

## Research Article

### Risk Factors of Retinopathy Among Diabetic's Patients in Benin in 2014

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#### Abstract

##### Background

The Diabetic Retinopathy (DR) is one of the most frequent and most crippling complications of the mellitus diabetes. Its frequency increases with the age and the duration of the evolution of the diabetes.

##### Objective

It was to analyze the risk factors of retinopathy among diabetic patients followed at the Unit of Diabetes of Departmental University Hospital of Borgou and Alibori for the duration of the study.

##### Methods

It was cross-sectional study including 189 diabetic patients followed in the Unit of Diabetes of DUHCB over a period going from May to August, 2014. These patients had benefited of a complete

ophthalmological examination. The retina lesions were appreciated using Slosse and Alaerts Classification. The data analyzed were performed with the Epi-data and Epi-info software version 3.5.3.

#### Results

The prevalence of diabetic retinopathy among the studied population was 17.5% (33/189). The mean age was  $55.2 \pm 12.3$  years. The sex ratio was 0.75 (M/F). The associated risks factors to the diabetic retinopathy were: age superior to 50 years ( $p=0.020$ ), the duration of the diabetes ( $p=0.000$ ), blood sugar over or equal to 1.26g/l ( $p=0.036$ ) and the presence of nephropathy ( $p=0.016$ ).

#### Conclusion

The frequency of diabetic retinopathy is low among the diabetics patients followed at the DUHCB since the starting of work in the Unit of Diabetes. The associated risks factors in our study are largely the same to those of anterior studies realized in various regions of the world. Its screening must be systematic among the diabetics.

**Keywords:** Associated risks factors; Duration of the diabetes; Diabetic retinopathy; Nephropathy

#### Introduction

Diabetes mellitus is a public health problem because of its increasing prevalence and the complications it creates [1]. These complications include the retinopathy that is the set of consecutive retinal lesions or related to diabetes. This is the most severe ocular complications of diabetes [2,3]. In industrialized countries, it is the leading cause of blindness in adult before the age of 50 years [4]. Among patients with diabetes, 75% will develop retinopathy 20 years after the diagnosis of the disease [5]. As for Gain and Thuret [6] in France, diabetic retinopathy occurs after 15 years of development, regardless of the type of diabetes. The risk of blindness is 25 times higher in diabetic patients than in subjects with no diabetes [7]. Diabetic retinopathy does not only impact the eyes. Indeed, the presence of retinopathy multiplies by 3 the risk of developing coronary artery disease or ischemic stroke. Retinopathy also promotes reduced productivity and impaired quality of life of people with diabetes [7,8]. According to a study by Tchabi et al., [9] at Cotonou National University Hospital Centre located in the south of Benin Republic, disease duration of diabetes greater than 10 years and a glucose imbalance are major risk factors for developing diabetic retinopathy. Another study by Djrolo et al., [10] in a population of black African diabetics in Cotonou concluded that during the development of diabetes mellitus, retinopathy and nephropathy are one for the other, a risk factor. In 2012, a study in the same CHUD-B/A about biological risk factors of diabetic retinopathy, reported that a poor glycemic control, LDL cholesterol and the presence of proteinuria were risk factors occurrence of this eye microangiopathy related to diabetes [11].

Our study aims to analyze the risk factors associated with retinopathy in diabetic patients followed in the management Unit of Diabetes at the Departmental University Hospital of Borgou and Alibori Borgou in 2014.

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## Patients and Methods

Our study is prospective, cross-sectional with descriptive and analytical and was conducted over three months, from May 26 to 27 August, 2014 at the unit of teaching and research in ophthalmology and the Unit of Diabetes care for the Departmental University Hospital of Borgou and Alibori.

In this study, all patients are diabetic and monitored in the Unit of Diabetes care for the Departmental University Hospital of Borgou and Alibori, who gave their informed consent and for whom a complete ophthalmic examination was performed. Sampling was done in a non-probability method and comprehensive techniques.

We conducted a systematic recruitment of all patients who gave informed consent.

The dependent variable was the presence of retinal lesions.

### We used the classification of Alart and Slosse [8] for retinal damage:

- Stage I: Segmental dilation of veins
- Stage II: Micro aneurysms + Stage I
- Stage III: Hemorrhages, exudates and micro aneurysms + Stage II
- Stage IV: Dilation of large vessels and bleeding Stage + III
- Stage V: Neovessels + Stage IV (stage retinopathy proliferative diabetic)
- Stage VI: Neovascular glaucoma + Stage V (stage complicated diabetic retinopathy)

The retinal angiography was not performed; our unit does not have it.

Independent variables were age, sex, cardiovascular risk factors (body mass index, hypertension, smoking, physical inactivity), duration of diabetes, balance of diabetes, complications (neuropathy, nephropathy, diabetic foot), therapeutic modalities and ophthalmologic data.

### Sociodemographic factors

**The professional categories:** Employees, retired persons, farmers, artisan, traders, drivers, rock and sand quarrier workers (regrouping diabetics with income generating activity); homemaker, student/student and others (were the group of those who do not have an income generating activity).

**Marital status:** Married (e) (lives in couple); single, divorced (e), widow (er) (constituted the group of those who were not living with a partner).

**Cardiovascular risk factors:** Body Mass Index (BMI), calculated using the formula: weight (kg)/height square (m<sup>2</sup>). It was expressed in Kg/m<sup>2</sup>.

### We had considered

- Skinny, any subject with a BMI < 18.5 kg/m<sup>2</sup>
- Normal weight, a BMI between 18.5 and 24.9 kg/m<sup>2</sup>
- Weight overload, any subject with a BMI between 25 and 29.9 kg/m<sup>2</sup>
- Obese, any subject with a BMI ≥ 30 kg/m<sup>2</sup>
- Tobacco (smoked, chewed or popular) whether we specified the number of package/year

**Sedentary:** No if the patient practice at least 30 minutes of moderate physical activity three times a week, or so.

### Features and other degenerative complications of diabetes

- The fasting glucose: Diabetes was balanced if the patient had a fasting glucose < 1.26g/l and unbalanced blood sugar when ≥ 1.26g/l [12]
- The neuropathy, if the patient had any of the following symptoms (burning, coldness, tingling, numbness)
- The nephropathy was revealed by a disturbed renal function tests (serum creatinine > 14mg/l) or the presence of albumin in the urine test strip or proteinuria after 24h
- Diabetic foot, if the presence of trophic disorder or amputation of the pelvic members and not otherwise.
- Hyper blood pressure, if the patient had a history of hypertension or antihypertensive treatment and not otherwise

### Eye data

**Visual acuity:** It was evaluated for each eye, in far vision using optotypes, 'E' of Snellen for illiterate and 'Monoyer' for scholars and in near binocular vision, using optotypes 'E' of Snellen for illiterate and Parinaud for scholars. We had grouped as follows: PPL AV < 1/20th, 1/20th ≤ AV < 3/10th and AV ≥ 3/10.

**The intraocular pressure:** It was valued by Goldman applanation tonometer after contact anesthesia by oxybupacaine. It was classified as follows: Hypotonia (IOP < 10mmHg), Normal (10 ≤ IOP < 21mmHg) and Hypertension (IOP ≥ 21mmHg).

### Difficulties encountered

- The interview with the participants, especially for the less and not educated had required much time. The location of the ophthalmology department on the first floor had not allowed all patients to perform the eye examination due to a musculoskeletal disability. To explore other complications of diabetes, the diagnostic tests have not been achieved (lack of funds)
- All these data were collected using an ad hoc form, through a questionnaire, physical examination and ophthalmoscopy performed for each patient
- The selected patients were reviewed by the ophthalmologist for a complete eye examination. Ophthalmoscopy was performed using a 90 diopters Volk lens after maximum pupil dilation with tropicamide drops 0.5%
- The collected data were supplemented with the counting of patient records
- The dependent variable was retinopathy among diabetics patients examined
- The independent variables were represented by socio-demographic factors (age, sex, occupation, education level, marital status), cardiovascular risk factors (BMI, hypertension, smoking, sedentary lifestyle), features and other degenerative complications of diabetes (duration of diabetes, fasting glucose, other degenerative complications are neuropathy, nephropathy, diabetic foot), therapeutic modalities (insulin, oral antidiabetics, the combination of the two), ophthalmologic data (eye complaints, measurement of visual acuity, slit lamp examination, measurement of IOP and examination of the ocular fundus)

- Data analysis was done by software Epi Info version 3.5.3
- For quantitative variables, the averages were presented with a standard deviation; regarding the qualitative variables, the proportions were expressed
- The frequency comparisons were performed using the chi-2 Pearson test (or Fisher's exact test as appropriate) and those averages using the student test. We performed a univariate analysis.
- For the different tests used, a p-value<0.05 was considered statistically significant
- The administrative authorities at various levels and the ethics committee gave their local agreement for carrying out the investigation
- The integrity of the patients was observed, the ophthalmologic examination was done in an appropriate setting
- All data collected during our investigation were used only in the context of this study and remained confidential

## Results

### General characteristics of patients

- The total number of patients who responded to our inclusion criteria was 189
- These diabetic patients had a mean age of 55.2 ± 12.3 years
- A female was predominated with sex ratio of 0.75
- Smoking was observed in 19 patients (10%), 67 patients (35.4%) were sedentary, 106 patients (56.1%) had hypertension and 111 patients (58.7%) overweight (Table 1)

	Effective	Percentage	P
<b>Age (Years)</b>			<b>0.02</b>
≤50	66	34.9	
>50	123	65.1	
<b>Sex</b>			<b>0.955</b>
Male	81	42.9	
Female	108	57.1	
<b>Level of instruction</b>			<b>0.199</b>
No schooling	71	37.6	
Primary	41	21.7	
Secondary	52	27.5	
Superior	25	13.2	
<b>Income Generating Activities (IGA)</b>			<b>0.298</b>
Yes	129	68.3	
No	60	31.7	
<b>Way of life</b>			<b>0.274</b>
Live in couple	150	79.4	

**Table 1:** Distribution of patients by general characteristics, Departmental University Hospital of Borgou and Alibori, Parakou.

### Frequency of diabetic retinopathy

Out of the 189 patients included in the study, 33 had diabetic retinopathy, which means a frequency of 17.5%. More than half of patients (57.6%) with diabetic retinopathy were at stage III (Table 2).

### Risk factors associated with diabetic retinopathy

Advanced age was a factor associated with diabetic retinopathy (p=0.020).

	Diabetic Retinopathy				p
	Total	Effective	Frequency	Odds Ratio (IC 95%)	
<b>Age (Years)</b>					<b>0.02</b>
≤50	66	6	9.1	0.35 (0.45; 0.91)	
>50	123	27	21.9	1	
<b>Sex</b>					<b>0.955</b>
Male	81	14	17.3	0.97 (0.45; 2.09)	
Female	108	19	17.6	1	

**Table 2:** Frequency of diabetic retinopathy according to the age and gender at Departmental University Hospital of Borgou and Alibori, Parakou.

There was no link between gender and diabetic retinopathy. Smoking, physical inactivity, high blood pressure and body mass index were not associated with diabetic retinopathy (Tables 1 and 3).

	Diabetic Retinopathy				p
	Total	Effective	Frequency	Odds Ratio (IC 95%)	
<b>Tobacco</b>					<b>0.907</b>
Yes	19	3	15.8	0.87 (0.23; 3.1)	
No	170	30	17.6	1	
<b>Sedentarity</b>					<b>0.279</b>
Yes	67	9	13.4	0.63 (0.27; 1.4)	
No	122	24	19.7	1	
<b>HBP*</b>					<b>0.564</b>
Yes	106	20	18.9	1	
No	83	13	15.7	0.7 (0.49; 2.32)	
<b>BMI** (Kg/m<sup>2</sup>)</b>					<b>0.097</b>
<18.5	6	1	16.7	0.60 (0.06; 5.4)	
[18.5-25]	72	18	25	1	
≥25	111	14	12.6	1.30 (0.15; 12.74)	

**Table 3:** Frequency of diabetic retinopathy according to cardiovascular risk factors at Departmental University Hospital of Borgou and Alibori, Parakou.

\*HBP: High Blood Pressure

\*\*BMI: Body Mass Index

In opposite, the duration of diabetes, the poor glycemic control of patients and kidney disease were associated with diabetic retinopathy (Table 4).

### Risks factors associated with therapy

Half of the patients, 99 (52.4%) were under only oral treatment, the majority (136 means 72%) patients did not followed a regular rhythm of systematic annual review of the eye fundus examination. Therapeutic characteristics are summarized in table 5.

## Discussion

In this study, diabetic retinopathy was seen in about two out of 10 patients (17.5%). This prevalence was close to the 15.8%, 23.9% and 17.1% respectively reported by Kyari et al., [1], Hussain et al., [13] and Donghyun et al., [14].

As concerned diabetic retinopathy, researches showed that pro-inflammatory cytokines and growth factors such as Vascular Endothelial Growth Factor (VEGF) contribute to the loss of blood retinal barrier and subsequently, to macular edema in various retinal pathologies, such as diabetic retinopathy [15].

	Diabetic Retinopathy				p
	Total	Effective	Frequency	Odds Ratio (IC 95%)	
<b>Seniority of diabetes (Years)</b>					<b>0.000</b>
≤10	151	16	10.6	0.09 (0.03; 0.22)	
[10-20]	32	14	43.7	0.11 (0.02; 0.63)	
>20	6	3	50	1	
<b>Glycemy (g/l)</b>					<b>0.036</b>
<1.26	64	6	9.4	0.36 (0.14; 0.93)	
≥1.26	125	27	21.6	1	
<b>Neuropathy</b>					<b>0.455</b>
Yes	133	25	18.8	1.38 (0.58; 3.30)	
No	56	8	14.3	1	
<b>Nephropathy</b>					<b>0.016</b>
Yes	137	30	21.9	4.57 (1.33; 15.73)	
No	52	3	5.8	1	
<b>Diabetic foot</b>					<b>0.416</b>
Yes	26	6	23.1	1.5 (0.55; 4.11)	
No	163	27	16.6	1	

**Table 4:** Frequency of diabetic retinopathy according to seniority, glycemic control and complications of diabetes at Departmental University Hospital of Borgou and Alibori, Parakou.

	Total	Diabetic Retinopathy (DR)		p	
		Effective	Frequency		
<b>Type of treatment</b>					<b>0.114</b>
ADO + Scheme	99	12	12.1		
OAD + Insulin	87	20	23		
Insulin alone + Scheme	3	1	33.3		

**Table 5:** Frequency of Diabetic retinopathy by therapeutic modalities of the surveyed patients with diabetes, CHUD-B/A, Parakou.

Also, clinically, hyperglycemia induces proliferative changes in diabetic retinopathy synergistically with other risk factors for vascular diseases [16].

In the study of Tchabi et al., [11] conducted in Parakou, northern part of Benin Republic in 2009 in the same unit, the prevalence of diabetic retinopathy was 36.6%. This difference could be due to the fact that in 2009, patients were not well followed through regular controls by an unit in charge of diabetics patients only; situation which exposed most of the diabetic patients to retinal complications.

Subjects younger than 50 years had a lower prevalence (9.1%) of diabetic retinopathy  $p=0.020$   $OR=0.35$   $IC\ 95\% (0.45; 0.91)$  in opposite to those older than 50 years (21.9%). In many studies Hussain et al., [13] and Moumen et al., [17], reported that older diabetics were more susceptible to diabetic retinopathy.

Sex did not influence the presence of retinopathy in our study, for instance male represented 17.3%  $p=0.955$   $OR=0.35$   $IC\ 95\% (0.97; 2.09)$  and female 17.6%. The association between gender and diabetic retinopathy is variously appreciated by authors. For Yu et al., [5] and Yang et al., [18] there was no association between sex and diabetic retinopathy. In opposite, male gender was recognized as predisposing factor for retinopathy according to Mathengue et al., [2].

In our series, the consumption of tobacco, physical activity, blood pressure and body mass index were not associated with retinopathy.

For instance, consumption of tobacco 15.8% with  $p=0.97$   $OR=0.87$   $IC\ 95\% (0.23; 3.1)$ , sedentarity 13.4% with  $p=0.279$   $OR=0.63$   $IC\ 95\% (0.27; 1.4)$ , absence of High blood pressure 15.7% with  $p=0.564$   $OR=0.7$   $IC\ 95\% (0.49; 2.32)$ ,  $BMI \geq 25$  12.6% with  $p=0.097$   $OR=1.30$   $IC\ 95\% (0.15; 12.74)$ .

Yang et al., [18] found the same association between physical activity level and retinopathy. In opposite, Thapa et al., [3] have reported that there is any association between tobacco consumption and retinopathy. The association between hypertension and diabetic retinopathy was variously appreciated. It was the same as concerned the body mass index. For Yu et al., [5], blood pressure would not influence the onset of retinopathy in diabetic patients. In opposite, in studies conducted by Kyari et al., [1] and Moumen et al., [17] diabetic patients with high blood pressure were more prone to complications such as retinopathy. Katulanda et al., [7] had reported no association between retinopathy and body mass index whereas Kyari et al., [1] reported that when the body mass index increased, the subjects were exposed to diabetic retinopathy.

According to Katulanda et al., [8] prolonged exposure of patients with hyperglycemia was a risk factor for complications. This could explain the association between diabetes and retinopathy observed in the present study. Thapa et al., [3], Thomas et al., [19], Jingi et al., [20] highlighted the same association. The imbalance of diabetes was a risk factor for complications. In this study, subjects with high blood sugar have developed over diabetic retinopathy. Rajalakshmi et al., [21] stressed the same association.

Retinopathy and nephropathy share common etiologic mechanisms and settled simultaneously in diabetics. This observation would explain the association between retinopathy and nephropathy in patients of this study. Yu et al., [5], Rajalakshmi et al., [18] and Abougalambou et al., [22] highlighted the same association.

## Conclusion

Retinopathy is a common and serious complication in diabetes because it leads to blindness. In our series, its frequency is reduced in diabetic patients followed at the Unit of Diabetes of Departmental University Hospital of Borgou and Alibori since the setting in function of the diabetes unit. Risk factors associated with it in our study are in large part identical to those of previous studies conducted around the world and are an imbalanced high blood sugar and nephropathy. The screening must be systematic in diabetics to reduce its prevalence.

**Conflicts of Interest:** None

**Authors Contribution:** All authors contributed to this work. They have read and approved the final manuscript.

## References

1. Kyari F, Tafida A, Sivasubramaniam S, Murthy GV, Peto T, et al. (2014) Prevalence and risk factors for diabetes and diabetic retinopathy: Results from the Nigeria national blindness and visual impairment survey. BMC Public Health 14: 1299.
2. Mathenge W, Bastawrous A, Peto T, Leung I, Yorston D, et al. (2014) Prevalence and correlates of diabetic retinopathy in a population-based survey of older people in Nakuru, Kenya. Ophthalmic Epidemiol 21: 169-177.
3. Thapa R, Joshi DM, Rizyal A, Maharjan N, Joshi RD (2014) Prevalence, risk factors and awareness of diabetic retinopathy among admitted diabetic patients at a tertiary level Hospital in Kathmandu. Nepal J Ophthalmol 6.
4. Massin P, Easter (2001) Epidemiology and pathophysiology of diabetic retinopathy. Encyclical Med Chir, Ophthalmology Endocrinology Nutrition. Pg No: 290-295.



5. Yu X, Song S, Yang F, Dai H, Yang Z (2015) Clinical features of diabetes retinopathy in elderly patients with type 2 diabetes in Northern Chinese. *Niger J Clin Pract* 18: 183-188.
6. Gain P, Thuret G (2003) Diabetic retinopathy and retinal complications of diabetes extra. In : Gain P (ed.). *Eye and Diabetes*, Université Jean Monnet, Saint-Etienne, France. Pg No : 243-254.
7. Katulanda P, Ranasinghe P, Jayawardena R (2014) Prevalence of retinopathy among adults with self-reported diabetes mellitus: The Sri Lanka diabetes and Cardiovascular Study. *BMC Ophthalmol* 14: 100.
8. Katulanda P, Waniganayake YC, Ranasinghe P, Wijetunga WU, Jayaweera M, et al. (2014) Retinopathy among young adults with Diabetes Mellitus from a tertiary care setting in Sri Lanka. *BMC Endocrine Disorders* 14: 20.
9. Tchabi S, Doutetien C, Amoussou-Guenou KD, Djossou\_Doutetien A, Sounouvou I, et al. (2006) Ophthalmoscopic and epidemiological aspects of diabetic retinopathy CNHU-HKM Cotonou. *The Benin Medical* 32: 38-41.
10. Djrolo F, Doutetien C, Attolou V (2001) Diabetic microangiopathy: a study of the correlation between retinopathy and nephropathy in a population of black African diabetics in Cotonou. *Louvain Med* 120: 305-309.
11. Tchabi S, Assavedo R, Affo Y, Boni S, Doutetien C (2012) Biochemical risk factors of diabetic retinopathy at the County Hospital Borgou, Benin *Journal of Medicine and Pharmacy* 2: 137-142.
12. Rodier M (2001) Définition et classification du diabète. *Médecine Nucléaire - Imagerie fonctionnelle et métabolique* 25: 91-93.
13. Hussain S, Qamar MR, Iqbal MA, Ahmad A, Ullah E (2013) Risk factors of retinopathy in type 2 diabetes mellitus at a tertiary care hospital, Bahawalpur Pakistan. *Pak J Med Sci* 29: 536-539.
14. Jee D, Lee WK, Kang S (2013) Prevalence and risk factors for diabetic retinopathy: the Korea National Health and Nutrition Examination Survey 2008-2011. *Invest Ophthalmol Vis Sci* 54: 6827-6833.
15. Titchenell PM, Lin CM, Keil JM, Sundstrom JM, Smith CD, et al. (2012) Novel atypical PKC inhibitors prevent vascular endothelial growth factor-induced blood-retinal barrier dysfunction. *Biochem J* 446: 455-467.
16. Maeda M, Fujio Y, Azuma J (2006) MTHFR gene polymorphism and diabetic retinopathy. *Curr Diabetes Rev* 2: 467-476.
17. Moumen A, Meftah A, El Masmoudi A, El Jadi H, Guerbouh AA, et al. (2014) Facteurs associés à la rétinopathie diabétique chez 173 patients diabétiques marocains. *Annales d'Endocrinologie* 75: 381-382.
18. Yang JY, Kim NK, Lee YJ, Noh JH, Kim DJ (2013) Prevalence and factors associated with diabetic retinopathy in a Korean adult population: The 2008-2009 Korea National Health and Nutrition Examination Survey. *Diabetes Res Clin Pract* 102: 218-224.
19. Thomas RL, Dunstan FD, Luzio SD, Chowdhury SR, North RV, et al. (2015) Prevalence of diabetic retinopathy within a national diabetic retinopathy screening service. *Br J Ophthalmol* 99: 64-68.
20. Jingi AM, Noubiap JJ, Ellong A, Bigna JJ, Mvogo CE (2014) Epidemiology and treatment outcomes of diabetic retinopathy in a diabetic population from Cameroon. *BMC Ophthalmol* 14: 19.
21. Rajalakshmi R, Amutha A, Ranjani H, Ali MK, Unnikrishnan R, et al. (2014) Prevalence and risk factors for diabetic retinopathy in Asian Indians with young onset type 1 and type 2 diabetes. *J Diabetes Complications* 28: 291-297.
22. Abougambou SS, Abougambou AS (2015) Risk factors associated with diabetic retinopathy among type 2 diabetes patients at teaching Hospital in Malaysia. *Diabetes Metab Syndr* 9: 98-103.