Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 847-857| ISSN:2251-6727

To Study Micro and Macrovascular Complications Among Type 2 Diabetic Patients with and Without Hypertension- A Prospective Study

Lalima Yadav[1*], N Abhinav Reddy[1], Nitika Kanth[1], T Pavithra Reddy[1], Dr. Pdss Prakash[2], Dr. M. Raviteja Raidu[3]
[1]Malla Reddy College Of Pharmacy, Maisammaguda, Hyderabad, Telangana, India- 500100
[2]Pharm.D, Assistant Professor, Malla Reddy College of Pharmacy Maisammaguda, Secunderabad500100
[3]MBBS, MD, Dept. of General Medicine, Malla Reddy Institute of Medical Sciences Suraram, Hyderabad- 500100
***Corresponding author:** Lalima yadav
Phone number: +91- 7893793081 Email: Lalimayadav68@gmail.com

(Received: 16 September 2024 Revised: 11 October 2024 Accepted: 04 November 2024)

KEYWORDS
Type 2 Diabetes Mellitus, Microvascular complications, Retinopathy, Nephropathy, Macrovascular complications, Coronary Artery Disease, Peripheral Artery Disease,

ABSTRACT:

BACKGROUND INFORMATION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder marked by hyperglycemia due to insulin resistance and impaired insulin secretion. It is a global health concern, associated with microvascular complications (retinopathy, nephropathy, neuropathy) and macrovascular complications (cardiovascular disease, stroke, peripheral arterial disease). Hypertension is a common comorbidity in T2DM, increasing the risk of these complications. Understanding the prevalence of these complications in T2DM patients with and without hypertension is essential for developing effective management strategies.

MATERIALS AND METHODS

This descriptive, non-experimental study included 176 T2DM patients, classified based on hypertension status (88 with hypertension, 88 without). The prevalence rates of microvascular and macrovascular complications were analyzed using various statistical tools, considering factors such as the type of complications, age, gender, and duration of hypertension and diabetes.

RESULTS

The highest prevalence of complications was observed in patients aged 51-60 years (37.50% with hypertension) and 41-50 years (35.23% without hypertension). Males showed a slightly higher prevalence of complications (54.55% with hypertension, and 55.68% without). Microvascular complications were more common in patients without hypertension (retinopathy 17.05%, neuropathy 55.68%), except for nephropathy, which was slightly more prevalent in those with hypertension (24.42%). Macrovascular complications were more prevalent in patients with hypertension (CAD 28.41%, PAD 2.27%, CVD 10.23%).

CONCLUSION

The study found a higher prevalence of both microvascular and macrovascular complications in T2DM patients with hypertension. However, while hypertension contributes to these complications, other factors, such as lifestyle, social history, and genetic predisposition, may also play a role. Further research is necessary to understand these interactions better and improve management strategies for T2DM patients.

INTRODUCTION

Diabetes mellitus (DM) is a metabolic condition defined by hyperglycemia resulting from impairments in insulin production, insulin action, or both. Type 2 diabetes includes individuals exhibiting insulin resistance (IR) and typically relative insulin deficiency. [1] The pathological hallmark of diabetes mellitus pertains to the vasculature, resulting in both microvascular and macrovascular complications. Prolonged hyperglycemia correlates with enduring damage and dysfunction of multiple organ systems, primarily

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 847-857| ISSN:2251-6727

impacting the eyes, nerves, kidneys, and heart. [2] The prevalence, growth, and distribution of diabetes significantly differ among nations. Diabetes is linked to nearly all chronic diseases. It complicates medical interventions and exacerbates existing ailments. Diabetes can lead to severe cardiovascular diseases and harm to the eyes, kidneys, and nerves, heightening the chance of limb amputation, eyesight impairment, and premature mortality. [2, 3] Global health spending on diabetes was estimated at USD 966 billion in 2021 and is anticipated to rise to USD 1,028 billion by 2030. Target 3.4 of the Sustainable Development Goals (SDGs) established by the United Nations (UN) is to decrease premature mortality from non-communicable diseases (NCDs) by one-third, a goal unattainable without the prevention and management of diabetes. [4] In 2021, the World Health Organization (WHO) initiated the Global Diabetes Compact, a worldwide project designed to achieve enduring enhancements in diabetes prevention and management, particularly for individuals residing in low- and middle-income countries (LMCs). [5]

PATHOGENESIS OF DIABETES

Plasmid concentrations of glucose prompt the central nervous system to release stored energy. Which is integral to the pathophysiology of diabetes. It is contingent upon arterial factors.

Plasma glucose, cerebral blood flow, tissue integrity, and the velocity of plasma glucose Concentrations diminish, along with supplementary metabolic substrates that are easily accessible. [6] Decreased plasma glucose levels induce an elevation in autonomic activity. Validation of minimal Plasma glucose levels is essential for diagnosing hypoglycemia. Hypoglycemia may elicit many responses, including decreased insulin secretion. [7] An increase in the secretion of hormones that antagonize glucose, such as glucagon and epinephrine, a more potent sympathetic nervous system reaction, related symptoms, in severe instances, coma, convulsions, or cognitive impairment. In specific patients with impaired glucose tolerance or early-stage type 1 or type 2 diabetes, late-onset hypoglycemia Occult diabetes may manifest. [8]

MICROVASCULAR COMPLICATIONS

Microvascular complications of diabetes are enduring health disorders that impact the small blood arteries (microvasculature) in several organs and tissues, usually arising from persistent hyperglycemia. [9] Microvascular disease primarily manifests in organs where glucose absorption is not reliant on insulin, such as the kidney, retina, and vascular endothelium, due to their exposure to glucose concentrations that closely align with blood glucose levels. [10] Diabetes mellitus (DM) is defined by organ impairment resulting directly or indirectly from persistent hyperglycemia. The chronic consequences of diabetes are conventionally categorized as macrovascular or microvascular based on the underlying pathophysiology. [11] The microvascular trio of retinopathy, nephropathy, and neuropathy is exclusive to diabetes. The majority of people with diabetes will exhibit one or more of them as either overt or subclinical signs throughout their condition. [12]

DIABETIC RETINOPATHY

Diabetic retinopathy (DR) is a diabetes-related condition that impacts the retina, the lightsensitive tissue located at the posterior segment of the eye. It transpires when elevated blood glucose levels cause harm to the diminutive blood vessels in the retina, resulting in various visual deficits and possibly significant visual impairment if not addressed. [13,14]

DIABETIC NEUROPATHY

Neuropathy encompasses a variety of disorders caused by damage to the peripheral nervous system, which includes the nerves outside the brain and spinal cord. [14] This damage disrupts the communication between the central nervous system and the rest of the body, leading to a range of symptoms that can significantly affect a person's daily life and functional independence. [15]

NEPHROPATHY

Nephropathy is the decline of renal function. The terminal phase of nephropathy is referred to as kidney failure and end-stage renal disease (ESRD). The global prevalence of DN is due to the significant rise in diabetes incidence globally. The principal categories are the Tervaert classification and the Mogensen classification. [16]

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 847-857| ISSN:2251-6727

MACROVASCULAR COMPLICATIONS
CORONARY ARTERY DISEASE (CAD)

Coronary artery disease (CAD) is defined by the constriction or obstruction of the coronary arteries, which deliver oxygenated blood to the cardiac muscle. The constriction is mostly attributed to plaque accumulation, comprising lipids, cholesterol, and other chemicals that deposit on the arterial walls, a phenomenon termed atherosclerosis. [17] Narrowed arteries diminish blood flow to the heart muscle, resulting in symptoms and consequences such as chest discomfort (angina) and myocardial infarctions. [18]

PERIPHERAL ARTERY DISEASE

Peripheral artery disease (PAD) refers to atherosclerotic occlusive disease of the lower extremity arteries in patients with diabetes mellitus (DM). [19] It is caused by a narrowing of the arteries outside of the heart and brain, leading to reduced blood flow in the legs and feet. Peripheral artery disease (PAD) is a significant complication associated with type 2 diabetes mellitus (T2DM), contributing to increased morbidity and mortality. [20]

CEREBROVASCULAR DISEASE

Cerebrovascular disease in type 2 diabetes includes both macrovascular and microvascular consequences. [21] Macrovascular disease generally pertains to bigger blood vessels and is frequently associated with atherosclerosis, characterized by plaque accumulation in the arteries, resulting in disorders such as transient ischemic attacks (TIAs) and strokes. Microvascular problems impact tiny blood vessels and may result in illnesses such as diabetic encephalopathy and cognitive impairment. [22]

MATERIALS AND METHODS

It is a prospective cross-sectional study on “analyzing micro and macrovascular complications among type 2 diabetic patients with and without hypertension” conducted at Malla Reddy Hospitals, Suraram, Hyderabad. The study was carried out for 6 months and the sample size was 175 patients. The study procedure was explained to the subject and informed consent was obtained from patients individually. After obtaining ethical clearance, all required information will be collected using a patient data collection form. Information was obtained regarding type 2 diabetic patients with or without a history of hypertension for assessing micro and macrovascular complications. Samples were collected based on inclusion and exclusion criteria, followed by collecting baseline demographic data for all participants with baseline assessments for microvascular and macrovascular complications. The inclusion criteria include male and female Patients with type 2 Diabetes mellitus with and without hypertension and Patients within the age group 18 to 65 years. The exclusion criteria include Patients with type 1 Diabetes Mellitus, Smokers, patients with acute illness, patients with secondary hypertension, patients who are overweight and obese (BMI 25 or more). The data was collected and entered into MICROSOFT EXCEL for analysis. IBM SPSS Software will be utilized for further analysis by a statistician to conclude. Thereafter, the results will be stratified and the detailed project report will be prepared and submitted.

RESULTS

Table 1: DISTRIBUTION ACCORDING TO AGE

Age (Years)	DIABETES WITH HYPERTENSION		DIABETES WITHOUT HYPERTENSION		Total Cases	Total %
	No.of cases	Percentage	No.of cases	Percentage		
</= 20	0	0.00%	5	5.68%	5	2.84%
21-30	2	2.27%	4	4.55%	6	3.41%
31-40	6	6.82%	11	12.50%	17	9.66%
41-50	25	28.41%	31	35.23%	56	31.82%
51-60	33	37.50%	23	26.14%	56	31.82%
>/= 60	22	25.00%	14	15.91%	36	20.45%
Total	88		88		176	

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 847-857| ISSN:2251-6727

The prevalence of diabetes varies significantly across age groups, revealing important trends. Among individuals aged 20 and under, very few cases are reported, indicating a low prevalence, particularly concerning hypertension. In the 21 to 30 age group, there is a slight increase in diabetes cases, yet the overall numbers remain low. A more substantial rise is noted in the 31 to 40 age bracket, especially among those without hypertension, suggesting a potential trend of increasing prevalence as age progresses. The age group of 41 to 50 experiences the highest number of cases, highlighting that individuals in this range are significantly affected by diabetes, both with and without hypertension. Similarly, those aged 51 to 60 also show a high prevalence, with a notable number of cases linked to hypertension. At the same time, there is a decrease in diabetes cases in the age group of 60 and above compared to the 51-60 cohort, a significant proportion of older adults still suffer from the condition, particularly in conjunction with hypertension. This data underscores the critical need for targeted interventions and awareness efforts as individuals age.

Table 2: DISTRIBUTION ACCORDING TO GENDER

SEX	DIABETES WITH HYPERTENSION		DIABETES WITHOUT HYPERTENSION	
	No.of cases	Percentage	No.of cases	Percentage
Male	48	54.55%	49	55.68%
Female	40	45.45%	39	44.32%
Total	88		88	

In the analysis of diabetes prevalence, males represent a slightly higher proportion of cases in both diabetes categories compared to females, with males comprising 55.6% of the total sample size. This indicates a comparable prevalence of diabetes regardless of hypertension status. Conversely, females account for a smaller proportion of cases, making up 45.4% of the total sample size. Although there is a noticeable difference in representation between the genders, it remains minimal, suggesting that diabetes affects both males and females in similar ways, warranting a comprehensive approach to prevention and treatment across both populations.

Table 3: DISTRIBUTION ACCORDING TO DURATION OF DIABETES

DURATION OF DIABETES (YEARS)	DIABETES WITH HYPERTENSION		DIABETES WITHOUT HYPERTENSION		
	No.of cases	Percentage	No.of cases	Percentage	Total %
1-5	63	71.59%	43	48.86%	60.23%
6-10	17	19.32%	32	36.36%	27.84%
11-15	6	6.82%	11	12.50%	9.66%
16-20	2	2.27%	2	2.27%	2.27%
Total	88		88		176

The duration of diabetes significantly influences its association with hypertension. The majority of cases reported are recent, lasting between 1 to 5 years, and a substantial 71.59% of these individuals also have hypertension. In contrast, among those with diabetes lasting 6 to 10 years, a higher percentage, 36.36%, are without hypertension, while only 19.32% have it. This trend continues in cases lasting 11 to 15 years, where overall prevalence decreases, and the proportion without hypertension rises slightly to 12.50%, compared to

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 847-857| ISSN:2251-6727

6.82% with hypertension. For those with diabetes lasting 16 to 20 years, the number of cases is limited, but interestingly, there is an equal distribution between individuals with and without hypertension. This pattern suggests that the relationship between diabetes and hypertension evolves, with hypertension being more prevalent in the early years of the condition.

Table 4: DISTRIBUTION ACCORDING TO DURATION OF HYPERTENSION

DURATION OF HYPERTENSION (YEARS)	No.of cases	Percentage
1-5	56	63.64%
6-10	24	27.27%
11-15	8	9.09%
16-20	0	0.00%
Total	88	

The duration of hypertension cases reveals a clear trend, with the majority being recent, lasting between 1 to 5 years, accounting for 63.3% of cases. A notable proportion, 27.3%, has persisted for 6 to 10 years. However, the prevalence declines significantly for longer durations, with only 9.1% of the 88 samples suffering from hypertension in the 11 to 15-year range, and none reported in the 16 to 20-year range. This data suggests that hypertension is predominantly a more recent condition, with fewer cases extending beyond a decade, indicating a need for early intervention and management to prevent long-term complications.

Table 5: DISTRIBUTION ACCORDING TO DIFFERENT TYPE OF VASCULAR COMPLICATIONS

Type of complication	Diabetes with hypertension	Diabetes without hypertension
None	8	17
Microvascular complications	46	52
Macrovascular complications	22	5
Both	12	14
Total	88	88

The data highlights a markedly higher prevalence of macrovascular complications among diabetic patients with hypertension, with 22 cases reported compared to just 5 in those without hypertension. This stark contrast suggests that hypertension significantly increases the risk of macrovascular issues in this population. In terms of microvascular complications, however, the prevalence is slightly lower among individuals with hypertension (46 cases) compared to those without (52 cases). While both groups experience significant levels of microvascular complications, the presence of hypertension does not drastically affect their incidence. Additionally, the number of individuals facing both microvascular and macrovascular complications remains relatively similar across both groups, with 12 cases in those with hypertension and 14 in those without. This indicates that the coexistence of both types of complications is common, regardless of hypertension status. Notably, the total number of individuals experiencing any form of complications is equal in both groups, at 88 each, but the distribution underscores hypertension's critical role in exacerbating macrovascular complications among diabetic patients.

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 847-857| ISSN:2251-6727

Table 6: DISTRIBUTION FOR RETINOPATHY CASES

Retinopathy	Groups				P Value
	Diabetes with hypertension	Percentage	Diabetes without hypertension	Percentage	
Yes	10	11.36%	15	17.05%	
No	78	88.64%	73	82.95%	0.388
Total	88		88		

The prevalence of retinopathy is slightly higher in individuals with diabetes but without hypertension compared to those who have both conditions. However, the p-value of 0.388 suggests that this difference is not statistically significant. Interestingly, a greater percentage of individuals with diabetes and hypertension do not exhibit retinopathy compared to their counterparts without hypertension, although this finding also lacks statistical significance. These results indicate that while there are observable trends in retinopathy prevalence related to hypertension status in diabetic patients, the differences are not strong enough to draw definitive conclusions.

Table 7: DISTRIBUTION FOR NEUROPATHY CASES

Neuropathy	Groups				P Value
	Diabetes with hypertension	Percentage	Diabetes without hypertension	Percentage	
Yes	34	38.64%	49	55.68%	
No	54	61.36%	39	44.32%	0.35
Total	88		88		

The prevalence of neuropathy is observed to be higher in individuals with diabetes but without hypertension compared to those who have both conditions. However, a p-value of 0.35 indicates that this difference is not statistically significant. Additionally, a greater percentage of individuals with diabetes and hypertension do not exhibit neuropathy compared to those without hypertension, although this difference also lacks statistical significance. These findings suggest that while trends in neuropathy prevalence exist regarding hypertension status among diabetic patients, the variations are not sufficient to establish a statistically significant relationship.

Table 8: DISTRIBUTION FOR NEPHROPATHY CASES

Nephropathy	Groups				P Value
	Diabetes with hypertension	Percentage	Diabetes without hypertension	Percentage	
Yes	27	30.68%	25	28.41%	
No	61	69.32%	63	71.59%	0.869
Total	88		88		

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 847-857| ISSN:2251-6727

The prevalence of nephropathy appears to be slightly higher in individuals with both diabetes and hypertension compared to those with diabetes alone. However, a p-value of 0.869 indicates that this difference is not statistically significant. Furthermore, a comparable percentage of individuals in both groups do not experience nephropathy, with a marginally higher proportion found in the non-hypertensive group. This difference, too, lacks statistical significance. These results suggest that while there may be observable trends in nephropathy prevalence associated with hypertension in diabetic patients, these variations are not strong enough to warrant definitive conclusions.

Table 9: DISTRIBUTION FOR CORONARY ARTERY DISEASE CASES

	Groups				
CAD	Diabetes with hypertension	Percentage	Diabetes without hypertension	Percentage	P Value
Yes	25	28.41%	15	17.05%	0.072
No	63	71.59%	73	82.95%	
Total	88		88		

The prevalence of coronary artery disease (CAD) is higher in individuals with both diabetes and hypertension compared to those with diabetes alone. Although the p-value of 0.072 indicates a noticeable difference, it does not reach statistical significance at the conventional alpha level of 0.05. Additionally, a greater percentage of individuals without hypertension do not have CAD compared to those with hypertension; however, this difference is also not statistically significant. These findings suggest a trend toward increased CAD prevalence among diabetic patients with hypertension, but the lack of statistical significance means further research is needed to confirm these observations.

Table 10: DISTRIBUTION FOR PERIPHERAL ARTERY DISEASE CASES

	Groups				
PAD	Diabetes with hypertension	Percentage	Diabetes without hypertension	Percentage	P Value
Yes	2	2.27%	0	0.00%	0.155
No	86	97.73%	88	100.00%	
Total	88		88		

Peripheral artery disease (PAD) is found in a small percentage of individuals with diabetes and hypertension, whereas it is not observed in those with diabetes alone. The p-value of 0.155 indicates that this difference is not statistically significant. Furthermore, nearly all individuals in both groups do not exhibit PAD, with a slightly higher percentage in the non-hypertensive group. However, this difference also lacks statistical significance. These results suggest that while there may be a trend toward a higher prevalence of PAD among diabetic patients with hypertension, the evidence is not strong enough to draw definitive conclusions.

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 847-857| ISSN:2251-6727

Table 11: DISTRIBUTION OF CEREBROVASCULAR DISEASE CASES

	Groups				
CVD	Diabetes with hypertension	Percentage	Diabetes without hypertension	Percentage	P Value
Yes	9	10.23%	4	4.55%	
No	79	89.77%	84	95.45%	0.15
Total	88		88		

Cardiovascular disease (CVD) is more prevalent among individuals with diabetes and hypertension than in those with diabetes alone. The p-value of 0.15 indicates that while there is a noticeable difference, it does not achieve statistical significance at the conventional alpha level of 0.05. Additionally, a greater percentage of individuals without hypertension do not have CVD compared to those with hypertension, although this difference also lacks statistical significance. These findings suggest a trend toward increased CVD prevalence in diabetic patients with hypertension, but the lack of statistical significance implies that further investigation is needed to establish a clearer understanding of this relationship.

Table 12: DESCRIPTIVE STATISTICS OF AGE, DURATION OF DIABETES MELLITUS, AND DURATION OF HYPERTENSION AMONG STUDY PARTICIPANTS

VARIABLE	AGE	DM-YRS	HTN-YRS
N	176	176	88
Mean	50.3	6.65	6.20
95% CI mean lower bound	48.7	6.05	5.49
95% CI mean upper bound	52.0	7.25	6.29
Median	52.0	7.25	5.00
Mode	52.0	5.00	5.00
Standard Deviation	11.2	4.02	3.36
Minimum	19	1	1.00
Maximum	65	20	15.0

The participants in the study have a mean age of approximately 50 years, reflecting a diverse range in both age and the duration of chronic conditions, such as diabetes and hypertension. The close alignment of the median and mode values across all variables suggests that the data distribution is relatively normal and not heavily skewed. Additionally, the lower standard deviation for the duration of hypertension indicates less variability in the duration of hypertension among participants compared to that of diabetes. This may imply that individuals in the study have more consistent experiences regarding hypertension duration, while diabetes shows a broader range of variability.

DISCUSSION

The study provides valuable insights into the complex relationship between hypertension and micro and macrovascular complications in type 2 diabetic patients. By examining these two groups, the study sought to elucidate the additional risk burden hypertension imposes on the development and progression of diabetes-related complications. The findings from this analysis can inform targeted prevention and management strategies for healthcare practitioners. The study was a cross-sectional analysis involving 176 participants diagnosed with type 2 diabetes mellitus (T2DM), evenly divided into two groups: 88 with hypertension and 88 without. The primary focus was to assess the prevalence of six key complications: diabetic retinopathy, neuropathy, nephropathy, coronary artery disease (CAD), peripheral artery disease (PAD), and stroke. A statistically significant age-related trend was observed, characterized by a pronounced increase in T2DM prevalence with advancing age. Notably, the

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 847-857| ISSN:2251-6727

prevalence of T2DM without hypertension was markedly low (5.68%) among participants aged ≤20 years, whereas the prevalence peaked in the 41-50 and 51-60 age groups, with an overall prevalence rate of 63.65%. This finding is concordant with previous research by Wang and Yang (2012), who reported a similar age-related increase in T2DM and hypertension prevalence in the Chinese population. [23]

Gender did not emerge as a significant determinant of diabetes prevalence in this cohort. Although males showed a slightly higher prevalence of diabetes (55.12%) compared to females (44.88%), the difference was not statistically significant. Both genders demonstrated comparable rates of diabetes with and without hypertension, suggesting that other factors, such as age, duration of diabetes, and comorbidities, may play a more critical role in determining risk. The analysis revealed a notable trend in the duration of diabetes and its association with hypertension. A significant proportion (71.59%) of recently diagnosed diabetes cases (1-5 years) also had hypertension, suggesting a strong correlation between the two conditions in the early stages of diabetes. However, as the duration of diabetes increased, the proportion of cases without hypertension rose, with 36.36% of cases with a duration of 6-10 years not having hypertension. This finding implies that while hypertension is a risk factor for developing diabetes, the association between the two conditions may weaken with longer-standing diabetes. This trend is consistent with previous research by Naseri and Esmat (2019-2020), who reported a mean duration of diabetes of 7.08 years (SD ± 5.95) among their study participants. [24]

The study population exhibited a mean age of 50 years, with a range of 19 to 65 years, demonstrating a diverse and representative sample across various age cohorts. The distribution of diabetes duration was relatively symmetric, with a mean of 6.65 years (SD = 4.02). In contrast, the mean duration of hypertension was slightly shorter, at 6.20 years (SD = 3.36), displaying a symmetric distribution with reduced variability, as evidenced by the congruent median and mode values of 5 years. A slightly higher prevalence of retinopathy was observed in individuals with diabetes alone (17.05%) compared to those with both diabetes and hypertension (11.36%), although the difference did not reach statistical significance (p = 0.388). The diabetes only group exhibited a higher prevalence of neuropathy (55.68%) compared to those with both conditions (38.64%), but the difference was not statistically significant (p = 0.35). A marginal increase in nephropathy prevalence was noted in individuals with both diabetes and hypertension (30.68%) compared to those with diabetes alone (28.41%), although the difference was not statistically significant (p = 0.869). These observations align with the findings of Bui and Jing (2018), who noted that the prevalence rates of neuropathy, retinopathy, and nephropathy were 23.5%, 17.4%, and 10.8%, respectively, among patients with T2DM in Tianjin, China. The multivariate logistic regression in their study identified the duration of diabetes, insulin use, hypertension, and dyslipidemia as significant risk factors for developing microvascular complications. [25]

A significantly higher prevalence of CAD was observed in individuals with both diabetes and hypertension (28.41%) compared to those with diabetes alone (17.05%), with a p-value of 0.072, indicating a trend towards statistical significance. PAD was present in a small proportion of patients with both conditions (2.27%), whereas no cases were observed in patients with diabetes alone. However, the difference did not reach statistical significance (p-value = 0.155). The coexistence of diabetes and hypertension was associated with a higher prevalence of CVD (10.23%) compared to diabetes alone (4.55%), although the difference did not attain statistical significance (p-value = 0.15).[23,26] This study underscores the synergistic impact of hypertension on the risk of macrovascular and microvascular complications in type 2 diabetic patients, highlighting the imperative for comprehensive management strategies that address both conditions. [27] The findings demonstrate a pronounced association between hypertension and coronary artery disease, as well as a significant burden of retinopathy and neuropathy, regardless of hypertension status. [28] These results emphasize the need for integrated care approaches that prioritize the concurrent management of diabetes and hypertension to mitigate the progression of these complications. [29] Future research directions should focus on elucidating the underlying mechanisms driving these interactions and evaluating targeted interventions to prevent and manage these

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(6), 847-857| ISSN:2251-6727

complications effectively, ultimately informing evidence-based guidelines for optimal patient care. [30]

CONCLUSION

The study of micro and macrovascular complications among type 2 diabetic patients with and without hypertension led us to the conclusion highlighting the critical importance of managing both diabetes and hypertension in patients with concurrent conditions. The findings demonstrate a significant increase in macrovascular and microvascular complications, particularly coronary artery disease, retinopathy, and neuropathy, in individuals with both diabetes and hypertension. Our study's findings also highlight the needfor more nuanced approaches to understanding the relationship between hypertension and vascular complications. By controlling for confounding factors such as medication adherence and glycaemic control, we may uncover more pronounced associations between hypertension and vascular damage. In conclusion, this study contributes meaningfully to the existing literature by suggesting a complex interplay between hypertension and micro and macrovascular complications in type 2 diabetes patients. Our findings underscore the importance of hypertension management and warrant further research to elucidate the mechanisms underlying this relationship.

References

1. Röder, P. V., Wu, B., Liu, Y., & Han, W. (2016). Pancreatic regulation of glucose homeostasis. *Experimental & Molecular Medicine*, *48*(3), e219.
2. Maiti, S., Akhtar, S., Upadhyay, A. K., & Mohanty, S. K. (2023). Socioeconomic inequality in awareness, treatment and control of diabetes among adults in India: Evidence from National Family Health Survey of India (NFHS), 2019–2021. *Scientific Reports*, *13*(1).
3. Dal Canto, E., Ceriello, A., Rydén, L., Ferrini, M., Hansen, T. B., Schnell, O., Standl, E., & Beulens, J. W. (2019). Diabetes as a cardiovascular risk factor: An overview of global trends of macro and micro vascular complications. *European Journal of Preventive Cardiology*, *26*(2_suppl), 25–32.
4. McKerrecher, D., & Waring, M. J. (2013). Property-based design in the optimisation of benzamide glucokinase activators: from hit to clinic. *Progress in Medicinal Chemistry*, *52*, 1–43.
5. Petersen, M. C., & Shulman, G. I. (2018). Mechanisms of insulin action and insulin resistance. *Physiological Reviews*, *98*(4), 2133–2223.
6. Perreault, K., Lagacé, J.-C., Brochu, M., & Dionne, I. J. (2016). Association between fat free mass and glucose homeostasis: Common knowledge revisited. *Ageing Research Reviews*, *28*, 46–61.
7. Häusl, A. S., Balsevich, G., Gassen, N. C., & Schmidt, M. V. (2019). Focus on FKBP51: A molecular link between stress and metabolic disorders. *Molecular Metabolism*, *29*, 170–181.
8. Moini, J., Adams, M., & LoGalbo, A. (2022). Pathophysiology of Diabetes. In *Complications of Diabetes Mellitus* (pp. 2–10). CRC Press.
9. Cerf, M. E. (2013b). Beta cell dysfunction and insulin resistance. *Frontiers in Endocrinology*, *4*, 37.
10. American Diabetes Association. (2010). Diagnosis and classification of diabetes mellitus. *Diabetes Care*, *33 Suppl 1*(Supplement_1), S62-9.
11. Galicia-Garcia, U., Benito-Vicente, A., Jebari, S., Larrea-Sebal, A., Siddiqi, H., Uribe, K. B., Ostolaza, H., & Martín, C. (2020). Pathophysiology of type 2 Diabetes Mellitus. *International Journal of Molecular Sciences*, *21*(17), 6275.
12. Vithian, K., & Hurel, S. (2010). Microvascular complications: pathophysiology and management. *Clinical Medicine (London, England)*, *10*(5), 505–509.
13. Raman, R., Vasconcelos, J. C., Rajalakshmi, R., Prevost, A. T., Ramasamy, K., Mohan, V., Mohan, D., Rani, P. K., Conroy, D., Das, T., Sivaprasad, S., & SMART India Study Collaborators. (2022). Prevalence of diabetic retinopathy in India stratified by known and undiagnosed diabetes, urban-rural locations, and socioeconomic indices: results from the SMART India population-based cross-sectional screening study. *The Lancet. Global Health*, *10*(12), e1764–e1773.

Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(6), 847-857| ISSN:2251-6727

14. Yang, Z., Tan, T.-E., Shao, Y., Wong, T. Y., & Li, X. (2022). Classification of diabetic retinopathy: Past, present and future. *Frontiers in Endocrinology*, *13*, 1079217.
15. Kusuhara, S., Fukushima, Y., Ogura, S., Inoue, N., & Uemura, A. (2018). Pathophysiology of diabetic retinopathy: The old and the new. *Diabetes & Metabolism Journal*, *42*(5), 364–376.
16. Coucha, M., Elshaer, S. L., Eldahshan, W. S., Mysona, B. A., & El-Remessy, A. B. (2015). Molecular mechanisms of diabetic retinopathy: potential therapeutic targets. *Middle East African Journal of Ophthalmology*, *22*(2), 135–144.
17. Kang, Q., & Yang, C. (2020). Oxidative stress and diabetic retinopathy: Molecular mechanisms, pathogenetic role and therapeutic implications. *Redox Biology*, *37*(101799), 101799.
18. Jasmine, A., Akila, Durai, V., Rani, A., Shriraam, V., Samya, Gayathri, & Mahadevan, S. (2021). Prevalence of peripheral neuropathy among type 2 diabetes mellitus patients in a rural health centre in South India. *International Journal of Diabetes in Developing Countries*, *41*(2), 293–300.
19. Gwathmey, K. G. (2016). Sensory neuronopathies. *Muscle & Nerve*, *53*(1), 8–19.
20. Pang, L., Lian, X., Liu, H., Zhang, Y., Li, Q., Cai, Y., Ma, H., & Yu, X. (2020). Understanding diabetic neuropathy: Focus on oxidative stress. *Oxidative Medicine and Cellular Longevity*, *2020*, 9524635.
21. Roohi, T. F., Mehdi, S., Aarfi, S., Krishna, K. L., Pathak, S., Suhail, S. M., & Faizan, S. (2024). Biomarkers and signaling pathways of diabetic nephropathy and peripheral neuropathy: possible therapeutic intervention of rutin and quercetin. *Diabetology International*, *15*(2), 145–169.
22. Viswanathan, V., & Mirshad, R. (2023). The burden of diabetic nephropathy in India: Need for prevention. *Diabetic Nephropathy*, *3*(2), 25–28.
23. Wang, Z., Yang, T., & Fu, H. (2021). Prevalence of diabetes and hypertension and their interaction effects on cardio-cerebrovascular diseases: a cross-sectional study. *BMC Public Health*, *21*(1), 1224.
24. Naseri, M. W., Esmat, H. A., & Bahee, M. D. (2022). Prevalence of hypertension in Type-2 diabetes mellitus. *Annals of Medicine and Surgery (2012)*, *78*(103758), 103758.
25. Bui, H. D. T., Jing, X., Lu, R., Chen, J., Ngo, V., Cui, Z., Liu, Y., Li, C., & Ma, J. (2019). Prevalence of and factors related to microvascular complications in patients with type 2 diabetes mellitus in Tianjin, China: a cross-sectional study. *Annals of Translational Medicine*, *7*(14), 325.
26. Viswanathan, V. (n.d.). Type 2 diabetes and diabetic nephropathy in India- magnitude of the problem. *Nephrol Dial Transplant*.
27. Qi, C., Mao, X., Zhang, Z., & Wu, H. (2017). Classification and differential diagnosis of diabetic nephropathy. *Journal of Diabetes Research*, *2017*, 8637138.
28. DeFronzo, R. A., Reeves, W. B., & Awad, A. S. (2021). Pathophysiology of diabetic kidney disease: impact of SGLT2 inhibitors. *Nature Reviews. Nephrology*, *17*(5), 319– 334.
29. Mohandes, S., Doke, T., Hu, H., Mukhi, D., Dhillon, P., & Susztak, K. (2023). Molecular pathways that drive diabetic kidney disease. *The Journal of Clinical Investigation*, *133*(4).
30. Duggan, J. P., Peters, A. S., Trachiotis, G. D., & Antevil, J. L. (2022). Epidemiology of coronary artery disease. *The Surgical Clinics of North America*, *102*(3), 499–516.