

Socio-Economic Factors Associated With Type 2 Diabetes Complications Among Patients In Kigali City, Rwanda

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Abstract- Diabetes is the growing public health issue where type 2 diabetes, estimating for 85% to 95% of all cases was considered by insulin confrontation as when the body no longer utilizes insulin adequately to control the blood sugar. In Rwanda, the Ministry of Health reported that in 2016, 43% of patients admitted in hospitals located in the City of Kigali were diagnosed with non-communicable diseases where diabetes took a part of 27.3% of the total bed occupancy. The general objective of this research was to examine socio-economic factors associated with Type 2 diabetes complications among Diabetic patients at Rwanda Diabetes Association Clinic. Specific objectives are; to determine diabetes complications among diabetes patients in the City of Kigali, to establish socio-economic factors associated with retinopathy among types 2 diabetes in the City of Kigali, assess socio-economic factors associated with nephropathy among type 2 diabetes in the City of Kigali, to establish socio-economic factors associated with neuropathy among type 2 diabetes patients in the City of Kigali. The study findings provide effective ways for diabetes management and treatment. Findings will also encourage future researchers to undertake feasibility study to ensure that patients are well managed. A cross-sectional researcher design was used. The target population was 748 registered at Rwanda diabetes association clinic the sample size was 261 patients. The sample size was gotten using simple random sampling technique. A structured questionnaire was distributed among diabetes patients in Kigali City to know their socio-economic status and diabetes complications. Qualitative data was analyzed using a content analysis while quantitative data was statistical methods. Results showed that 52.7% had completed secondary school, 48.2% had regular employment, 60.2% had less than 100,000Frws, and 82.7% used other type of insurance than mutual health insurance. Findings show that 23.2% had developed diabetic retinopathy, 8.9% have developed nephropathy, while 7.7% have developed diabetic neuropathy. A multivariable indicates that odds of developing retinopathy are higher for secondary illiterate/primary holders with a low income, beneficiaries of mutual health insurance and patients with no permanent job. The odds of developing nephropathy are higher for illiterate; primary schools (OR 1.34, 95% CI 1.07-5.10), p-value those with a middle income (OR 1.36, 95% CI 0.84-2.19) or low income (OR 1.66, 95% CI 1.02-2.72), those who were covered by mutual health insurance (OR 2.48, 95% CI 1.16-4.95) and no permanent job (OR 2.23, 95% CI 1.12-4.43). Qualitative results show that diabetes complication among patients was aggravated by their respective low socio-economic and living conditions. The odds of developing diabetic neuropathy are higher for illiterate, primary, those with low income, beneficiaries of mutual health insurance and those with no employment. The study recommends the reduction of socioeconomic inequalities and a decrease of high rate of complications related to diabetes mellitus.

Index Terms- Diabetes Complications, Diabetes Mellitus, Mutual Health Insurance, Nephropathy, Neuropathy, Retinopathy Socio-economic Status,

I. INTRODUCTION

The growing problems worth taking up in public health sector is diabetes and its associated complications (IDF, Mbaya, 2010; WHO, 2016). In 2014, 8.5% of diabetes patients were 18 years old and above. In fact, in 2016, diabetes mellitus become the immediate root that caused the death of 1.6 million people. The prevalence of diabetes worldwide is 3% among 170 million infected (Azumah & Amandi, 2011). The study denotes that that

the rate of diabetes in Southern province of Rwanda was 13.1% (WHO 2015). Recently, the rate of diabetes is estimated to 3.2% while 1,918 people dead each year because of diabetes. In Rwanda, 4.4% of diabetic patients had stroke, vascular complications like nephropathy, coronary artery disease (CAD) and erectile dysfunction. Types 2 diabetes was called the killer due to hyperglycemia, leading to pathologic and functional adjustment in target tissues without clinical symptoms. Studies reported that increasing rates of diabetes, and its complications have association with SES (Safraj *et al* 2012; WHO, 2015). Few describe influences of socioeconomic status and the progression of diabetes complications. Furthermore, exploration of socioeconomic factors associated to Type 2 Diabetes among people living with diabetes in the City of Kigali, Rwanda is not known. The researcher sought to assess socioeconomic factors associated with Type 2 Diabetes in terms of impact of level of income, educational attainment and occupational position on the diabetes complications among Type2 diabetes patients.

The research objectives were:

- i. To determine diabetes complications among Type 2 diabetes patients in the City of Kigali;
- ii. To establish socio-economic factors associated with retinopathy among Type 2 diabetes patients in the City of Kigali;
- iii. To assess socioeconomic factors associated with nephropathy among type 2 diabetes patients in Kigali City ;
- iv. To establish socioeconomic factors associated with neuropathy among types diabetes patient in the City of Kigali.

II. REVIEW OF LITERATURE

The researcher revised past documents on diabetes and its associate different factors that can affect the level of diabetes (MoH, 2014). The existing empirical literature was reviewed according to three objective of the present study.

2.1 Common Diabetic complications among Type Diabetes Patients

Therefore, complications connected to diabetes is subdivided into microvascular and macro vascular. People who had diabetes had an enhanced risk of progressing atherosclerotic, cardiovascular, peripherical vascular and cerebrovascular diseases. Difficulties linked with diabetes may subcategorized into microvascular and macro vascular (Nisar, 2015). The microvascular problems appear owing to deterioration of small blood vessels while that of macrovascular appear owing to miscarriage to wider blood vessels. The microvascular disease involve miscarriage to eyes (retinopathy) causing blindness, kidneys (nephropathy) causing renal problems, nerves (Neuropathy) causing ineffectiveness and powerlessness, and foot ulcer causing amputations Nisar, 2015). The microvascular and macro vascular related problems owing to diabetes had pertinent place in public health (Nisar,2015; Tunceli, 2005) argued that people with micro and macrovascular problems devete a total management expenses of up to two and half times in comparison to those without completions. The consideration cost of treatment diabetes was serious by microvascular and macrovascular problems that were the crucial root of healthcare costs (Beulens, 2010).

In sub-Sahara African, the risk of serious diabetes problems was high and expensive (Kapur, 2011). These were emotional distress (Brown *et al*, 2014), stroke (Walker, 2010), neutral damage, food ulcer causing subtraction, heart attack, kidney damage and blindness (American Diabetes Associated, 2010) and decreased life expectancy (Kumar,2014). Therefore, diabetes usually is linked with some commodities in Tanzania, where 4.4% of people living type 2 diabetes had been diagnosed with stroke (Walker, *et al.*, 2010). Type 2 diabetes was seen as silent killer due to hyerglycemia which may be available a long time before diagnosis, leading to pathologic and functional adjustments in target parts without clinical symptoms (Safraj, 2012).The macro vascular complications are for instance heart attack, strokes, and deficiency in blood stream to legs. The micro and macro vascular related problems has clear effect on public health (Nisar, 2015) asserted that people living with micro and macro vascular problems employ 2/3 of total management expenses in comparison with those without those complications. The significant expenses of treatment has been aggravated by microvascular and macro vascular difficulties that were the greatest causes of healthcare expenses (Beulens, *et al.*, 2010).

However, in Sub-Sahara Africa, the risk of serious diabetes related effects are high and expensive (Mayer,2011).Therefore, these are for instance emotional distress (Brown *et al.*, 2014), stroke (Walker *et al.*,2010), neutral damage, foot ulcer causing subtraction of legs, heart attack, kidney damage and blindness (American Diabetes Association, 2010), and decreased life expectancy (Nisar,2015). Therefore, besides the aforementioned complications, diabetes is usally related to some comorbidities. For example, people living with diabetes nephropathy had high risk for having cardiovascular morbidity. In Tanzania, 4.4% of diabetes patients had stroke (Walker, *et al*, 2010). Types 2 diabetes was called the killer due to hyperglycemia, leading to pathologic and functional adjustment in target tissues without clinical symptoms.

2.2 Socio-Economic Factors with Type 2 Diabetes Complications

Socio-economic factors that influence complications include, lack of enough money, inaccessibility to necessary assets for managing patients' conditions, and decreased personal production at working place or stricter education. The financial resources plays a role to expected resources to preserve good health conditions. Moreover, as it reveals, occupation may as well be affected by past diseases. Wealth, the long term buildup of material resources may safeguard the effect of temporarily low income due to consuming a great percentage of income in comparison with those who had high financial resources (Raphael, 2012). Therefore, in 2014, 8.5% of people living with diabetes were 18 years and above and in 2016 diabetes mellitus become greatest disease that cause 1.6 million to lose their life. In addition, the prevalence of diabetes worldwide is 3% among 170 million infected. (Brown, *et al*, 2014). The prevalence of diabetes worldwide is a global disease. However, type 2 diabetes estimates for 90% of diabetes cases. More than 100 million persons generally had diabetes and most they were not diagnosed. The general estimate rate among adult diabetes in USA was 8.4%. However, a research carried out in Nigeria on the prevalence of types 2 diabetes and discovered that 2.7% among people in Nigeria (Ross, 2010).

Diabetes prevalence had enhanced for the past two decades and the estimate was around 30 million patients and in 2010, it has been 285 million and will rise to 438 million by 2030. The prevalence of type 1 and type 2 diabetes is generally increasing (Safraj, 2012). Therefore, type 2 diabetes prevalence is increasing rapidly than type 1 diabetes owing to reduced activity as many countries are becoming more efficient and industrialised stimulating an increased obesity and population aging (Stolar,2010). The prevalence of diabetes in Philippines was 2-3%, 2.3% Malaysia and 1.2% in Japan. 170 million people and three and four millions of new cases appear every year (WHO, 2017). Low prevalence of diabetes is found in United Kingdom, and Scandinavian in percentage between 0.01% to 0.1%, meaning the average of diabetes is less than 1% (Twagirumukiza & Van Bortel, 2011). The higher prevalence was found in Egypt in range of 15% to 20% (IDF, 2013). The prevalence of diabetes in Eastern Africa estimate 3.00%, West Africa 4.14% Central Africa 7.82%, Southern 0.72%, (sub-Saharan Africa:200-2013). The lower prevalence of diabetes of HCV was Zimbabwe (1-3%), (Kenya (1.7%), Sudan (2.8%), Gabon (9.2%), and CAR (2.4%) (Mercy, 2013).

Scholars in USA assessed a relationship between area of residence and personal level of SES (Walker,(2010). There is a fact of positive correlation regarding area of residence and the level of income or revenue. Poverty and material deprivation, is denoted as the lack of resources to attain the expectation for health, can contribute to continuous struggle to create conclusions (Raphael, 2012). Employment become a pertinent indicators of socioeconomic status and respect in advanced communities and it expresses material circumstances. Employment level in advanced communities assesses respect, duties, physical activities and job positions (Kapur, (2011) Meanwhile, diabetes is able to reduce personal production for job they are occupying if is not managed appropriately, which may stimulate to additional occupation associated issues (Wilkinson, 2013). Occupation may affect diabetes complications by establishing conditions that may affect behavior. Patients with the best job allow improved accessibility to health care, facilitate them to acquire financial means to obtain appropriate shelter and good nutritional status for living not in dangerous neighborhoods and enhance the chance to be involved in health promotional behaviors (WHO, 2014). In the current analysis, the extent of discrepancies was examined by several studies. Based on methods used, counties assessed SES measurements (education, income and occupation) selected, the researcher must establish different prevalence's (Aharddh, *et al*, 2011). In accordance with a meta-analysis done by Ahardg *et al.*,(2011), persons with low job position, low level of educational attainment, and low level of income were 1.31 (CI 95% 1.09-1.57), 1.41 (CI 95% 1.28-1.55), and 1.40 (95% CI 1.04-1.88) consecutively with greatest risk of Type 2 diabetes than those with favorable SES (Aharddh, *et al.*,2011).

The few study conducted in Rwanda show that the general population of about 11.9 million prevalence of diabetes was 45.7% (RBC, 2017). The study conducted among 324 patients attending Rwanda Military Hospital found the rate of diabetes 28.4% among respondents above 55 old, 28.4% among younger respondents aged (18-35 years). The diabetes was positively and highly related to adults persons (>55 years) and disclosure to booster from traditional practices was determined in positive way (P value = 0.036) risk factors of infection the prevalence of diabetes in general population is not clear (Umumararungu et al, 2017). In Rwanda there are not exact risk factors for diabetes. The few study reiterate that the rate of Type 2 Diabetes in Southern province of Rwanda was 13.1% and 3.9% outside of Rwanda (WHO 2015). Recently, Diabetes Atlas show that the rate of diabetes in Rwanda is estimated to 3.2% of people living with diabetes and 1,918 patients are losing their life each year.

Limited level of education attainment decrease individual production and cause additional issues related to their job occupation (Wilkinson, 2013). Education is fixed after early adulthood. In some countries, possibly including Rwanda, education may be affected by the level of income and it is possible that disadvantaged health conditions in childhood may affect the quantity and quality of education obtained (Group Health Research Institute, 2012).

2.2.3 Relationship between Socioeconomic Factors and Type 2 Diabetes Complications

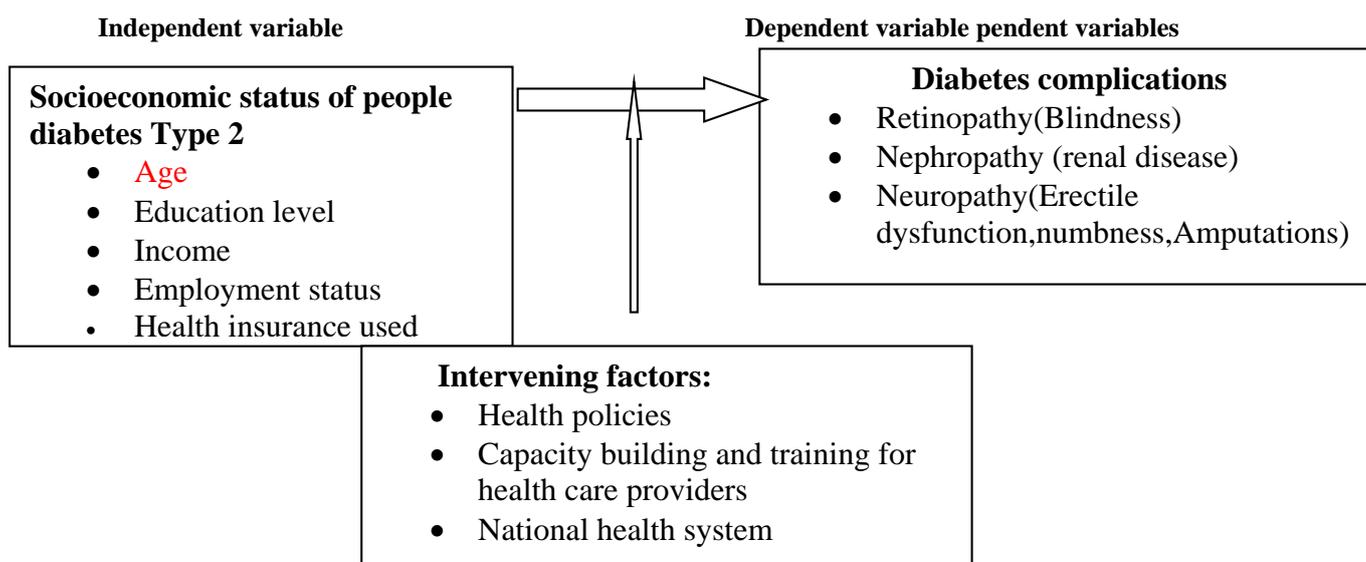
Most of studies at international level have endeavored to demonstrate the association between the prevalence of diabetes and its complications. The impact of health elements, diabetes can be positively correlated below 16 years of age (Berihun & Nuru, 2012). A study carried out in America show that the diabetes related

hypertension demonstrated as statistically significant with diabetes in multivariate inferential analysis (Safraj, 2012). Regional studies in Africa demonstrated the way in which the rate of diabetes has been connected to several factors. A study conducted in Nigeria revealed that factors influencing diabetes are marital status, employment, location, availability of health facilities and other complication were demonstrated as factors associated with diabetes (Oladeinde *et al*, 2012). Regional studies have been conducted in Kenya, Ethiopia, Uganda and Tanzania evidenced the relationship between these factors and diabetes incidence of low birth weight is highly linked to the accessibility to medicaments (Walker, 2010).

Therefore, SES discrepancies affect different stages of type 2 diabetes as pre-diabetes, onset, illness and mortality. The biological and social factors had effect on health of persons from fetus period to death (WHO, 2014) and diabetes without expectation. The biological determinants at birth impact the development of diabetes later and it was assumed that about 40% of tendencies to diabetes were associated with heredity problems (Woolf & Braveman, 2011). They were preventable as persons would be affected by factors connected to parent's biological factors, age and onset, region and ethnic group (WEF (2015). All the above considerations evidenced that the quality of life relies on capacity to have a nutrition, physical activities, upholding an effective follow up of blood glucose level (Youssef, 2013). The study had evidenced that the role of clinical elements and behavior option to anticipate and manage T2D did not suitably demote associated results, for people on low poor status (Dinca-Panaitescu, et al, 2011). Preventive measures had tried to discourse carefully chosen challenges that emanate from social factors like in cultural terms taken copying strategies (Dinca-Panaitescu, et al, 2011). However, most of important copying strategies to provide care include respecting the promotion of using community resources to fulfill people's expectations (Group Health Research Institute, 2012).

2.4 Conceptual Framework

This section provides a systematic schema indicating the link among independent, dependent and intervening variables. In this regards, about conceptualizing socio-economic status and diabetes complications.



Socio-economic factors were using respondents' educational attainment, income status, employment status and types of public health insurance. Education level as classified as illiteracy, primary education, secondary education, university (tertiary). The categories of household net income were high, middle and low income level which were calculated according to household monthly income. The types of public health insurance dichotomized by mutual health insurance scheme. Therefore, occupation status was categorized as regular, irregular or no occupation. Diabetes complications was measured by retinopathy (blindness), nephropathy (renal disease) and neuropathy (erectile dysfunction). Therefore, all of these were moderated by intervening factors such as health policies, capacity building and training for health care providers and national health system. In this regard, the researcher assessed effects of each indicator of independent variable to each indicator in dependent variable.

III. MATERIALS AND METHODS

This paper used a cross sectional research design. This design refers to a design in which the investigator assess the effect and exposure in the research respondents at the same time. The reasons of using a cross-sectional research involve the assessment of burden of disease in a population and was pertinent in reporting to plan and

allocation of health facilities. This design would be descriptive and used to assess the burden of a special disease in a defined a population.

Diabetic patients are the epicenter of data related to socioeconomic status and diabetes mellitus patients. The total population of this study was 748 patients who were registered in the clinic during the period concerned with the study. 625 patients are registered in January and 123 patients are registered up to February in 2020. The size of the sample from the total population was calculated using Yamane’s formula (Yamane, 1967) as follows

$$n = \frac{N}{1 + N(e^2)}$$

Whereby= Sample Size; N=Population Size; e= Level of Significance that was given as 0.05

$$n = \frac{748}{1 + 748(0.0025)}$$

$$n = \frac{748}{2.87}$$

$n = 260.62 \approx 261$ the sample size was 261 patients.

This paper used simple random sampling techniques. Simple random sampling technique was denoted as a technique where every subject of the entire population takes equal and autonomous chance of selection. In addition, purposive sampling technique involves the choice of a representative group from the entire population taking into consideration the availability of evidences supposing as whether they were representative of the whole population. Generally, this technique was suitable when the research focused on assessment of several and particular specific variables. This study used a well-designed questionnaire to gather quantitative information. The researcher used quantitative approach and the questionnaire was distributed in the community screened diabetes living in Kigali City for further investigation of socio- demographic factors among people and to know the medical history for diabetes. The study carried out a pre-test before the actual data. The neighboring health facilities located in in Rwamagana District was used as a pilot study setting among patient with diabetes who were not comprised in the final sampled population. This study adopted quantitative data analysis using Statistical Package for Social Sciences (SPSS) version 21.0 for the evaluation of statistical significance helped in analyzing statistical information in order to establish the relationship between socioeconomic factors and diabetes complications among people living with diabetes. Therefore, descriptive statics were used to demonstrated and calculate frequency, percentages, mean and standard deviation while inferential statistics was used for generating both bivariate and multivariate analysis.

IV. 4. RESULTS PRESENTATION

4.1 Socio-Demographic Characteristics

Some of respondents are patients that have selected to attend Rwanda Diabetes Association Clinic in the City of Kigali.

Table 4. 1 Characteristics of Patients Diagnosed with Diabetes

Variables	Values	Frequency	Percentage
Gender	Male	88	33.7
	Female	173	66.3
Age	18-34	147	56.3
	>35 years	114	43.7
Marital Status	Married	238	91.2
	Not Married	23	8.8
Duration of Diabetes	<10 years	138	52.7
	10-20 years	88	33.8
	>20 years	35	13.5
Education level	Illetrate& Primary	66	25.3
	Secondary Level	138	52.7
	University level	57	22.0
Employment	No employment	72	27.5
	Irregular employment	63	24.3
	Regular employment	126	48.2
Monthly Income level	<100,000Frws	157	60.2
	100,001Frws-200,000Frws	58	22.2

	>200.001Frws	46	17.6
Type of health insurance	Mutual Health Insurance	45	17.3
	Others	216	82.7

Source: Primary data (2022)

The characteristics of all participants presented in Table 4.1 demonstrated that 88 (33.7%) studied patients are male and 173(66.3%) respondents female. About 147(56.3%) respondents were between 18-34 years old, while 114(43.7%) were more than 35 years old. Furthermore, 238(91.2%) respondents were married and 23(8.8%) respondents were unmarried. Finally, 138(52.7%) respondents have a duration of diabetes less than 10 years, 88(33.8%) have between 10 and 20 years duration of diabetes and 35(13.5%) respondents have more than 20 years duration of diabetes. Socio-economic factors of all participants are shown in Table 4.2. Concerning educational profile of diabetic patients, 66 (25.3%) respondents are illiterate or completed their primary school, 138(52.7%) had completed secondary school, 57(22.0%) had completed tertiary education. Findings on employment status, found out that 72 (27.5%) were unemployed, 63(24.3%) had irregular employment while 126(48.2%) had regular employment. The average monthly household income in Rwandan Francs was used to assess the level of income, in this regards, 157(60.2%) had less than 100,000Frws, 58(22.2%) respondents earned between 100,001Frws and 200,000Frws. In addition, 46 (17.6%) earned more than 200,000Frws Thus the overall, participants are living in low socio-economic situation. Finally, about type of health insurance, 45(17.3%) used mutual health insurance, while 216 (82.7%) of diabetes patients are using other type of insurance (SORAS, SONARWA).

4.2.

4.3. Diabetes Complications among Type 2 Diabetes Patients in the City of Kigali

The third research objective identified diabetes complications among Type 2 diabetes patients in Kigali City. There were three outcomes in the research, all connecting to diabetes completions: retinopathy, neuropathy and nephropathy. These were three main long term microvascular complications among patients typically developed.

Table 4. 2 Identification of Diabetes Complications among Type 2 Diabetes Patients in the City of Kigali

Diabetes Complication	Total (N=261)	
	Frequency	Percentage
Retinopathy(Blindness)		
Yes	61	23.2
No	200	76.8
Nephropathy(renal disease)		
Yes	23	8.9
No	238	91.1
Neuropathy		
Yes	20	7.7
No	241	92.3

Source: Primary Data (2022)

Results presented in Table 4.2, it has shown that 61(23.2%) respondents developed retinopathy while 200 (76.8%) did not present retinopathy, 23(8.9%) respondents had nephropathy while 238(91.1%) did not have nephropathy. About neuropathy, 20 (7.7%) had developed neuropathy complication while 241 (92.3%) did not present neuropathy.

4.3 Socioeconomic Factors Associated with Retinopathy among Type 2 Diabetes in the City of Kigali

The second objective determined socioeconomic factors associated with retinopathy among type 2 diabetes patients in Kigali City. The following Table 4.3 depicts on the perception of respondents.

Table 4.3 Bivariate Associated SES with Diabetic Retinopathy

Variables	Description	Diabetic Retinopathy				Chi-Square	P-Value
		Developed Retinopathy		Not Developed Retinopathy			
		N	%	N	%		
Gender	Male	9	14.8	79	39.5	1.455	0.22
	Female	52	85.2	121	60.5		
Age	18-34	21	34.4	126	63.0	12.564	0.004
	>35 Years	40	65.6	74	37.0		
Marital Status	Married	43	70.5	195	97.5	4.941	0.026
	Not Married	18	29.5	5	2.5		
Duration	<10Years	24	39.4	114	57.0	4.400	0.033
	10-20Years	6	9.8	82	41.0		
	>20 Years	31	50.8	4	2.0		
Education	University	11	18.0	55	27.5	12.567	0.002
	Secondary	30	49.2	108	54.0		
	Illiterate/Primary	20	32.8	37	18.5		
Income	High	9	14.8	37	18.5	12.702	0.002
	Middle	16	26.2	42	21.0		
	Low	36	59.0	121	60.5		
Employment	Regular	23	37.7	103	51.5	7.724	0.102
	Irregular	17	27.9	46	23.0		
	No employment	21	34.4	51	25.5		
Type of insurance	Other insurance	47	77.1	169	84.5	12.670	0.005
	Mutual Health Insurance	14	22.9	31	15.5		

Source: Primary Data (2022)

The study findings presented in Table 4.3 presents a bivariate analysis between SES and diabetic retinopathy where $X^2 = 12.567$ at p-value 0.002 educational profile of diabetes patients is associated with developing diabetic retinopathy, $X^2 = 12.702$ at p-value 0.002 income level is associated with diabetic retinopathy. Moreover, employment status of diabetic patients is associated with diabetic retinopathy with 7.724 at p value < 0.102. Therefore, it was revealed that different types of insurance used can lead to the degree of diabetic retinopathy complications with $X^2 = 12.670$ at p-value 0.005. In conclusion, socioeconomic factors presented in Table 4.4 are taken as factors associated with diabetic retinopathy owing the p values being significant (p value < 0.005). Except employment where p value is > 0.005.

Table 4.4 Multivariable Logistic Regression Analysis for SES and Diabetic Retinopathy

Variable	AOR	95% C.I		P-Value	
		Lower	Upper		
Education level					
University	57	1.00			
Secondary	138	1.28	0.84	1.95	0.007
Illiterate/Primary	66	1.85	1.07	3.17	0.101
Income level					
High	46				
Middle	58	1.36	0.84	2.19	0.014
Low	157	1.66	1.02	2.72	0.122
Employment					
Regular	126	1.00			
Irregular	63	1.80	1.13	2.85	0.001
No employment	72	2.00	1.30	3.09	0.361
Health insurance					
Other insurance	216	1.00			0.005
Mutal Health Insurance	45	2.27	1.29	3.92	0.814

Table 4.4 demonstrated the adjusted ORs for diabetic retinopathy in accordance with socioeconomic factors. The researcher found out that odds of developing retinopathy are higher for secondary illiterate/primary level holders (OR1.85, 95% CI 1.07-3.17) with low income (OR 1.66, 95% CI 1.02-2.72), beneficiaries of mutual health insurance (OR 2.27, 95% CI 1.29-3.92) and patients with irregular (OR 1.80, 95% CI 1.13-2.85) or no occupation (OR 2.00, 95% CI 1.30-3.09) in comparison with those with higher socioeconomic factors.

4.3 Socio-economic Factors Associated with Nephropathy among Type 2 Diabetes Patients in the City of Kigali

Table 4. 5 Bivariate associated SES with Diabetic Nephropathy

Variables	Description	Diabetic Retinopathy				Chi-Square	P-value
		Developed Nephropathy		Not Developed Nephropathy			
		N	%	N	%		
Gender	Male	10	43.5	78	32.8	131.061	0.001
	Female	13	56.5	160	67.2		
Age	18-34	19	82.6	128	53.8	0.681	0.409
	>35Years	4	17.4	110	46.2		
Marital Status	Married	3	13.0	235	98.7	33.676	0.001
	Not Married	20	87.0	3	1.3		
Duration	<10	16	69.6	122	51.3	4.133	0.042
	10-20	6	26.1	82	34.5		
Education	>20Years	1	4.3	34	14.2	12.567	0.002
	University	3	13.1	54	22.7		
Income Level	Secondary	13	56.5	125	52.5	12.702	0.002
	Illiterate/Primary	7	30.4	59	24.8		
	High	2	8.7	44	18.5		
Employment	Middle	8	34.8	50	21.0	7.724	0.102
	Low	13	56.5	144	60.5		
	Regular	7	30.4	119	50.0		
Type of insurance	Irregular	7	30.4	56	23.5	12.670	0.005
	No employment	9	39.2	63	26.5		
	Other insurance	17	73.9	199	83.6		
	Mutual Health Insurance	6	26.1	39	16.4		

Source: Primary Data (2022)

Information in Table 4.5 depicts on a bivariate analysis between SES and diabetic nephropathy where $X^2 = 12.567$ at p-value 0.002 educational profile of diabetes patients is associated with developing diabetic nephropathy, $X^2 = 12.702$ at p-value 0.002 income is associated with diabetic nephropathy. Moreover, employment status of diabetes patients is associated with diabetic nephropathy with 7.724 at p-value < 0.102. Therefore, the study revealed that type of insurance used can lead to the degree of diabetic nephropathy complications with $X^2 = 12.670$ at p-value 0.005. In conclusion socioeconomic factors presented in Table 4.4 are taken as factors associated with diabetic nephropathy owing the p value are significant (p value < 0.005). Except employment which its p value is > 0.005.

Table 4.6 Multivariable Logistic Regression Analysis for SES and Diabetic Nephropathy

Variable	AOR	95% C.I		P Value	
		Lower	Upper		
Education level					
University	57	1.00			
Secondary	138	1.47	0.78	2.87	0.002
Illiterate/Primary	66	1.34	1.07	5.10	0.423
Income level					
High	46	1.00			
Middle	58	1.36	0.84	2.19	0.001
Low	157	1.66	1.02	2.72	0.101
Employment					
Regular	126	1.00			
Irregular	63	2.23	1.12	4.43	0.001
No employment	72	2.42	1.27	4.65	0.005
Health insurance					
Other insurance	216	1.00			
Mutual Health Insurance	45	2.48	1.16	4.95	0.102

Source: Primary Data (2022)

The study findings indicated that adjusted ORs for diabetic nephropathy relied on SES variables. In this regards, greater odds of developing nephropathy for illiterate. Primary graduates school (OR 1.34, 95% 1.07-5.10), those with a middle income (OR 1.34, 95% 1.05-5.10) or low income (OR 1.66, 95% CI 1.02-2.72), for beneficiaries of mutual health insurance (OR 2.48, 95% CI 1.16-4.95) and with irregular (OR 2.23, 95% CI 1.12-4.4.3) or job (OR 2.42, 95% CI 1.27-4.65).

4.4 Socio-economic Factors Associated wth Neuropathy among Type 2 Diabetes Patients in Kigali City.

Table 4. 7 Bivariate associated SES with Diabetic Neuropathy

Variables	Description	Diabetic Neuropahy				Chi-Square	P-value
		Developed Neuropathy		Not Developed Neuropathy			
		N	%	N	%		
Gender	Male	13	65.0	75	31.1	7.813	0.005
	Female	7	35.0	166	68.9		
Age	18-34	5	25.0	142	58.9	14.046	0.002
	>35 Years	15	75.0	99	41.1		
Marital Status	Married	6	30.0	232	96.3	7.765	0.005
	Not Married	14	70.0	9	3.7		
Duration	<10	16	80.0	122	50.6	8.012	0.004
	10-20	2	10.0	86	35.7		
	>20Years	2	10.0	33	13.7		
Education	University	3	15.0	54	22.4	12.567	0.002
	Secondary	4	20.0	134	55.6		
	Illiterate/Primary	13	65.0	53	22.0		
Occupation	High	1	5.0	45	18.7	12.702	0.002
	Middle	1	5.0	57	23.6		
	Low	18	90.0	139	57.7		
Employment	Regular	4	20.0	122	50.6	7.724	0.102
	Irregular	7	35.0	56	23.2		
	No employment	9	45	63	26.2		
Type of insurance	Other insurance	13	65.0	203	84.2	12.670	0.005
	Mutual Health Insurance	7	35.0	38	15.8		

Source: Primary Data (2022)

Information reflected in Table 4.7 depicts on a bivariate analysis between SES and diabetic neuropathy where $X^2 = 12.567$ at p-value 0.002 educational profile of diabetic patients is associated with developing diabetic neuropathy, $X^2 = 12.702$ at p-value 0.002 income is associated with diabetic neuropathy. Moreover, employment status of diabetic patients is associated with diabetic neuropathy with 7.724 at p-value < 0.102. This study revealed that type of insurance used can lead to the degree of diabetic neuropathy complications with $X^2 = 12.670$ at p-value 0.005. In conclusion socioeconomic factors presented in Table 4.4 are taken as factors associated with diabetic neuropathy owing their p value being significant (p value < 0.005). Except employment which has p value is > 0.005.

Table 4.8 Multivariable Logistic Regression Analysis for SES and Diabetic Neuropathy

Variable		AOR	95% C.I Lower	Upper	P Vluce
Education level					
University	57	1.00			
Secondary	138	1.47	0.78	2.87	0.004
Illiterate/Primary	66	1.34	1.07	5.10	0.340
Income level					
High	46				
Middle	58	1.36	0.84	2.19	0.002
Low	157	1.66	1.02	2.72	0.107
Employment					
Regular	126	1.00			
Irregular	63	2.23	1.12	4.43	0.031
No employment	72	2.42	1.27	4.65	0.109
Health insurance					
Other insurance	216	1.00			0.001
Mutal Health Insurance	45	2.48	1.16	4.95	0.103

Source: Primary Data (2022)

The study findings given in Table 4.9 evidenced that the adjusted ORs for diabetic neuropathy in accordance with SES variables. In this regards, higher odds of developing diabetic neuropathy for illiterate or primary graduates persons (OR 1.32, 95% CI 1.07-5-10), low income (OR 1.66, 95% CI 1.02 -2.72), beneficiaries of mutual health insurance (OR 2.48, 95% CI 1.16-4.95) AND persons with no occupation (OR 2.42, 95% CI 1.27-4.65).

V. DISCUSSION OF FINDINGS

The study investigated the correlation between socio-economic factors and diabetic complications of retinopathy, neuropathy and nephropathy among diabetes patients, findings demonstrated that among patients with diabetes, the odds of developing retinopathy, neuropathy and nephropathy are greater for persons with low SES, like those with primary and secondary education level, those with a lower or middle income level, those in the first and second category of social classification and those with no occupation. The present study retaliated that education is the most commonly used measure of SES in epidemiological studies. Those with the lowest educational attainment have been report to exhibit the highest prevalence of diabetes complication (Stringhini, *et al.*,2012).Moreover, educational level is a strong predictor of mortality among adults with diabetes (Fano, *et al.*, 2013). In the present study, educational level, high education was suggestive of of a lower risk of developing diabetes complication such as nephropathy, neuropathy and retinopathy, and the correlations were strong and all types of complications. Therefore, future studies in patients with high levels of education are needed to explain these findings according to several aspects of lifestyle. Unexpectedly, people with secondary and tertiary education level did not show a strong point in attaining all specific objectives.

Occupation level was correlated with high rate of diabetes in Asia and Europe (Gary-Webb, 2013) probably owing to the fact that income facilitates persons to buy various goods and services to improve lifestyle. It has been reported that people with low income have presented more diabetes complications than those with high income. However, in the present study, employed patients had less chance of developing diabetes complications. Consistent with the present study findings, another clinical study in Rwanda indicated that higher income is related to a greater prevalence of type 2 diabetes and high BMI was responsible for this association (Mukeshimana, 2010).In Rwanda, only four past researches had assessed the correlation between SES with Types 2 Types. The

study relying on public servants established that public servants found that prevalence of diabetes was higher among those with low educational attainment and low work (Mukeshimana, 2010). Even though a research aiming at target population observed at low income persons aimed to possess higher diabetes treatment rate. As to the association of SES and with diabetes complications in Rwanda, there was no examination to date, this makes ours the first, as other assessment of this correlation in Rwanda must be assessed.

VI. CONCLUSIONS AND RECOMMENDATIONS

In conclusion, this study examined socioeconomic factors influencing development of diabetes complications for patients at Rwanda Diabetes Association. In this regards, three diabetic complications are retinopathy, nephropathy and neuropathy. Three complications were the most common and significant microvascular types of complications among diabetes. The research demonstrated that low SES as shown by low educational attainment, low income and lack of occupation, first and second category of social classification was associated with a high percentage of diabetes complications among young people. Results from predictive model were gotten to acquire good awareness of those factors that stimulate diabetes complications. However, odds analysis for predictive factors have been established. Generally, retinopathy came from predictive factors than for nephropathy and neuropathy.

Reconsidering results discussed in chapter, and conclusion drawn from the concluding remarks, the following recommendations would ameliorate the living conditions of diabetes patients: Design and implement program to increase raise awareness about dangers of diabetes in Kigali city and entire country especially among Diabetes patients. To ensure that diabetes patients attend such awareness programs, considering using patient friendly approaches to increase its effectiveness; to encourage patients to have interventions that should decrease complication and social determinants. The study recommends that people living with diabetes should increase management and treatment strategies using social assist ace to decrease further complications and additional problem, stimulating metabolic control and ameliorate health outcomes. Good diet, physical exercises and education should be the core of patient treatment to help to control and stabilize their level of diabetes. Patients should be aware of diabetes control importance and consequences. The study recommends to conduct further research on socioeconomic status and diabetes complications among patients at Rwanda Diabetes Association in the City of Kigali. It is crucial to evaluate the application of diabetes general guidelines of international diabetes forum. The study finding proposes that attention should be paid to considering determinants such as health expenditure for diabetes, duration of diabetes, and smoking and health related behaviour. The study suggests a need to conduct further research on socioeconomic status and diabetes complications among patients at Rwanda Diabetes Association in the City of Kigali. Further research can be undertaken to evaluate the application of diabetes general guidelines of international diabetes forum. The study findings suggest that attention should be paid to considering determinants such as health expenditure for diabetes, duration of diabetes, smoking and health related behavior.

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REFERENCES

- [1] American Diabetes Association-Diabetes Care (2013). Economic Costs of Diabetes in the US in 2012. *Diabetes Care Journal* 36(4), 1033-1046.
- [2] Azumah, YC, Amandi, A.N (2011). Diabetes Mellitus and Some of its Effects on Eyes among Adults of Rural Communities of Ohafia LGA. *International Journal of Advanced Medical Service and Applied Research*, 11(1):13-29.
- [3] Beulens, J.W.(2010). The Global Burden of Diabetes and Its Complications; an Emerging Pandemic. *European Journal of Cardiovascular Prevention & Rehabilitation*, 17 (1),3-8.
- [4] Booth GL (2010), Bhattacharya O, et al. Diabetes. In: Bierman AS, editor. Project for an Ontario Women's Health Evidence-Based Report: Volume 2. Toronto; 2010.
- [5] Brown, J. B., Ramaiya, K., Besançon, S., Rheeder, P., Tassou, C. M. Mbanya, J.-C., Schneider, E. (2014). Use of Medical Services and Medicines Attributable to Diabetes in Sub-Saharan Africa. *Journal Pone.9* (9),10-67
- [6] Dall, T. M., Zhang, Y., Chen, Y. J., Quick, W. W., Yang, W. G., & Fogli, J. (2010). The economic burden of diabetes. *Journal of Health Affairs*, 29(2), 297 -303.
- [7] Dinca-Panaitescu S, Dinca-Panaitescu M, Bryant T, Daiski I, Pilkington B, Raphael D.(2011).Diabetes prevalence and income: results of the Canadian Community Health Survey. *Health Policy* 99(2):116-23.
- [8] IDF (2012), *The IDF Diabetes Atlas*. 6th Edition edn. Brussels: International Diabetes Federation; 2012.
- [9] IDF (2013), *Chapter 1-4 in Diabetes Atlas Brussels: The International Diabetes Federation*, 2013
- [10] Kapur A (2011) Influence of Socio-Economic Factors On Diabetes Care. *International. Journal of Diabetes for Developed. Countries* 2011; 21: 77- 85.
- [11] Kumar A (2014), Pathologic Basis of Disease, 7th ed, Saunders Company, 1189-1206.
- [12] Liburd LC, Jack L Jr, Williams S, Tucher P Intervening on the Social Determinants of Cardiovascular Disease and Diabetes. *Am J Prev*; 29 (5): 18-24..
- [13] Mayer D (2011). The long-term impact of health on economic growth in Latin America. *World Development*. 29, 1025-1033. 2001
- [14] MedicineNet.com (2015). <http://www.medicinenet.com/diabetes/focus.htm>
- [15] MoH (2015), Ministry of Health. Annual Report. Kigali-Rwanda
- [16] Nisar, A (2015). Association of Diabetic Neuropathy with Duration of Type 2 Diabetes and Glycemic Control. *Cureus*, 7(8).
- [17] Raphael D (2013). The Social Determinants of the Incidence and Management of Type 2 Diabetes Mellitus: are we prepared to rethink our Questions and redirect our Research Activities? *Intel J Helath Care Aaur*. 16(3).
- [18] RDA (2015). Rwandan Diabetes Association education needs assessment. Kigali Rwanda
- [19] RDA (2016) Diabetes in Rwanda against all odds. Kigali Rwanda.
- [20] Ross N.(2010). 14-Year Diabetes Incidence: The role of Socioeconomic Status. *Health Re* [p.21(3):19-28.
- [21] Safraj, S (2012). Socioeconomic Position and Prevalence of Self-Reported Diabetes in Rural Kerala, India Results from the Prolife Study. *Asia-Pacific Journal of Public Health*, 24(3), 480-486.
- [22] Stolar, M (2010). Glycemic Control and Complications in Type 2 Diabetes Mellitus. *The American Journal of Medicine*, 123 (3), 3-11.
- [23] Twagirumukiza M, Van Bortel LM (2011).Management of hypertension at the community level in Sub-Saharan Africa towards a rational use of available resources *Hum Hypertension* 25(1):47-56
- [24] Walker, R., (2010). Stroke incidence in rural and urban Tanzania: a prospective, community-based study. *The Lancet Neurology*, 9 (8), 786-792.
- [25] WEF (2015). Global Competitiveness Report, 2014-2015. <http://www.cfr.org/search/?Ntt=noncommunicable+disease&submit.x=0&submit.y=0>
- [26] WHO (2014) *Global status report on non communicable diseases*. Geneva: World Health Organization; 2014.
- [27] WHO (2015) *World Health Organization*. Global Report on Diabetes. Available at:<http://www.who.int/diabetes/en/>
- [28] Marquis, B.(2012). Leadership roles and management functions in nursing: Theory and application; Lippincott Williams; China
- [29] WHO (2016) *WHO. Diabetes: World Health Organization*; Available from: <http://www.who.int/mediacentre/factsheets/fs312/en/>.
- [30] Wilkinson R, Marmot M, editors. Social Determinants of Health : the Solid facts. 2nd ed. [Monography on the Internet]. Copenhagen,Denmark:World.
- [31] Woolf SH, Braveman P.(2011) Where health disparities begin: the role of social and economic determinants and why current policies may make matters worse. *Health Aff (Millwood)* 30(10):1852-9.
- [32] Youssef N.(2013).Associations of depression anxiety and antidepressants with histological severity of nonalcoholic fatty liver disease. *Liver International*, 33(7), 1062-1070.
- [33] Stringhini S, Tabak AG, Akbaraly TN, Sabia S, Shipley MJ, Marmot MG, (2012). *Contribution of modifiable risk factors to social inequalities in type 2 diabetes: prospective Whitehall II cohort study. BMJ*. <https://doi.org/10.1136/bmj.e5452> PMID: 22915665
- [34] Fano V, Pezzotti P, Gnani R, Bontempi K, Miceli M, Pagnozzi E, (2012). The role of socio-economic factors on prevalence and health outcomes of persons with diabetes in Rome, Italy. *Eur J Public Health*. 23(6):991-7.
- [35] Kondo N. (2012).Socioeconomic disparities and health: impacts and pathways. *Journal of Epidemiology*. 2012; 22(1):2-6.
- [36] Reisig V, Reitmeir P, Doring A, Rathmann W, Mielck A.(2017) Social inequalities and outcomes in type 2 diabetes in the German region of Augsburg. A cross-sectional survey. *International Journal of Public Health*.52 (3):158-65.
- [37] Gary-Webb TL, Suglia SF, Tehranifar P.(2013) Social epidemiology of diabetes and associated conditions. *Curr Diab Rep*. 13(6):850-9.

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