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Prevalence and Associated Factors to Severe Forms of Diabetic Retinopathy in Patients Received at the Angiography Unit of the Central Hospital of Yaounde

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Abstract

Purpose: The objective of our study was to determine the prevalence and factors associated with severe forms of diabetic retinopathy (DR) in patients received at the angiography unit of the Yaounde Central Hospital (YCH). **Problem:** Ocular complications have a particular place because of the social impact and the major handicap they cause. Diabetes in Cameroon affects 615,000 people, i.e. an overall prevalence of 6%, and it represents an important cause of blindness. Among the complications related to diabetes, diabetic retinopathy accounts for 2.6% of blindness in the world. **Methods:** We conducted a retrospective cross-sectional study of 476 diabetic patients over a three-year period from 2018 to 2020 at the ophthalmology unit of the Yaoundé Central Hospital. We retained complete diabetic patient records for the main data collected. Statistical analysis of the results was performed with Epi Info version 7.2.2.6 and Excel 2013 analysis software, with data compared using chi 2 with a threshold of p < 0.05 significant level. **Results:** The prevalence of DR at the angiography unit was estimated at 75.16%, of which 68.05% was type 2 and 7.10% was type 1. There was a statistically significant association between the duration of diabetes and the presence of DR (p=0.000).

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The angiographic diagnosis of DR in 359 (75.42%) patients corresponding to 711 (74.84%) eyes, and diabetic macular edema in 196 (41.09%) patients corresponding to 387 (40.73%) eyes. Severe forms of diabetic retinopathy were present in 35.72% of the patients with DR, i.e. in 230 (32.35%) eyes. The risk factors for DR were glycemic control, duration of diabetes and hypertension. **Conclusion:** Hence the importance of insisting on preventive measures and education of the diabetic patient, within the framework of a global and multidisciplinary management strategy, in order to prevent the untoward complications of ocular damage.

Keywords: Characteristics; Epidemiology; Diabetic retinopathy; Yaoundé Central Hospital.

1. Introduction

Diabetes mellitus is an endocrine disease with a steadily increasing prevalence worldwide [1]. Diabetic retinopathy (DR) is its most common microvascular complication, affecting more than one-third of the global diabetic population [2]; [1]. The risk of developing diabetic retinopathy increases with many factors among which the duration of diabetes progression is the most important [2]. The increase in global population and average life expectancy predicts an increase in the number of diabetic patients to half a billion people by 2035 [1]. This will result in a predictable increase in DR, its severe forms causing visual impairment or blindness [1]; [3]. Few epidemiological data are available on DR in sub-Saharan Africa due to the paucity of studies on the subject. According to hospital data collected from a few countries in this region, the prevalence of DR ranges from 15% to 52% [4]. The rate of blindness and low vision attributable to DR is 8% and 11% respectively according to a South African study [5]. In Cameroon, the prevalence of diabetic retinopathy is 42% according to a 2010 hospital study; in subjects with this ocular complication of diabetes 21.1% of eyes examined were visually impaired and 6.9% of eyes examined were blind (Koki and his colleagues 2010). We did not find any studies in the Cameroonian context less than ten years old that address the epidemiological determinants and factors associated with DR, yet the quantitative and qualitative improvement in human and infrastructural resources used in diabetes management, and the increasing incidence of diabetes in sub-Saharan Africa are likely to have altered the data on this complication over the last decade [4,5].

The aim of this work is therefore to determine the prevalence and factors associated with severe forms of diabetic retinopathy received at the angiography unit of the Yaoundé Central Hospital (HCY) in order to account for the variations observed over the last decade, and to contribute to the literature on this pathology in our setting.

2. Materials and methods

2.1. Research type

Methodology is a discourse on the chosen method. It is a text that one elaborates on how one does research [6]. For this work, we conducted a retrospective and prospective descriptive cross-sectional study. The ophthalmology department of the Yaoundé Central Hospital served as the setting for our study, which lasted three months, from June to the end of August 2021. Our source population consisted of patients affected by diabetes, those among diabetic patients who have a prescription for angiography examination and who presented

to the angiography/laser unit of the ophthalmology service of the central hospital during the period 2018, 2019, 2020 whose indication is diabetic retinopathy.

2.2. Inclusion and Exclusion

We used several criteria to obtain the number of patients selected for our work. These are criteria that grouped all complete patient records for the study performed containing: medical history, complications of angiographic forms of DR and visual acuity, and results of the retinal angiography examination validated by an ophthalmologist of the department.

We excluded confounding factors such as associated pathologies, i.e., all retinal diseases responsible for hemorrhages or exudates on the fundus, in addition to DR and its risk factors (e.g., posterior uveitis, retinal vascular occlusion)

2.3. Sampling Procedures

In our study, the sampling was exhaustive over a period of three consecutive years. However, we enrolled 476 type 1 and type 2 diabetic patients; for which 361 records were diabetic patients with DR and 115 records were diabetic patients without DR.

2.4. Data Collection and analysis

We used a data sheet inspired by the patient angiography examination form and literature data on the different aspects of the study; as well as a laptop computer with data collection and analysis software installed. After validation of our research protocol, we obtained an authorization from the ethics committee at the School of Health Sciences of the Catholic University of Central Africa for ethical clearance and a research authorization at the Central Hospital of Yaoundé for collection.

First of all, we gathered all the AGF summary forms and sorted them to retain only the forms of diabetic patients, then we retained those whose medical diagnosis was DR. Our data collection was carried out on the data sheets and each time we called the patients to complete the missing data if they existed. We retained the complete forms that included the diagnosis and interpretation of the angiography given by the ophthalmologists of the department.

We recorded the collected data and analyzed them with the statistical software Epi infos version 7.2.2.6 and Excel 2013. The qualitative variables were described by their number and percentage. While quantitative variables were described by their mean +/- standard deviation or by their median (interquartile range) according to the normality of the distribution. We associated the categorical variables and diabetic retinopathy using the odds ratio. Differences between proportions were analyzed using contingency tables and applying the Chi-2 or file test when the theoretical number of people in a cell was less than 5. The association between variables was done by logistic regression in order to eliminate confounding factors. The comparison of quantitative variables and diabetic retinopathy was done by applying the ANOVA or Kruskal-Wallis test depending on the normality

of the distribution. We used an α -error threshold of 5%; mean values were expressed with their 95% confidence intervals. Differences were considered statistically significant for P values <0.05. Illustrations of the results were designed using Microsoft Office Excel 2013 software and represented as Figures or tables.

We collected 476 records of diabetic patients received in the angiography unit of the Central Hospital of Yaoundé during the study period. This corresponded to 950 eyes because two patients were monolphthalmic. The flow chart below shows the selection of our sample.



Figure 1: Participant Selection Flowchart.

3. Results

3.1. Characteristics of diabetic retinopathy and diabetic maculopathy in the sample

We found an angiographic diagnosis of DR in 359 (75.42%) patients corresponding to 711 (74.84%) eyes, and diabetic macular edema in 196 (41.09%) patients, corresponding to 387 (40.73%) eyes. Severe forms of diabetic retinopathy were present in 35.72% of patients with DR, i.e. in 230 (32.35%) eyes out of 711 examined. The proliferating form was observed in 24.84% of the eyes examined (see Figure 2 and Figure 3 below).

The distribution of DR according to age showed a more frequent involvement of patients whose age was between 45 and 74 years, i.e. 87.18% of the study population with the interval [60-75] as the modal class, representing 50.97% of the patients (see Table 3). The mean age of patients with DR was 59.83 ± 10.33 years. Male and female patients had DR in equal proportions, 180(50.14) males and 179(49.86) females, respectively.

Diabetic macular edema was present in 182(50.84%) patients with DR, but also in 11(9.65%) patients without DR. Severe forms of diabetic macular edema were less frequent than those of DR. They were found in 2.60% of patients (see Figure 3). We found neither ischemic maculopathy nor mixed maculopathy among the

angiographic diagnoses of the diabetic patients examined.



Figure 2: Distribution of diabetic retinopathy stages in the study population.



Figure 3: Distribution of Diabetic Macular Edema in the study sample.

3.2. Factors associated with diabetic retinopath3.2.1. Risk factors for DR found

The known risk factors for diabetic retinopathy found in our study were: duration of diabetes, glycemic control and hypertension and type of diabetes.

• Duration of diabetes progression

The mean duration of diabetes in the study population was 11.42 ± 7.30 (1 - 41) years, with a median of 11 years. In patients with DR, this duration was 12.25 ± 7.17 years. There was a statistically significant association between the duration of diabetes and the presence of DR (p=0.00). There was also a statistically significant association between the age of the patients and the presence of DR, especially at the extremes of [17-30 years] and [75-87 years].

• Glycemic control

Most patients had unbalanced diabetes. The mean glycated hemoglobin (Hb1AC) level was 8.38±2.52 (3.6 -

14.50), with a median of 8.00 (6.5-14.50).

• Hypertension

We found hypertension in 233 patients, or 95.81% of patients with DR. The association of DR with hypertension was not statistically significant (p = 0.27).

• Type of diabetes

The majority of patients with DR had type 2 diabetes, i.e. 90.55% of the study population. Type 2 diabetes was present in 45 (9.45%) patients. There was no statistically significant association between the type of diabetes and the presence of DR in our series (p=0.69) as shown in Table 1.

3.2.2. Other factors associated with DR

We found a statistically significant association between the professions of student (p=0.041) or shopkeeper (p=0.013) and the presence of DR (see Table 2). The presence of diabetic macular edema (p = 0.000) and treatment of diabetes with oral antidiabetic drugs (p = 0.042) were also significantly associated with the angiographic diagnosis of DR (see Table 1).

Variables	Diabetic retinopathie		OR (IC 050())	P-Value
	Present N=359 n(%)	Absent N=115 n(%)	(IC 95%)	
Type of diabetes				
Type 1	33(9,19)	12(10,43)	0,87(0,4-1,70)	0,692
Type 2	326(90,81)	103(89,57)		
Diabetic Macula oedema				
Present	182(50,84)	11(9,65)	9,7(5,0-18,60)	0,000
Absent	176(49,16)	103(90,35)		
Diabetes treatment				
Hygienic and dietary measures	16(4,47)	8(7,02)	0,6(0,3-1,50)	0,287
OAD + Insuline	47(13,13)	8(7,02)	2,0(0,9-4,40)	0,074
Insuline	71(19,83)	15(13,16)	1,6(0,9-3,00)	0,103
Oral antidiabetics (OAD)	225(62,57)	84(72,81)	0,6 (0,4-0,90)	0,042
Comorbidities				
Yes	240(67,04)	70(61,40)	1,3(0,8-1,90)	0,270
No	118(32,96)	44(38,60)	· · · · ·	

Table 1: Other factors associated with diabetic retine	pathy.
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3.3. Multi-variate analysis of factors associated with DR

All significant and weakly non-significant variables (0.05 to 0.1) were included in the multivariate analysis model. This was a logistic regression with DR as the dependent variable. The following table represents the

independent factors associated with the occurrence of diabetic retinopathy after adjustment for confounding factors. The factors favoring the occurrence of diabetic retinopathy were: commercial occupation and the presence of diabetic macular edema. On the other hand, the factors reducing the latter were: being under 30 years of age; being over 75 years of age; and the presence of other abnormalities.

Variables	Rapport de cotes ajusté (I.C 95%)	Valeur P ajustée
Aged less than 30 years	0,1(0,0-0,90)	0,046
Aged more than 75 years	0,6(0,2-0,80)	0,023
Being a student	0,6(0,1-2,30)	0,182
Commercial worker	1,6(1,1-3,20)	0,035
Intake of oral antidiabetics	0,8(0,4-2,10)	0,102
Presence of diabetic macula	11,2(4,7-19,40)	0,000
oedema		
Presence of other anomalies	0,6(0,4-0,90)	0,027

Table 2: Independent factors that promote or reduce the chances of diabetic retinopathy.

3.4. Comorbidities

We found comorbidities associated with diabetes in 65.82% of patients in our series. Among them, arterial hypertension was the most frequent at the systemic level (95.81%) as well as cataract and glaucoma at the ocular level, in 58.82% and 32.35% of cases respectively.

3.5. Visual impairment and blindness in the study population

The mean visual acuity of the patients was $-0.3+/-0.61 \log MAR (5/10 +/- 2.5/10)$ in the right eye and $-0.3 +/-0.65 \log MAR (5/10 +/- 2.6/10)$ in the left eye with a median of $-0.3 \log MAR (-0.5\log MAR a -0.2\log MAR)$. Visual acuity examination noted on the patients' pre-angiographic charts showed cases of profound visual impairment. We found poor vision in 96 eyes, i.e. 11.21%, and blindness in 7.20% of the eyes examined.

We found 6 cases of bilateral blindness, i.e. 1.26% of our sample.

Discussion

3.6. Prevalence and stages of diabetic retinopathy

The prevalence of DR in our sample was 74.84%, much higher than that reported 10 years earlier by Koki and his colleagues (2010) in the same study site, which was 42% [7]. The rate of diabetic macular edema in our series (41.09%) was almost 4 times higher than that reported by Koki and his colleagues (2010), which was 10.6% [7]. In a systematic review of the epidemiology of DR and MDD in Africa published in 2013, Burgess and his colleagues note the variable nature of the prevalence of DR and MDD depending on the source population [5]. For community-based studies, the author notes a prevalence of DR ranging from 30.2 to 31.6% and from 0.9 to 1.3% for diabetic maculopathy, including WMD [8]. In hospital-based studies the same author reports more variable prevalences, ranging from 7.0 to 62.4% for DR and 1.2 to 31.1% for diabetic

maculopathy. In addition to the selection bias that is almost inevitable in a specialized reference unit for these conditions, it is also necessary to consider the difference in human, financial, and technical resources for optimal patient care, as already noted by Gning and his colleagues in Senegal (2007) [9].

The relatively high proportion of DR and MDD compared to that observed by Koki and his colleagues (2010) in our study site in 2006 could be explained, beyond the reasons mentioned above, by a larger sample size in our study, which was collected over a period of 3 years, compared to that of Koki and his colleagues (2010), which was collected over a period of one year. The increase in the diabetic population, particularly type 1 diabetes, in sub-Saharan Africa is certainly another reason [5], [4]. Severe forms of diabetic retinopathy represented 32.35% of eyes examined, including 7.36% of pre-proliferative forms (severe DRNP) and 24.84% of cases for the proliferative form. Koki and his colleagues (2010) found in our study site 22.97% of eyes with the proliferating form and 31.29% with the proliferating form, i.e. 54.26% of severe forms of the disease [7]. This results in a decrease of the severe forms of DR of about 21.91% during the last decade.

This improvement in the stages of DR could be explained by greater access to screening for ocular complications of diabetes. Quantitative improvement in human resources in endocrinology and ophthalmology could be one of the primary reasons. Since the beginning of the last decade, the School of Medicine and Biomedical Sciences has included training curricula in endocrinology and ophthalmology in its specialized medical training options [10]. The popularization of mass screening means through the eye disease screening campaigns organized by the PNSO and the organization of activities specific to screening for diabetes and its complications on the occasion of the annual diabetes day may have contributed to this favorable development [11].

3.7. Factors associated with DR

The leading studies on the microvascular complications of diabetes, and especially on diabetic retinopathy which is the main one, are the United Kingdom Prospective Study (UKPDS) for type 2 diabetes and the Diabetes Control and Complications trial (DCCT) for type 1 diabetes [12]

These two studies each showed in the corresponding type of diabetes the predominance of the level of glycemic control and blood pressure control among the risk factors for DR. Thus, a one-point decrease in Hb1Ac would reduce the risk of developing DR by 31%, just as a 10mmHg reduction in mean blood pressure would result in an 11% decrease in the risk of developing [11].

In our series, the mean glycated hemoglobin level was 8.38 ± 2.52 with a median of 8.00, for a target of 7% to be reached to talk about balance. There was a statistically significant association in univariate analysis between Hb1Ac level and the risk of DR occurrence. In addition, 95.81% of the patients in our study had hypertension as an additional risk factor for DR, although this association was not statistically significant in our study. In the UKPDS study, severe forms requiring retinal photo coagulation represented 2.6%, well below the rate observed in our study, which was 32.35%, and in that of Koki and his colleagues (2010), ten years earlier, of the order of 54.26% [7]. This difference could be explained by the difficulties in maintaining glycemic and blood pressure

control of diabetic patients in our setting. The lack of financial resources for a sustainable access to antidiabetic drugs and a diet often out of reach of patients, the relative lack of trained staff and an adequate number of management centers are some of the reasons mentioned to explain this situation [9]. In a study conducted in the hospital where our study site is located, Ngassam and his colleagues (2012) showed the prohibitive cost of monitoring type II diabetes (the most common form) in our environment, evaluated globally at 274.9USD, i.e. 4.8 times the minimum wage [13]. Despite this handicap, the significant reduction observed in our study compared to the rates initially reported by Koki and his colleagues (2010) allows us to conclude that there has been an overall improvement in patient follow-up, probably due to easier access to specialized human resources in the patient follow-up chain [7].

Continued improvement in patient access to specialized medical care for hypertension and diabetes could contribute to a significant reduction in the number of DR cases in our setting. Apart from the extreme ages mentioned above as associated with an increased risk of DR in our series, multivariate analysis showed that occupation as a shopkeeper, the presence of MDD, or other comorbidities were statistically significantly associated with the risk of DR occurrence. According to the literature, there does not appear to be a difference between races in community-based studies on the prevalence of DR (4,5).

The occupation of shopkeeper found as a factor associated with DR in our study would not be of particular note to us beyond the relative prevalence of this occupation in our sample. However, it would be opportune to carry out in-depth investigations in this group in search of specific factors, notably hypertension and glycemic control, that could explain its association with DR.

The association of DME with the occurrence of DR is easily explained by the linearity of the pathophysiology of the two entities. Retinal microvascular alterations in diabetes mellitus are essentially parietal. Thus, the development of microaneurysms, which represent the first observable elementary lesions of DR, is associated with an increase in the vascular permeability of retinal capillaries predominantly at the posterior pole and the occurrence of diabetic macular edema [14].

3.8. Prevalence of blindness and visual impairment

In our series 11.21% of eyes examined were visually impaired while 7.20% of these eyes were blind. While the proportion of visually impaired in diabetes has halved compared with Koki's 2010 study, which reported 21.1% visually impaired eyes at this site, the rate of blindness has hardly changed. It was 6.9% in his study. Blindness due to diabetes is the leading cause of blindness of all etiologies in developed countries, accounting for up to 85% of all blindness (15,4).

It is undeniable that if nothing is done, the rapid increase in the number of people with diabetes in sub-Saharan Africa will be accompanied by an exponential increase in the number of patients with DR and potentially the number of cases of blindness due to diabetes. In 2007, the International Diabetes Federation predicted an increase of more than 95% in the number of people with diabetes by 2025, or about 15 million Africans [9] and 24 million by 2030, while the WHO predicted a global increase of more than 300 million new cases of diabetes

over the same period [5]. It is therefore timely to continue efforts to improve access to basic diabetes care starting with increased screening, multiplication and decentralization of resources for diagnosis and management of DR as suggested by several authors on the issue in Sub-Saharan Africa (5,4).

The initiative of a national diabetic blindness program is encouraged in our setting as suggested by Koki in 2010, in order to limit the psychosocial and economic burden related to diabetic retinopathy in our country [7].

3.9. Difficulties encountered

Generally speaking, the collection went well. However, certain significant difficulties influenced this research work. These included the refusal to participate by certain patients whom we called by telephone, who claimed not to understand French but only their mother tongue. We also noted that some of our patients were no longer alive.

3.10. Limitations of the study

Our study was conducted at a single research site. This does not allow us to claim generalization of the results obtained, nor does it allow a comparative analysis approach.

4. Conclusion

Diabetic retinopathy is one of the major causes of visual impairment, with a prevalence of 74.95% in our study, slightly higher than that reported by Koki and his colleagues (2010) 10 years earlier in the same site and blindness caused by diabetic retinopathy was 6.9% [7]. It is a leading cause of visual impairment in subjects over 60 years of age.

The main risk factors for the onset and aggravation of diabetic retinopathy are the length of time diabetes has been present, poor glycemic control and high blood pressure. Significant progress has been made in recent years in the prevention and treatment of diabetic retinopathy. Hence the improvement of its stages. Early detection of diabetic retinopathy and awareness of regular fundus monitoring are key elements in its treatment. The importance of blood sugar and blood pressure control in preventing the progression of diabetic retinopathy must also be emphasized. New therapies are now available that may, in the short term, limit the progression of diabetic retinopathy or prevent the onset of blindness. For earlier detection of DR and consequently to prevent diabetes-related blindness, we recommend a more active role for the state, nongovernmental organizations, medical and nursing staff in raising awareness of diabetic patients' follow-up, education and dissemination of information. The initiative of a National Program for the Control of Diabetic Blindness as suggested by Koki in 2010 would be timely. Finally, we hope that this study will serve as a starting point for others in order to improve the conditions of care for the diabetic population and specially to reduce the prevalence of this pathology and its complications as well as the risk factors.

5. Recommendations

The results of this study have shown that diabetic retinopathy gets into its severe form when it is not detected early due to the lack of specialized health personnel in ophthalmology within the diabetes management team unit of most hospitals. This late detection is amplified by the lack of ophthalmological equipment and devices in most hospitals. There should therefore be in each hospital, a synergy that facilitates communication between the diabetes management unit and the ophthalmology department, favoring that a patient being monitored for diabetes must at the same time be consulted in ophthalmology. At the community level, screening campaigns for diabetes and diabetic retinopathy would be an asset to facilitate this early detection and thus prevent serious forms of diabetic retinopathy.

In addition, the severe form of diabetic retinopathy is caused by the poor follow-up of diabetes due to poor compliance in taking medications which are not always accessible as well as some exams; all this combined with the lack of information and the lack financial means. It is therefore time to subsidize the management of diabetes and diabetic retinopathy while making available to local pharmacies specialty products allowing the management of diabetes, namely insulin and oral antidiabetics. Finally, sensitizing communities, families and healthcare personnel on the risks associated with the worsening of diabetic retinopathy may lead to massive awareness and acute adherence to the diabetes management protocol while monitoring the warning signs of diabetic retinopathy.

References

- R. Simó *et al.*, "Non-Traditional Systemic Treatments for Diabetic Retinopathy: An⁽¹⁾_{SFP}Evidence-Based Review," *Curr. Med. Chem.*, vol. 22, no. 21, pp. 2580–2589, Jun. 2015, doi: 10.2174/0929867322666150520095923.
- [2] J. G. Lawrenson *et al.*, "Interventions to increase attendance for diabetic retinopathy screening," *Cochrane Database Syst. Rev.*, vol. 1, p. CD012054, Jan. 2018, doi: 10.1002/14651858.CD012054.pub2.
- [3] S. Sivaprasad and E. Pearce, "The unmet need for better risk stratification of non-proliferative diabetic retinopathy," *Diabet. Med.*, vol. 36, no. 4, pp. 424–433, Apr. 2019, doi: 10.1111/dme.13868.
- [4] E. Masson, "Rétinopathie diabétique à Dakar et revue de la littérature africaine," *EM-Consulte*. https://www.em-consulte.com/article/79898/retinopathie-diabetique-a-dakar-et-revue-de-la-lit (accessed Sep. 02, 2022).
- [5] P. I. Burgess, G. Msukwa, and N. A. Beare, "Diabetic retinopathy in sub-Saharan Africa: meeting the challenges of an emerging epidemic," *BMC Med.*, vol. 11, no. 1, p. 157, Jul. 2013, doi: 10.1186/1741-7015-11-157.
- [6] B. A. Nkoum, Initiation à la recherche: une nécessité professionnelle (Presse UCAC). 2012. [Online].

Available: https://www.worldcat.org/title/initiation-a-la-recherche-une-necessiteprofessionnelle/oclc/880579077

- [7] G. Koki *et al.*, "Diabetic retinopathy in black Africans: An angiographic study," *Santé Montrouge Fr.*, vol. 20, pp. 127–32, Jul. 2010, doi: 10.1684/san.2010.0207.
- [8] P. I. Burgess, I. J. C. MacCormick, S. P. Harding, A. Bastawrous, N. A. V. Beare, and P. Garner, "Epidemiology of diabetic retinopathy and maculopathy in Africa: a systematic review," *Diabet. Med.*, vol. 30, no. 4, pp. 399–412, Apr. 2013, doi: 10.1111/j.1464-5491.2012.03756.x.
- [9] S. B. Gning, M. Thiam, F. Fall, K. Ba-Fall, P. S. Mbaye, and L. Fourcade, "LE DIABÈTE SUCRÉ EN AFRIQUE SUBSAHARIENNE ASPECTS ÉPIDÉMIOLOGIQUES, DIFFICULTÉS DE PRISE EN CHARGE," p. 5, 2007.
- [10] J. J. Bigna, J. R. Nansseu, J.-C. Katte, and J. J. Noubiap, "Prevalence of prediabetes and diabetes mellitus among adults residing in Cameroon: A systematic review and meta-analysis," *Diabetes Res. Clin. Pract.*, vol. 137, pp. 109–118, Mar. 2018, doi: 10.1016/j.diabres.2017.12.005.
- [11] C. Nanfack, G. Koki, L. Mbuagbaw, and B. L. Assumpta, "Diabetic retinopathy at the Yaoundé Central Hospital in Cameroon: epidemiology and angiographic findings," Nov. 16, 2012. https://www.panafrican-med-journal.com/content/article/13/54/full/ (accessed Sep. 05, 2022).
- [12] UKPDS, "Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33)," *The Lancet*, vol. 352, no. 9131, pp. 837–853, Sep. 1998, doi: 10.1016/S0140-6736(98)07019-6.
- [13] E. Ngassam *et al.*, "P318 Cout de la prise en charge du diabète de type 2 a l'hopital central de yaounde," *Diabetes Metab.*, vol. 38, p. A105, Mar. 2012, doi: 10.1016/S1262-3636(12)71420-9.
- [14] R. Jin, Y. Guo, and Y. Chen, "Risk factors associated with emergency peripartum hysterectomy.," *Chin. Med. J. (Engl.)*, vol. 127, no. 5, pp. 900–904, 2014.
- [15] L. Osterberg and T. Blaschke, "Adherence to Medication," N. Engl. J. Med., vol. 353, no. 5, pp. 487–497, Aug. 2005, doi: 10.1056/NEJMra050100.