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Prevalence of Dyslipidemia and Its Associated Risk Factors Among Diabetic Patients Attending Muhima District Hospital, Kigali City, Rwanda

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Abstract: Dyslipidemia is the most important independent predictor of cardiovascular diseases in diabetic patients. The risk of cardiovascular heart diseases in hyperglycemic patients is two to four times more as compare to normal. Although many researches revealed the prevalence and associated risk factors of dyslipidemia in diabetic patients across the world, this information is not well known in Rwanda, hence the need to carry out this research. The main objective of this study was to determine the prevalence of dyslipidemia and its associated risk factors in diabetic patients. The present was a cross-sectional study carried out at Muhima district hospital from February to April 2018. This study was conducted in 100 patients where males were 38 while females were 62. Men were seen less exposed to dyslipidemia with 15.78% versus 22.58% for women. Some other risk factors associated with dyslipidemia were intake of fatty diet with 91.6% of dyslipidemia; overweight (31.25%), history of diabetes (31.81%); obesity (12.50%) and physical exercises (15.78%). There was 28% of patients who had poor control of their blood glucose level (having HBA1C level greater than 7%), while 62% had a good blood glucose management with the HBA1C level of less than 7%.

Keywords: Dyslipidemia, Diabetes, Risk Factors

1. Introduction

Dyslipidemia is the elevation of plasma cholesterol, triglycerides (TGs), or both or a low high-density lipoprotein (HDL) level that contributes to the development of atherosclerosis. Causes may be primary (genetic) or secondary, diagnosis is by measuring plasma levels of total cholesterol, TGs and individual lipoproteins and treatment involves dietary changes, exercise, and lipid-lowering drugs [9, 20].

People with high total cholesterol have approximately twice the risk for heart disease as people with ideal levels [21].. There are four different phenotypes of dyslipidemia: (a) Isolated hypertriglyceridemia was defined as having serum triglycerides ≥1.7mmol/L or on medication and total cholesterol <6.2 mmol/L. (b) Isolated hypercholesterolemia was defined as having total cholesterol ≥6.2 mmol/l or on medication and triglycerides <1.7mmol/L. (c) Mixed hyperlipidemia was defined as having triglycerides ≥1.7 mmol/L and total cholesterol ≥6.2 mmol/L. (d) Isolated low HDL-C was defined as having HDL-C ≤1.03 mmol/L in male and ≤1.29 mmol/L in female without hypercholesterolemia nor hypertriglyceridemia.[National Cholesterol Education Program-Adult Treatment Panel III [12].

In fact, it is the body composition components, mainly body fat and lipid profiles that are responsible for increase prevalence of this disease. The term diabetic dyslipidemia comprises a raised triglycerides, reduced HDL and excess of

small, dense LDL particles [3]. Lipid abnormalities are linked with diabetes because insulin resistance or deficiency affects key enzymes and pathways in lipid metabolism. It is believed that the composition of lipid particles in diabetic dyslipidemia is more atherogenic than other types of dyslipidemia. This means that even normal lipid concentrations might be more atherogenic in diabetic than in non-diabetic people [17].

Dyslipidemia plays a crucial role in causing atherosclerosis which is the narrowing of blood vessels due to the accumulation of fats in blood vessel's walls [8]. This situation will immediately result in the hypertension, when chronic leads to cardiovascular disease the leading cause of death in most developed countries as well as developing countries including Rwanda, dyslipidemia are disorders of the rates of synthesis or clearance of lipoproteins from the bloodstream [6].

Diabetes, often referred to by doctors as diabetes mellitus, describes a group of metabolic diseases in which the person has high blood glucose (blood sugar), either because insulin production is inadequate (type I), or because the body's cells do not respond properly to insulin (type II), or Gestational diabetes that occurs in pregnant women usually between 24th and 28th week of pregnancy [5]. Patients with high blood sugar typically experience polyuria (frequent urination), thirsty (polydipsia) and hunger (polyphagia) [1].

The frequency of diabetes is increasing worldwide due to the high susceptibility to environmental insulin, characterized by a high BMI (Body Mass Index), a high body fat percentage and a high level of insulin resistance; all forms of diabetes are characterized by absolute or relative deficiencies in insulin secretion and lipid& protein metabolism; the chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels [11]. Diabetes is a major challenge for health and development in the 21st century, this chronic and incurable disease is largely preventable but remains responsible for millions of deaths annually and many more life-threatening complications, according to the Diabetes Atlas the prevalence of diabetes in Rwanda is about 3.16% [16]. It is evident that some Rwandese could be dying of complications caused by dyslipidemia as a consequence of diabetes. Although many researches revealed the prevalence and associated risk factors of dyslipidemia in diabetic patients across the world, this information is not well known in Rwanda, hence the need to carry out this research. The Main objective of this study was to determine the prevalence of dyslipidemia and its associated risk factors in diabetic patients attending Muhima DH. Specific objectives were: to determine total cholesterol, LDL, HDL and glycated hemoglobin (Hb1ac) in blood samples of diabetic patients and to determine risk factors associated with dyslipidemia in diabetic patients.

2. Materials and Methods

2.1. Study Design

This study was carried out at Muhima District hospital (DH). This health facility is located in Nyarugenge district, Kigali city, Rwanda country. The study design was a cross-sectional study carried out from February to April 2018. Population targeted by this study was every diabetic patient who attended Muhima DH in the duration of the study. Diabetes patients of all ages, who attended Muhima DH during study period, were considered for this study. Venous blood were collected from diabetic patients who attended Muhima DH during the time of study. A total of selected 100 diabetic patients were subjected to the research and their blood were analyzed at Muhima DH laboratory.

2.2. Sample Size

The sample size was calculated using the following formula:

$$Sample\ Size = \frac{\frac{z^2 Xp(1-p)}{e^2}}{1 + \frac{z^2 Xp(1-p)}{e^2 N}}$$

(SurveyMonkey, 2018)

e: is the desired margin of error, which is usually less or equal to 4%. In this study, principal investigators decided to consider e of 2%

Z: is the z-score which is usually equal to 1.96 for a 95% confidence interval

P: Percentage at which the sample size will be accurate, P is considered to be 99%

N: Is population size, for this case N=150

So, if replaced the values in the formula,

Sample size becomes 100 diabetic patients

2.3. Procedure

Blood were collected in a vacutainer containing clotting factors (dried tube) using blood collecting needle, needle-holder/adapter; alcohol, a gauze bandage, then blood sample were taken to the biochemical laboratory for the analysis.

Blood glucose levels were determined by glucose oxidase method using Humastar 80 analyzer [14]. Lipid profiles including Total cholesterol, High density lipoprotein (HDL), Low density lipoprotein (LDL) were measured using humastar 80 analyzer. Questionnaire was used in the current study in order to get information regarding demographic characteristics, possible risk factors including obesity, history of diabetes and dyslipidemia, fatty diet intake and physical exercises.

Patients of all age and gender presented with diabetes and who attended Muhima district hospital within the period of the study was subjected to the study. Patients attending Muhima district hospital by the time of the study without a history of diabetes were not considered as part of the study. Data were analyzed by SPSS software version 20. Data were

expressed as mean ±standard deviation. ANOVA was used for deducting the mean within and between groups. Risk factors were analyzed in terms of percentages using MS excel version 2013.

The study was conducted after getting ethical approval and permission letters from Muhima DH. Ethical clearance was sought from ISPG research, consultancy and publication committee. Participants were informed about the aim of the study and were participating voluntarily in the study. Clear instructions were given to participants and the confidentiality of the research findings was insured to them. Results were communicated to the responsible health workers at the study area. A total of 100 diabetic patients from Muhima DH were considered for this study. Venous blood was collected from the patients. The samples were stored at room temperature and were analyzed in 24hours following collection. At the end of the study, the samples were disposed according to health facility's guidelines under study.

3. Results

Table 1 shows that among 100daietic patients who participated in this study, 20%developed cholesterolemia (>240 mg/dl), 8% were having high LDL (>160mg/dl) whereas 21% were having elevated HDL (>40 mg/dl). In addition, 28% of the patients had elevated glucated hemoglobin (HBA1C >7%).

Table 1. *Blood lipid profiles, glycated hemoglobin and glucose levels among diabetic patients.*

Parameter	Low values	Normal values	High values	Mean average (mg/dl)	Total
Cholesterol	0	80 (80%)	20 (20%)	194.03 (±48.20)	100
HDL	29 (29%)	50 (50%)	21 (21%)	49.91 (±16.24)	100
LDL	28 (28%)	64 (64%)	8 (8%)	112.78 (±36.56)	100
Blood glucose	1 (1%)	29 (29)	70 (70%)	174.81 (±70.45)	100
HBA1C	40 (40)	32 (32%)	28 (28%)	7.97 (±2.16)	100

Table 2. *Blood cholesterol level according to age group.*

Age group	Low	Normal	High	Total
16-20	0	2	0	2
21-25	0	2	1	3
26-30	0	2	2	4
31-35	0	8	0	8
36-40	0	5	1	6
41-45	0	7	0	7
46-50	0	8	2	10
51-55	0	16	2	18
56-60	0	11	2	13
61-65	0	7	4	11
66-70	0	4	8	12
71-75	0	1	1	2
76-80	0	1	0	1
81-85	0	1	0	1
86-90	0	1	1	2
Total	0	76	24	100

Table 2 shows that the critical age group with an elevated cholesterol level is 66-70. The table also shows that the age group that was not on a risk of developing dyslipidemia were 16-20, 31-35, 41-45, 76-80 and 81-85, where none of the patients developed high blood cholesterol levels.

Table 3. *Blood HDL levels according to age group.*

Age group	Low	Normal	High	Total
16-20	1	1	0	2
21-25	1	1	1	3
26-30	3	1	0	4
31-35	1	5	2	8
36-40	2	2	2	6
41-45	5	0	2	7
46-50	0	6	4	10
51-55	4	9	5	18
56-60	3	9	1	13
61-65	5	3	3	11
66-70	1	9	2	12
71-75	1	0	1	2
76-80	1	0	0	1
81-85	1	0	0	1
86-90	0	2	0	2
Total	29	48	23	100

The table above shows that the age groups 41-45 and 61-65 have high numbers of patients with low good cholesterol (HDL) level. The table also shows that the good number of patient (48) were having normal HDL.

Table 4. *Blood LDL according to age group.*

Age group	Low	Normal	High	Total
16-20	1	1	0	2
21-25	0	2	1	3
26-30	1	3	0	4
31-35	2	6	0	8
36-40	2	4	0	6
41-45	1	4	2	7
46-50	4	5	1	10
51-55	1	7	10	18
56-60	3	10	0	13
61-65	3	6	2	11
66-70	0	5	7	12
71-75	0	2	0	2
76-80	0	1	0	1
81-85	0	1	0	1
86-90	1	1	0	2
Total	19	58	23	100

Table 4 shows that dyslipidemia is abundant in the 51-55

age group, with a big number of patients with an elevated bad cholesterol (LDL). The table also shows that the majority of age groups were not having high LDL.

Table 5. *HBA1C levels according to age group.*

Age group	Low	Normal	high	total
16-20	1	0	1	2
21-25	3	0	0	3
26-30	1	3	0	4
31-35	1	2	5	8
36-40	3	3	0	6
41-45	3	3	1	7
46-50	4	3	3	10
51-55	9	5	4	18
56-60	5	1	7	13
61-65	5	4	2	11
66-70	2	8	2	12
71-75	0	0	2	2
76-80	1	0	0	1
81-85	0	0	1	1
86-90	1	1	0	2
Total	39	33	28	100

Table 5 shows the values of glycated hemoglobin in different age groups, with the age group 56-60 being the class with a big number of patients having an elevated HBA1C level (HBA1C>7%). It is clear from the table that most of the patient (72%) were in good control of diabetes (HBA1C <7%).

Table 6. *Blood glucose levels according to age group.*

Age group	Low	Normal	high	total
16-20	0	0	2	2
21-25	0	1	2	3
26-30	0	1	3	4
31-35	0	1	7	8
36-40	0	3	3	6
41-45	0	2	5	7
46-50	0	2	8	10
51-55	0	4	14	18
56-60	1	5	7	13
61-65	0	6	5	11
66-70	0	4	8	12
71-75	0	0	2	2
76-80	0	0	1	1
81-85	0	0	1	1
86-90	0	0	2	2
Total	1	29	70	100

Table 6 shows blood glucose levels among different age groups, where the age group 51-55 has a high number of patients with an elevated blood glucose level.

Table 7. *Risk factors associated to dyslipidemia.*

Type of risk factor		Total number	Frequency of dyslipidemia	Percentage of dyslipidemia
Overweight (BMI 25-29)		32 (32%)	10	31.25%
Obesity (BMI>30)		24 (24%)	3	12.50%
Family history of atherosclerosis		14 (14%)	2	14.21%
Family history of diabetes		22 (22%)	7	31.81%
Sex	Male	38 (38%)	6	15.78%
	Female	62 (62%)	14	22.58%
Physical exercises		38 (38%)	6	15.78%
Fatty diet		12 (12%)	11	91.6%

Table 7 shows that among these risk factors, eating fatty diet is the most associated factor with dyslipidemia among diabetic patients with 91.6%. It also shows that overweight is more associated with dyslipidemia with 31.25% among diabetic patients who were having overweight. In addition, the findings revealed a higher prevalence in females (22.58%) than males (15.78%). Inadequate exercises or lack of physical exercise was found to be also a risk factor for developing dyslipidemia with 15.78% among diabetic patients who were not doing physical exercises or doing them in inadequacy. It is clear that history of atherosclerosis and obesity play a minor role compared to other risk factors assessed in having dyslipidemia with only 14.21% and 12.50% respectively.

4. Discussion

Dyslipidemia has become a worldwide public health problem, and the prevalence varies according to the socioeconomic, cultural and ethnic characteristics. The first aim of this study was to analyze the prevalence of dyslipidemia and its associated risk factors in diabetic patients who attended Muhima DH. In a study conducted in Kenya on prevalence of dyslipidemia and the associated Factors among Type 2 diabetes patients in Turbo Sub-County, Kenya, the prevalence of dyslipidemia was 86.1%, the employment status and physical activity were strongly associated with dyslipidemia [19]. The prevalence in that area was too high compared to that of the current study (20%). Physical activity was also associated with dyslipidemia in both studies (Turbo Sub-County, Kenya and the current study). Furthermore, the current study prevalence was quite low compared to the findings found in Tanzania where the prevalence of dyslipidemia was 95% in the studied area [4]. The prevalence of current study (20%) was also higher compared to the study done in Nigeria where the

prevalence was revealed to be 74% [7]. This difference these prevalence may be due to the variation in cut-offs, methodologies used and difference in stage of urbanization in the various settings used to assess for dyslipidemia [2].

This prevalence revealed that the dyslipidemia among diabetic patients in Muhima DH was 20% which was considerably lower than the one in Chongqing, China according to the study they did (37.4%). According to the Chinese National Nutrition and Health Survey in 2002, the dyslipidemia was 18.6%, whereas slightly lower than was found in some cities in China [19-22%], [15]. The differences between this study and other studies may be due to different genetic predisposition, socioeconomic stratum and lifestyles of the studied subjects, as well as diagnostic criteria used. In addition, the prevalence of dyslipidemia in current study was higher than that in Venezuela [23%] Bangladesh [24%] and Brazil [25%], [15]. In the current study, the major types of dyslipidemia among diabetic patients were hypercholesterolemia and high LDL. This phenomenon probably reflects the increase intake of high simple carbohydrates and high-fat diets in recent decades, which obviously affects the blood cholesterol concentration. Until now, the interventions for hypertriglyceridemia were not available; therefore, further research into effective intervention measures is needed.

In this study, both the cholesterol and LDL value were higher for women than for men, which may be related to the differences in the prevalence of overweight and obesity. These measurements were significant higher for women than for men. This study was in conformity with other studies like in Chongqing, China [15], which also showed the prevalence of dyslipidemia and obesity were higher for women. However, it was different from that of some other populations in which found a higher percentage of dyslipidemia and obesity for men. Furthermore, the prevalence of dyslipidemia peaking at 51 to 56 years for LDL and 66 to 70 years for total Cholesterol. The highest prevalence of dyslipidemia among 51 to 56 years probably due to the lack of physical exercises and routine work depending on the socioeconomic life which was account for the excessive fat accumulation. This finding indicated that routine screening program for blood lipid levels should be performed and effective interventions programs should be implemented in this age group for diabetic patients at Muhima DH. The prevalence of dyslipidemia 66 to 70 years may be also related to the lack of physical exercises and fatty diet intake.

This study revealed the possible risk factors for dyslipidemia, interestingly, a negative relationship was observed between the family history of diabetes and the prevalence of dyslipidemia among the study population. Obesity was not identified as risk factor for dyslipidemia in our study because obese individuals who have dyslipidemia are only 12.50%. Epidemiological studies found that the association between dyslipidemia and obesity is mediated through an etiopathological mechanism. Therefore, according to this study, high BMI may not be considered as first-stage screening tools to detect dyslipidemic individuals in diabetic patients.

In addition, it is worth noting that the same relationship was observed between regular physical activity and dyslipidemia. Thus, an appropriate community based prevention strategy emphasizing behavioral changes, especially promoting physical activity, are required to control the epidemic of dyslipidemia even if the value of those who do not practice physical exercises are not yet in a dyslipidemic zone, it is remarkably seen that the more people practice physical activities, the more they are away from the risk of being dyslipidemic. In the current study, there was a large number of patients (72%) with a normal or a good control of diabetes having a good HBA1C value (<7%), with the age range of 56-60 being the critical class with many patients who have an increased HBA1C level (7 patients being 25% of 28 patients who had high HBA1C>7%). Contrary to the study by Nicholas *et al.,* 2008, it shows that the prevalence of high HBA1C in diabetic patients in Berlin, Germany was above the age of 75 years old (210 patients being 37.90% of 554 patients who had high HBA1C>7%) [10].

5. Conclusion

To sum up, the prevalence of dyslipidemia was 20% in the studied population, characterized mainly with increased low density lipoproteins and cholesterol in blood. Sex, age, overweight, physical activity were found to be associated with dyslipidemia. Authors recommend that dyslipidemia and its associated risk factors should be monitored along blood sugar levels while managing diabetic patients throughout. Diabetic patients should improve self-management towards prevention of dyslipidemia and its negative impact on daily life.

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