

The prevalence and factors associated with ocular complications among patients with type 2 diabetes  
in Onandjokwe hospital.

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This research assignment is submitted in partial fulfilment of the requirement for the degree of Master of Family Medicine (MMed), Division of Family Medicine and Primary Care, Department of Interdisciplinary Health Sciences, Stellenbosch University.

DECLARATION:

I, Dr Njuki P N, the undersigned, hereby declare that the work contained in this assignment is my original work and that I have not previously submitted it, in its entirety or in part, at any university for a degree. I also declare that ethics approval for the study was obtained from the Health Research Ethics Committee of Stellenbosch University (IIREC); Ethics Reference #: S14/03/065, and Ministry of Health and Social Services (MOHSS); Ref: 17/3/3.

Signature: .

Date: ..... 05/10/2015

## **ABSTRACT**

### **Background**

The prevalence of diabetes mellitus and its complications is rising globally and many factors which include sedentary lifestyle, obesity, aging, population growth among others have been attributed to this. Ocular complication adversely affects communities and individuals.

### **Aim**

To determine the prevalence and factors associated with ocular complications among patients with type 2 diabetes at Onandjokwe hospital

### **Methods**

A cross-sectional survey was conducted. Data on presence of hypertension, HIV infection, and level of FPG for 61 patients with diabetes was extracted from the patients' records. Weight and waist circumference measurement, and eye examination were carried out. Using systematic random sampling, participants were recruited from the two male and female medical wards, and the two medical general outpatient departments.

### **Results**

Of the 61 patients who had eye examinations, 39% had ocular complications with abnormalities in visual acuity, 32 (52%) being the most common. Other abnormalities included visual field defects 30 (49%), lenticular defects 28 (46%), retinal defects 25(41%), conjunctival defects 25 (41%) and raised intra ocular pressure 15 (25%).

Patients with age greater than 50 years had a slightly higher prevalence of ocular complications 31 (52.5%) as was the case with high Fasting Plasma Glucose (FPG) and high blood pressure with 38 (65.5%) and 33 (55%) respectively. However, only BMI ( $p=0.008$ ) was found to have a statistically significant association with development of ocular complications among the participants with high BMI increasing risk of ocular complications 8.5 times (Fisher exact 8.5,  $p$ -value 0.008).

### **Conclusion**

There was a high prevalence of ocular complications among patients with diabetes in Onandjokwe hospital. BMI was found to be a significant modifiable associated factor among patients with of ocular complications.

## TITLE

**The prevalence and factors associated with ocular complications among patients with type 2 diabetes in Onandjokwe hospital.**

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## INTRODUCTION

The number of people with diabetes is increasing due to population growth, aging, urbanization, increasing prevalence of obesity and physical inactivity.<sup>1</sup> The prevalence of diabetes for all age-groups worldwide was estimated to be 2.8% in 2000 and 4.4% in 2030, with the estimated total number of people with diabetes to rise from 171 million in 2000 to 366 million in 2030.<sup>1</sup> There is a general increase in prevalence of diabetes in the developing world with diabetes being the fifth among the top ten diseases in United Bulawayo Hospital, Zimbabwe.<sup>2</sup> About 1.6 million people are living with diabetes in Kenya (16 people per 100 000 population),<sup>3</sup> and in Namibia, diabetes is seen as one of the greatest threats to health with 3 650 new cases (0.04 per 100 000 population) of the disease recorded in the country's public health facilities between July 2010 and July 2011.<sup>4</sup>

Diabetes is associated with derangement in insulin production or utilization which results in hyperglycaemia. The latter is associated with a myriad of short and long term complications such as cardiovascular diseases and stroke, foot ulcers and limb amputations, blindness<sup>5</sup>, kidney disease and neuropathy. Diabetes also increases the risk of death. People with type 2 diabetes (T2DM), compared with people without diabetes, had a twofold increased risk of all-cause mortality and a threefold increased risk of cardiovascular mortality, adjusted for smoking.<sup>6</sup> In New York, it was found that, in 2010, diabetes ranked as the fifth cause of premature death. Furthermore it is well known that cancer and heart disease which ranked first and second respectively as causes of untimely death are associated with diabetes.<sup>7</sup>

Diabetes has been associated with a wide range of ocular complications, such as; diabetic retinopathy (a leading cause of blindness), cataracts, anterior ischaemic optic neuropathy, diabetic papillopathy, and ocular movement disorder.<sup>8</sup> In addition, diabetes is a known risk factor for

glaucoma and ocular ischaemic syndrome. It is also a possible risk factor for retinal vein and artery occlusion, retinal arteriolar emboli and corneal diseases.<sup>8</sup> The importance of diabetic retinopathy and cataract as leading causes of visual impairment and blindness has been elucidated by the many studies already carried out. Ocular complications such as retinopathy, cataracts, visual impairments and blindness, have well been demonstrated to be prevalent among diabetic patients.<sup>9-14</sup>

There is a wide variation in prevalence of diabetic ocular complications among different studies. Prevalence of blindness in Africa is estimated by World Health Organization (WHO) to be between 1.2% and 1.5% and a cataract prevalence of 5.2% was found.<sup>15</sup> Low vision and blindness in adults in Gurage zone, central Ethiopia was found to be 7.9% and 12.1% respectfully and the attributed causes included cataracts, trachoma, and glaucoma.<sup>16</sup> The difference in prevalence of cataracts among patients with diabetes has been found to vary between 12% and 44.9%, retinopathy between 7% and 55%, glaucoma 3%, and corneal diseases 73.6%.<sup>17-20</sup> These differences in prevalence were observed in populations with different risk factors and confounding factors.

Ocular complications affect individuals and communities adversely. Individuals with visual loss have difficulties carrying out activities of daily living such as reading, watching television, driving and walking. Ocular complications also affect an individual's social and emotional wellbeing and the community economically; from both direct and indirect costs. It is important to clearly identify the types and nature of ocular complications among populations so as to develop and implement strategies that will effectively address them.

There are many factors associated with development of complications in patients with diabetes. These factors include age at diagnosis, duration of diabetes (time related variables), diabetes control, plasma cholesterol levels and high density lipoprotein cholesterol levels.<sup>14, 21-24</sup> This is not without controversy as the role of some factors such as age, sex, marital status, occupation and education level have been found to have no association with development of ocular complications.<sup>25,</sup>  
<sup>26</sup> In addition co-morbidities and medications could independently cause complications and are important confounders.

There is scanty information on prevalence of ocular complications and the risk factors among the patients with diabetes in Onandjokwe. The lack of such information impacts district health care planning negatively. This study aims at bridging this information gap by determining the prevalence and factors associated with occurrence of ocular complications among patients with diabetes in

Onandjokwe. Information from this research will be useful in the formulation and implementation of strategies aimed at preventing, treating and reducing progression of complications. It will also be useful in making projections on resources needed to address the health challenges posed by ocular complications among patients with diabetes..

## **AIM AND OBJECTIVES**

The aim of the study was to determine the prevalence of and factors associated with ocular complications among patients with type 2 diabetes at Onandjokwe hospital.

The objectives were to:

1. determine the types and prevalence of ocular complications among patients with type 2 diabetes at Onandjokwe hospital
2. describe the prevalence of factors known to be associated with ocular complications (age, years with diabetes, glycaemic control, hypertension, and obesity) among patients with type 2 diabetes at Onandjokwe hospital.

## **METHODS**

### **Study design**

A descriptive cross-sectional study design was used.

### **Setting**

Onandjokwe hospital is a 350 bed capacity referral hospital located in the North-western part of Namibia. According to census data from the most recent census in 2010,<sup>27</sup> Onandjokwe district has a population of 150,000 with an annual growth rate of 2.2%. The catchment population includes the nearby Ondangwa town with 6000 inhabitants. Onandjokwe hospital receives referral from 3 nearby district hospitals and a number of health centres, clinics and outreach points. -The patients visiting Onandjokwe hospital are predominantly from the rural settings and patients on chronic medications are not exempted from paying hospital fees. However, one fee caters for all services received.

### **Study population**

The target population was all diabetic patients who visited Onandjokwe hospital either as in-patients or as out-patients. From hospital statistics, Onandjokwe hospital offers diabetic care to about 400 patients. Assuming a prevalence of ocular complications of between 5 and 10, a sample of between 62 and 103 was considered representative using a confidence interval of 95%. Systematic random sampling was used to recruit every second patient presenting at the site. -A total of —85 participants were enrolled from the two medical wards (male and female) and the two consulting rooms of medical out-patient department. Initial plan was to recruit patients admitted into medical wards

only. However, due to problems with the sample size, patients attending medical out-patient clinic for follow up were included. The inclusion of out-patients affected data quality as it turned out that they were poorly investigated. Due to incompleteness of data in some patients, findings on 61 participants were analysed and reported on.

**Inclusion criteria:**

- Known diabetic on treatment for at least one year.
- Participants 18 years and older
- Participants admitted to the medical wards or attending follow up in Onandjokwe hospital during the study period.

**Exclusion criteria:**

- Non consenting patients
- Very sick patients.
- Blind patients

**Data collection tools and processes**

The participants were recruited from the two (male and female) medical wards and two medical out-patient consulting rooms over a period of nine months (from 1<sup>st</sup> August 2014 until 30<sup>th</sup> April 2015). Relevant demographic data and baseline information of the participants consisting of the age (in years calculated from the date of birth to the date of examination), sex (male or female), and duration since diagnosis of diabetes (in years, calculated from date diabetes was diagnosed to date of examination). Also recorded were previous admissions, previous operations, any complications and co-morbidities such as hypertension and results of recent laboratory results for urinalysis, fasting blood sugar, glycated haemoglobin (HBA<sub>1</sub>C), urea and electrolytes and Human Immunodeficiency Virus (HIV) infection status (all as documented in the health passport or clinical notes). HIV status was recorded as positive if so documented, negative if the result is at less than 3 months old, or unknown if no HIV test done in the last 3 months except for those HIV positive. These were recorded in the data extraction sheet by the trained research assistance under the supervision of the registered nurse in charge of the site. The weight (measured in Kilograms using a standardised weighing scale for adults), height (measured in centimetres using a wall mounted height meter) and waist circumference (measured at the waist midpoint between the lowest rib and the iliac crest using a tape measure) of each participant were determined using standard validated scales and tape measures and recorded in the data extraction tool.

The patients were then interviewed and examined for the presence of ocular complication in the eye clinic by the registered nurse with ophthalmology training, the main researcher and the specialist physician. All the information was entered into the data abstraction tool developed and a copy attached as appendix 2. Ocular complications looked for included all previously documented ocular problems and surgery, complications in the eye lids, conjunctiva, cornea, iris, lens and vitreous. Specific tests done included vision examination using Snellen eye chart, colour vision using Ishihara test, abnormalities in eye movements, pupil response to light, visual field analysis, ocular pressures using calibrated tonometer, and the dilated eye was examined for pathology in the retina. Patients with suspected retinal and optic nerve abnormalities were referred to the ophthalmologist for confirmation, further assessment and management.

### **Explanation of factors studied**

Age was calculated as number of completed years from the date of birth to the date of data entry. The age was then categorized into above 50 and  $\leq 50$  years with those above 50 years expected to have more ocular complication.<sup>29</sup> Gender was captured as either male or female with the male gender suspected to be a risk factor for developing ocular complication.<sup>29</sup>

Years with diabetes were calculated in years from the date diabetes was diagnosed to the date of data entry. The years with diabetes were then categorized into more than 5 years and less than 5 years. The more years with diabetes, the greater would be the expected prevalence of ocular complication.<sup>18</sup>

Participants were categorised as having high blood pressure if they were on treatment as documented in the clinical records. Patients who are recorded as hypertensive but controlled with life style modification were recorded as hypertensive. It was expected that the participants with hypertension would have more ocular complications.<sup>18</sup>

HIV infection statuses of the participants were determined according to the latest HIV test documented in the clinical records. If the HIV test result was positive, the HIV status was recorded as positive in the data extraction tool. If the test was negative, the HIV status was recorded as negative if less than three months old, and as unknown if greater than three months. If no HIV test documented, the HIV status was recorded as unknown.<sup>28</sup>

The Body Mass Index (BMI) was calculated by dividing the weight of the participant (in kilograms) with the square of the height of the participant ( $m^2$ ). The BMI was categorised into more than 25 Kg/ $m^2$  and less than 25 Kg/ $m^2$ . The participants with BMI above 25 Kg/ $m^2$  were expected to have a higher prevalence of ocular complications.<sup>29</sup>

Waist circumference was categorized to above 88cm in females and 102cm in males and below 88 and 102 in females and males respectively. Participants with higher waist circumference were expected to have higher prevalence of ocular complications.<sup>30</sup>

Glycaemic control was classified according to levels of fasting blood sugar. Levels of Fasting Plasma Glucose (FPG) > 7.0 mmol/L was classified as uncontrolled diabetes.<sup>18</sup>

### **Data analysis**

The data collected was entered into an excel spreadsheet, cleaned and analysed using STATA version 10 by a consultant statistician from Stellenbosch University, department of statistics. Categorical (predictor) variables namely gender, age, years with diabetes, eyes screening in the last five years, blood sugar control, presence of hypertension, and HIV positive status were compared in contingency tables, and a chi-square test used to determine if there is any statistical significant difference. Where values were very small, Fisher Exact test was used instead. The outcomes of interest, i.e. ocular complication observed was analysed in terms of their frequencies and further analyzed against the predictor variables.

### **Ethical consideration**

Approval was granted by the Health Research Ethics Committee (HREC); Ethics Reference number: S14/03/065, the Ministry of Health and Social Services (MOHSS); Ref: 17/3/3 and the hospital research and ethics committee. Only consenting participants were recruited and the data extraction tool was anonymous.

## RESULTS

Characteristics of the participants

The table below represents the characteristics of the participants

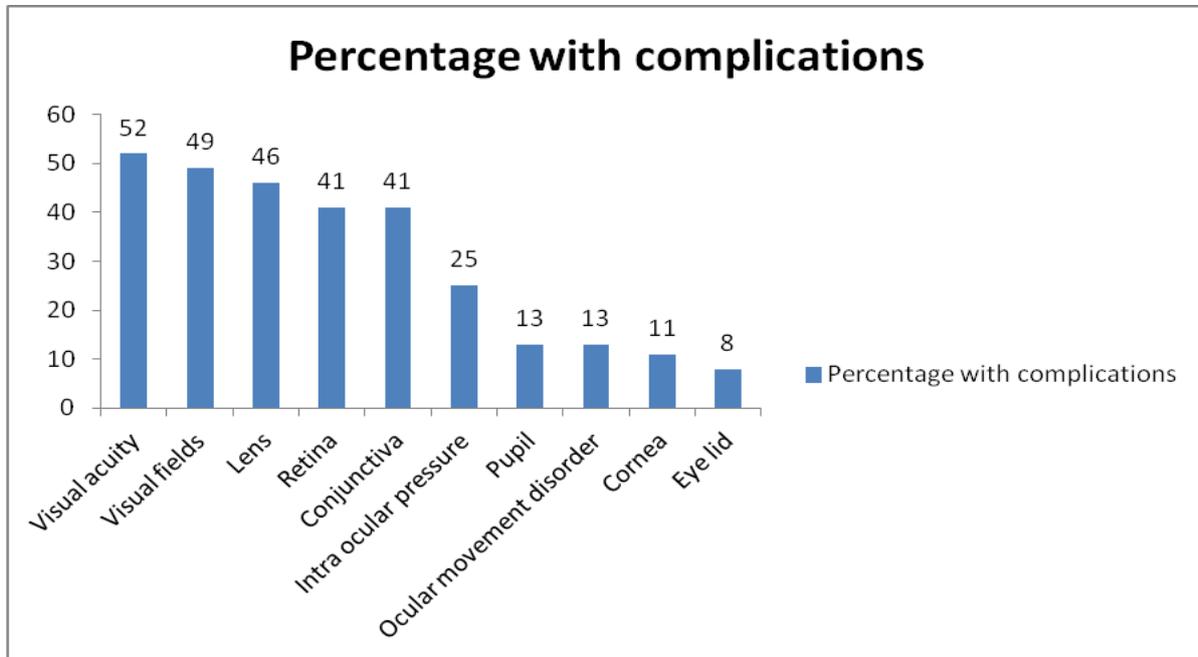
Table 1: Demographic characteristics of participants

Characteristic	Category	Frequency	Percentage
<b>Sex</b>	Male	36	57
<b>Education level</b>	Grade 12 and below	57	95
<b>Years with diabetes</b>	< 5years	33	60
<b>Waist circumference</b>	High	29	52
<b>Body Mass Index (BMI)</b>	>25	22	40
<b>Co morbidities (HPT)</b>	Present	43	69
<b>HIV status</b>	Positive	5	8
	Negative	36	58
	Unknown	21	34

The age of the patients ranged from 18 years to 90 years with a mean of 52.4 and a standard deviation of 16.9. The Body Mass Index (BMI) of the participants ranged from 16 Kg/m<sup>2</sup> to 42 Kg/m<sup>2</sup> with a mean of 24.8 Kg/m<sup>2</sup>, a standard deviation of 5.8 and variance of 34.3. The BMI is a recognised risk factor to development of complications among diabetic patients. Most 52 (87%) of the participants had no eye examination in the last five years. The 8 (13%) who had an eye screening in the last five years had one or two eye examinations and not the annual eye screening recommended.<sup>31</sup> Of all the participants 40 (66%) had FPG above 7 mmol/L.

Efforts were made to obtain results for glycated haemoglobin (HbA1c), lipogram, and creatinine. However, these were not routinely done which is a pointer to poor evaluation of patients for complication. This was further exemplified by lack of eye examinations among the patients. Available guidelines recommend annual eye screening for patients with diabetes.

Figure 1 below summarises the anatomical and functional ocular complications observed among the participants in percentage. The highest percentages of complications were noted in the visual acuity, visual fields, lens, retina and conjunctiva.



**Figure 1.** Percentage of ocular complications in patients with diabetes at Onandjokwe hospital.

### Prevalence of ocular complication

A total of 61 patients were examined. Of these examinations, 39% had ocular complications, with abnormalities in visual acuity, 32 (52%) being the predominant abnormality. Other abnormalities included abnormalities in the visual field 30 (49%), lens 28 (46%), retina and conjunctiva 25 (41%) each, raised intra ocular pressure 15 (25%), pupil and ocular movements 8 (13%) each, cornea 7 (11%) and eye lid 5 (8%). This demonstrates a high overall prevalence of ocular complications (39%) which can adversely affect the lives of our patients and the control of diabetes. Some of the complications are progressive and early identification and treatment improves outcomes. There were also 14 (23%) patients with cataract, 10 (16%) with retinopathy, and 3 (5%) with glaucoma.

### Factors associated with ocular complications

Table 2 below summarises the prevalence of ocular complication among patients with factors studied and compared with participants without the factor of interest.

**Table 2:** Results of analysis of factors associated with diabetes ocular complications (OC)

Factor	Presence of OC		Absence of OC		Total	p-value
	n	%	n	%		
Gender (n=61)	26	44.1%	33	55.9%	59	0.693
Age (n=61)	31	52.5%	28	47.5%	59	0.289
BMI (n=55)	22	40.0%	33	60.0%	55	0.008
Years with DM (n=54)	21	38.9%	33	61.1%	54	0.092
Eye screening (n=58)	7	12.1%	51	87.9%	58	0.108
Fasting Plasma glucose (FPG) (n=60)	38	65.5%	20	34.5%	58	0.563
Hypertension (n=60)	33	55.0%	27	45.0%	60	1.000
HIV (n=39)	5	12.8%	34	87.2%	39	1.000

Except for the BMI, the factors studied did not show any statistically significant difference in the prevalence of ocular complication compared to participants without the factor as all the p-values were greater than 0.05. Patients with high BMI had a 8.5 fold increases in chance of developing ocular complications (Fisher exact 8.5, p-value 0.008).

## DISCUSSION

People with diabetes have higher prevalence of ocular complications such as visual impairment, Diabetic Retinopathy (DR), cataracts, and glaucoma. The participants in our study had a general prevalence of ocular complications of 39%, with specific prevalence's of impairment of vision (52%), lens (46 %), retina (41 %) and increased intra-ocular pressures 15 (25 %).

Diabetic Retinopathy (DR) and cataracts are important causes of blindness that impacts life and diabetes control negatively; hence the profusion of studies on them among ocular complications in diabetic patients. Prevalence of DR has been found to range between 5 and 55%.<sup>5,8,10,12,17,32</sup> Other ocular complications include ocular movement disorders,<sup>8</sup> and blindness. Blindness rates ranged from 1.8% to 23.5%<sup>33,34</sup> with DR as the leading cause of blindness. The participants of this study had many abnormalities of vision which could mainly be attributed to abnormalities in the lens (46 %), and the retina (41 %). A more focused study to ascertain this assertion should be carried out.

In the USA, visual impairment has been observed to be more frequent in patients with diabetes (11.8%) than in patients without diabetes (5.9%).<sup>5</sup> Un-correctable visual impairment was more prevalent (3.8%) among those with diabetes compared to (1.4%) those without. Our patients had a higher prevalence of visual impairment (52%) which can be attributed to poor health seeking behaviour. Furthermore visual impairment is also associated with factors such as low socio-economic status which might apply in our settings.<sup>5</sup>

In a meta-analysis of twelve studies published in 2004, diabetic patients were found to be at a significantly increased risk of developing primary open-angle glaucoma.<sup>35</sup> A total of 15 (25 %) of our patients had increased intra-ocular pressures and were referred for further evaluation by an ophthalmologist. Lack of regular eye screening in our population has led to accumulation of patients with high intraocular pressure.

Determinants of development of ocular complications among people with diabetes range from the time dependent variables such as age of the patient, age at diagnosis, and time since diabetes was diagnosed to other variables such as the glycaemic control, presence of co-morbidities such as high blood pressures, hypercholesterolemia, renal and neurological complications.<sup>23, 24, 35</sup> In addition, there are a wide range of social determinants that impact on development of complications among people with diabetes.<sup>5</sup> Participants in this study were relatively younger with a median age of 52 years. Participants with age greater than 50 years and with high BMI, poor glycaemic control and hypertensive had higher prevalence of ocular complications.<sup>23</sup>

A multi-centre case controlled study demonstrated no significant association of development of complications in diabetic patients with age, gender, marital status, and occupation and education level.<sup>25</sup> In our study, fewer male participants 26 (44%) had complications. Patients with age greater than 50 years had a slightly higher prevalence of ocular complications 31 (52.5%) which was not statistically significant. The same multi-centre study found an increased risk of developing complications with the type of diabetes, time since diabetes was diagnosed, poor glycaemic control, presence of uncontrolled hypertension, and presence of diabetic nephropathy and neuropathy.<sup>25</sup> A study done in Nigeria<sup>23</sup> observed a strong positive association between Fasting Plasma Glucose (FPG) level, duration of diabetes, risk of retinopathy and cataracts. In Onandjokwe, patients with uncontrolled FPG and hypertension had higher prevalence of ocular complications at 38 (65.5%) and 33 (55%) respectively although not statistically significant. Probably the distribution of our patients could be responsible for the observations in the contrary. In particular, patients who had diabetes for less than 5 years comprised 65% of the sample, compared to 55.5 % of the study in Nigeria having had diabetes for less than 10 years. The study done in Nigeria had lower rates of hypertension (53%) compared to 69% of our patients, and had older participants with the age group 50-70 years comprising 50% of the study population.

Age was found to be an important factor in development of ocular complication<sup>33,34</sup> with incidence of blindness increasing from 1.4% to 4.8% with age at diagnosis. In our study, age ( $p=0.096$ ) was found to have no significant association with development of ocular complications among our patients. This could be due to the relatively younger population with a median age of 52 years. BMI ( $p=0.008$ ) was found to have significant association with development of ocular complications among our patients within high BMI increasing risk of ocular complications 8.5 times (Fisher exact 8.5,  $p$ -value 0.008). Most of participants (60%) had normal BMI providing a great opportunity for intervention.

Very few of the participants, (8%), had a positive HIV status with the rest being either HIV negative (58%) or status unknown (34%). Ministry of Health and Social Services estimates adult HIV prevalence in the population as 13.3%. There is no indication of percentage with unknown HIV status. HIV testing was not offered as part of the study and therefore it was difficult to control for HIV infection as an important confounder.

It is possible that the prevalence of ocular complications among our patients depends on factors such as the interaction between patients and the health care system, particularly accessibility of care, the coordination among different health professionals and the social support systems<sup>25</sup> as well as the factors studied. Other factors not studied such as co-morbidities, triglycerides concentration, medications and blood pressure control<sup>32</sup> could be important risk factors and thus confounding explanations for ocular complications observed.

## **CONCLUSION**

There was a high prevalence (39%) of undiagnosed ocular complications among patients with diabetes in Onandjokwe hospital. Development of ocular complications among patients with diabetes depends on many factors. BMI was found to be a significant modifiable determinant of the development of ocular complications. Patients with high blood pressure and poor glycaemic control had higher prevalence of ocular complications.

## **Recommendations**

Based on the findings of the study, Onandjokwe hospital should develop and adhere to Standard Operating Procedures (SOP) for screening patients with diabetes for all complications. The SOP should be based on existing and evidence based guidelines on diabetic care and should be complimented with adequate resources.

There should be concerted efforts to identify and manage factors attributable to the development of ocular complications among patients with diabetes. The quality of care provided should be augmented by incorporating monitoring investigations such as glycated haemoglobin (HbA1c), lipogram, and creatinine.

### **Limitation of the study**

The study relied on laboratory investigations as ordered by the treating clinician. No additional tests were ordered for the study purpose only as there was no budget for this. Nearly all the patients were monitored for glycaemic control using FPG. Other tests which could have been useful in assessing factors responsible for ocular complications were not available. Similarly, HIV status of about 1/3 of the patients was unknown.

In addition to the limitation caused by under investigations, there was a general incompleteness of records leading to exclusion of participants due to unavailability of data.

The patients included in the study were only those diagnosed to have diabetes and co-morbidities studied were as recorded. It is possible that among the patient population there were patients who were undiagnosed, and among the diagnosed patients, it is possible that there were undiagnosed co-morbidities.

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