independent risk to the prevalence of retinopathy in this cohort, after adjusting for the combined effects of age and sex in a logistic model. The small effect of blood pressure may be due to the relatively high rate of hypertension treatment (60%) among type 2 diabetes patients; only 27% of the controls with diagnosed hypertension were on anti-hypertensive treatment, suggesting that diabetes patients have a greater motivation to seek medical attention, compared to individuals with only hypertension. In addition, given the real and perceived seriousness of the complications of diabetes, spouses may be more willing to divert their often meager resources to the care of their diabetic partners.

Unlike blood pressure, both duration of diabetes and level of glycemic control were major risk factors for diabetic retinopathy. The odds ratio comparing persons having diabetes for 10 years or more, to persons having diabetes for less than 5 years, was 7.3 (95% CI, 4.3–12.3) for retinopathy, which is

Table 6. Distribution of odds ratios (OR) evaluating the association between the prevalence of retinopathy, cataracts, and duration of diabetes: The AADM Study

Diseases	# of Persons	# with Disease	Duration (years)	OR (95% CI)*
Retinopathy	368	25	0–4.9	1.0 (reference)
	208	34	5–9.9	2.6 (1.5–4.5)
	230	85	10+	7.3 (4.3–12.3)
Cataracts	372	111	0–4.9	1.0 (reference)
	210	98	5–9.9	1.6 (1.0–2.4)
	232	155	10+	2.6 (1.7–4.0)

* Odds ratios were adjusted for age, sex, and BMI.

consistent with previous reports from several studies in both developed and developing countries.[38,44–48]

The average duration of type 2 diabetes in this population was about 7 years. The strong association observed between duration of diabetes and prevalence of diabetic retinopathy clearly indicates that the level of glycemic control in this cohort was, indeed, poor; about 60% of patients having the disease for 10 years or more also had some form of retinopathy, compared to 17% of those having the disease for less than 5 years. Similarly, patients with the worst level of glycemic control had more than 3 times the risk of developing type 2 diabetes, compared to those with the "best" control in this cohort.

A consistent association between poor glycemic control and diabetic retinopathy has been described in several populations.[49–53] The Diabetes Control and Complications Trial (DCCT) demonstrated, in a large cohort of patients with type 1 diabetes, the importance of hyperglycemia as a major risk factor for diabetic microvascular complications, including retinopathy, neuropathy, and nephropathy.[54] The results of the United Kingdom Prospective Diabetes Study (UKPDS) also demonstrated that tight glycemic control, with any of several therapeutic regimens, would significantly reduce the risk for long-term microvascular complications of type 2 diabetes.[55,56] An important public health message to be gleaned from these large-scale studies is that there is no threshold for the relationship between blood glucose and reduced risk, and that 'optimal' glycemic control in a patient with type 1 or type 2 diabetes is a blood glucose level as close as possible to that of an individual without diabetes.[50]

Level of urbanization appeared to correspond to the prevalence of both diabetic retinopathy and cataracts. In Nigeria and Ghana, the more urbanized cities had the highest prevalences of both diabetic retinopathy and cataracts. In these cities, the lifestyle is more Western, and the prevalence rates of diabetic retinopathy approximate the prevalence reported in Western populations. It is plausible that this urban-rural gradient exists because patients in the urban centers had better health care, and survived long enough to develop retinopathy and be examined, while rural patients with no health care died before developing retinopathy, or did not survive long enough with their retinopathy to be available for examination. This is a known issue in epidemiology, hence the expressed: P=In*D; where P=prevalence, In=incidence, and D=duration of diseases.[57]

Worldwide, 50% of all cases of diabetes remain undiagnosed.[58] The rate of undiagnosed diabetes in sub-Saharan Africa may be higher than 50%. Consequently, when the frequency of screening for type 2 diabetes increases, and better technology for ocular examination is used, the prevalence of reported diabetic retinopathy in Africa may be significantly higher, probably approaching estimates from industrialized countries.

The most effective method for the treatment of diabetic retinopathy, and prevention of the new blood vessel formation that ultimately leads to blindness, is photocoagulation.[59,60] Vision may also be restored with the time-consuming and expensive vitrectomy. Results from Sweden clearly demonstrate that early diagnosis and treatment can potentially eliminate blindness due to diabetic retinopathy.[61] However, even in the United States, it has been estimated that only 60% of patients requiring retinopathy treatment actually receive it.[60,62] These expensive and skill-based treatment modalities are not available to the vast majority of sub-Saharan Africans with diabetic retinopathy. The poor availability of treatment for diabetes and its complications in sub-Saharan Africa, would conceivably make diabetic retinopathy a major cause of blindness in the future.

In the long term, the contribution of diabetic retinopathy to visual impairment may approximate its contribution to blindness in industrialized countries. Currently, cataracts represent a greater visual impairment concern in West and Central Africa, and probably other parts of Africa, as well.[62] Though type 2 diabetes contributed significantly to the development of cataracts in this population, the high prevalence of cataracts in the control population demonstrates that other cataractogenic factors, unrelated to type 2 diabetes, play an important role in the development of cataracts.

This study provided compelling evidence that developing strategies for diabetes prevention, glycemic control, and early/regular eye examination, would reduce the impact of diabetes on vision. In addition, investment in the relatively inexpensive surgical treatment of cataracts in West Africa would improve the quality of life for people with ocular complications.

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