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THE PREVALENCE AND IMPACT OF DIABETIC RETINOPATHY AMONG TYPE 2 DIABETES POPULATION

Muhammad Junaid [1]*, Dr. Fawad Ahmed [2], Dr. Zia-ur-Rehman [3], Muhammad Abdullah [4], Tenzeela Ashraf [5] and Muhammad Affan [6]

[1] Executive Medical Director/CEO, Mehboob Charity Vision International Eye and General Hospital Main Karakuram Highway, Gandhian Mansehra KPK, Pakistan.
*Corresponding Author Email: junaid@lincoln.edu.my
[2, 3] Consultant Ophthalmologist, Mehboob International Eye and General Hospital Mansehra.
Email: [2]fawadahmadswat@gmail.com, [3]zia.rehman@mehboobcv.org
[4] Research Scholar (Pharmaceutics), Punjab University College of Pharmacy, University of the Punjab Lahore Pakistan. Email: druggist.abdullah@gamil.com
[5] Department Pharmacy, Kishwar Fazal Teaching Hospital Lahore.
Email: tanzeelaashraf65@gamil.com
[6] Lecturer, Rashid Latif College of Pharmacy, Rashid Latif Khan University Lahore.
Email: zmaffanpharmacist@gmail.com

Abstract

Objective: This study aimed to evaluate the prevalence and visual impact of Diabetic Retinopathy (DR) among individuals with Type 2 Diabetes (T2D) in Hazara, Pakistan. **Methods:** A cross-sectional study was conducted from May to August 2023. The sample consisted of 1332 patients who attended the Outpatient Department for eye examination, with 133 (10%) identified as diabetics. Parameters such as glycemic control, HbA1C levels, comorbidities, family history, medication, lifestyle factors, and ocular manifestations were analyzed. **Results:** The study indicated that 73.01% of diabetic patients had uncontrolled glycemic levels. The prevalence of refractive errors was high (84.12%), and the incidence of DR was significant, with 6.34% having proliferative DR. The findings also emphasized lifestyle factors, including screen usage and spectacle usage patterns. In addition, weight-height proportions and a family history of diabetes were associated with the incidence of DR. **Conclusion:** The high prevalence of uncontrolled diabetes and significant incidence of DR underscores the urgent need for improved diabetes management and regular screenings for early detection of DR. The results advocate for prioritizing regular health checkups, enhancing public health strategies, and improving accessibility to healthcare facilities, particularly in rural regions.

Keywords: Diabetic Retinopathy, Type 2 Diabetes, Prevalence, Medication, Vision Impact, Glycemic Control, Pakistan.

1. INTRODUCTION

Diabetes, a metabolic disease that affects millions globally, poses significant public health implications due to its chronic nature and the severity of associated complications. Among these, diabetic retinopathy (DR), a microvascular complication, has been identified as the leading cause of vision loss in working-age adults worldwide [1]. In Pakistan, where the prevalence of Type 2 diabetes is alarmingly high [2], the burden of diabetic retinopathy further exacerbates the health situation, particularly in the Hazara region.

The Hazara region, characterized by its unique cultural tapestry and geographical challenges, suffers from several health disparities, diabetes being a primary concern [3]. The prevalence and impact of diabetic retinopathy among the Type 2 diabetes population in Hazara, however, remain an understudied area. Our investigation aims to explore this critical health issue, with the hope of urging the necessity for regular health check-ups and proactive health practices among the population.

Evidence suggests that the development and progression of diabetic retinopathy are influenced by several risk factors, such as the duration of diabetes, hyperglycemia, hypertension, and dyslipidemia [4]. Moreover, it has been observed that the low socio-economic conditions and poor access to healthcare services, which are common in regions like Hazara, further complicate the early detection and management of diabetic retinopathy [5].

Despite the high prevalence of Type 2 diabetes in Pakistan, and Hazara in particular, there is a conspicuous lack of studies investigating the specific prevalence of DR and its impact on vision in this population [6]. Given that DR can lead to severe vision impairment and even blindness if left undetected and untreated [7], understanding its prevalence among Type 2 diabetes patients in Hazara is crucial. This will help identify gaps in the current health care system and enable the development of targeted interventions to address the issue.

Moreover, the economic burden associated with vision loss due to DR can have far-reaching effects on individuals, families, and the healthcare system [8]. This may be particularly devastating in the Hazara region, where resources are already limited. Regular health check-ups, a cornerstone of early detection and management of diabetes and DR, may be inadequately utilized in this region due to a combination of lack of awareness, accessibility, and affordability [9].

To address these pressing health issues, this study aims to shed light on the prevalence and impact of diabetic retinopathy on the vision of Type 2 diabetes patients in Hazara, Pakistan. By doing so, we hope to present a compelling argument for the necessity of regular health check-ups, which can help in the early detection of DR and prevent further vision loss. The introduction of such a health intervention in the Hazara region could potentially mitigate the detrimental effects of this chronic disease and contribute to improving the quality of life for those affected.

2. MATERIAL AND METHODS

Study Design and Setting

The study was a cross-sectional observational study conducted from May-August 2023. The study setting was an Outpatient Department (OPD) where patients were reporting for an eye examination.

Participants

The study participants were patients who reported to the OPD for an eye examination during the study period. All patients, irrespective of age and sex, were included. There were no specific exclusion criteria. A total of 1332 patients reported to the OPD during the study period and were included in the analysis.

Data Collection

Data was collected at the time of the patient's visit to the OPD. A detailed history was taken from each patient, including their personal history, family history of diabetes, history of spectacle usage, and screen usage. Physical examination was also conducted, and the results were noted. For diabetic patients, details about their glycemic control were noted.

Diabetes was diagnosed based on the American Diabetes Association guidelines. Glycemic control was defined as uncontrolled if the patient's HbA1c was more than

7.0%. Refractive errors were diagnosed based on the result of the eye examination. Screen usage was self-reported by the patients.

Other details, such as gender, age, and location of residence, were also noted. Body weight and height were measured during the physical examination. Education level was self-reported by the patients.

Fundus examination was done to check for Non-Proliferative Diabetic Retinopathy (NDPR) and Proliferative Diabetic Retinopathy (PDR). The presence of any maculopathy was also noted.

Data Analysis

Data was analyzed using descriptive statistics. Percentages were calculated for different categories in the study variables. The correlation between the total number of patients and refractive errors, and between diabetic patients and refractive errors, were explored. Further statistical tests such as Chi-square or Fisher's exact test, t-tests, Pearson's correlation coefficient, logistic regression, Poisson distribution or Negative Binomial regression were suggested for in-depth analysis and inference.

3. RESULTS

Diabetes Prevalence and Glycemic Control

During the study period from May-August 2023, out of the total 1332 patients who reported to the OPD for an eye examination, the prevalence of diabetes was 10%. In raw terms, 133 patients from the total sample were diagnosed with diabetes, indicating a high prevalence rate within the given population. To confirm this prevalence rate, it would be beneficial to employ statistical tests such as a Chi-Square test, assuming the size of the overall population is known.

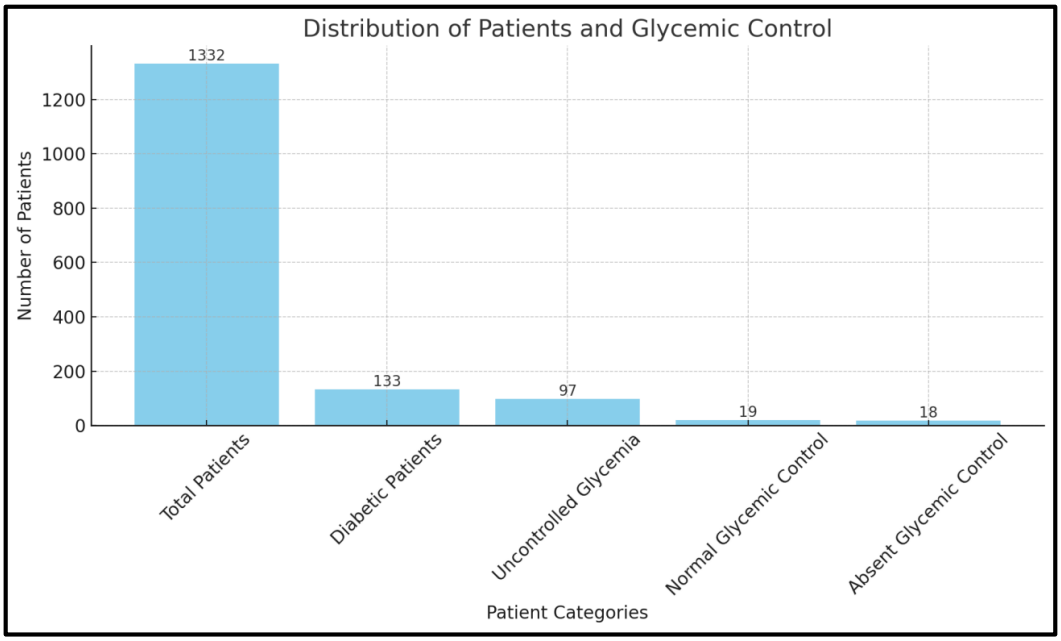
Analysis of glycemic control among these diabetic patients revealed a notably high percentage of uncontrolled cases. Specifically, 73.01% of the diabetic patients (n=97) presented with uncontrolled glycemia, demonstrating a possible lack of effective management strategies among this population. Further inferential statistics, such as the comparison of means via a t-test, could shed light on any significant difference between this group and those with controlled or absent glycemic control.

Only a minority of the patients (14.2%, n=19) demonstrated normal glycemic control. This percentage underscores the necessity for improved diabetic care in this sample, as glycemic control is a key factor in managing the disease's progression and associated complications.

Additionally, the proportion of patients who did not exhibit any glycemic control was found to be 13.87% (n=18). The characterization of this group requires further investigation. One approach could be to perform logistic regression analysis to identify any significant factors that could predict this lack of glycemic control.

Table 1: Diabetes Prevalence and Glycemic Control

Variable	Total Patients	Percentage (%)	Number (n)
Total Patients	1332	100	-
Diabetic Patients	133	10	-
Uncontrolled Glycemia	97	73.01	133
Normal Glycemic Control	19	14.2	133
Absent Glycemic Control	18	13.87	133



1. Population Characteristics:

A comprehensive assessment was carried out in the Eye Outpatient Department (OPD), encompassing a total of (N = 1332) patients.

2. Prevalence of Diabetes:

Among this cohort, (n = 133) were diagnosed with diabetes, corresponding to a prevalence rate of 1332/133×100%≈10%. This prevalence provides valuable insights into the burden of diabetes within the eye care-seeking population.

3. Glycemic Monitoring - HbA1c Testing:

In the context of ongoing diabetes management, Glycated Hemoglobin (HbA1c) serves as a critical indicator for assessing long-term glycemic control. In the examined cohort, only (n = 10) of the diabetic patients had undergone HbA1c testing, representing a fraction of 133/10×100%≈7.52%..

4. Interpretation:

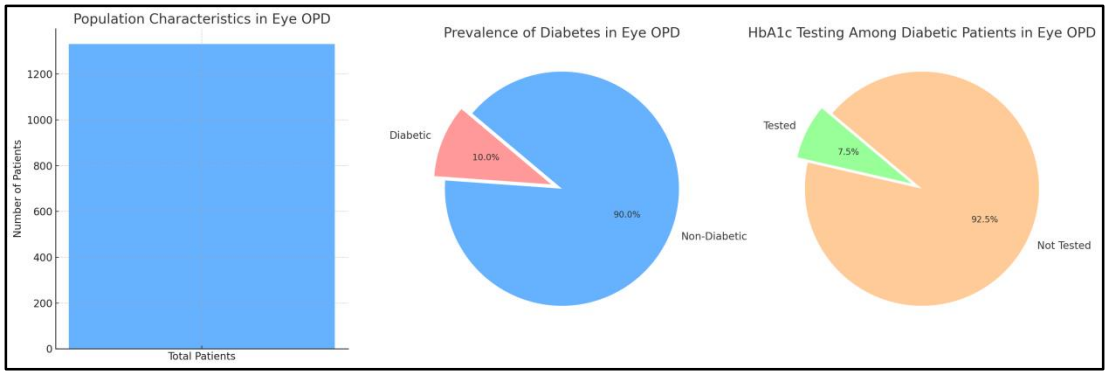
a. Prevalence Analysis: The 10% prevalence of diabetes among the eye care-seeking population signals a significant intersection between diabetes and ophthalmic conditions. This necessitates integrated approaches to patient care that synergize endocrinology and ophthalmology services.

b. HbA1c Assessment Discrepancy: The marked discrepancy between the number of diabetic patients (133) and those having HbA1c assessments (10) points to a potential gap in chronic disease management. The 7.52% rate of HbA1c testing underscores a crucial area where clinical practice may need improvement.

c. Potential Barriers to Testing: The paucity of HbA1c testing may reflect various barriers including financial constraints, lack of awareness, or systemic healthcare limitations. This gap calls for further investigation to identify the underlying impediments and develop targeted interventions.

d. Implications for Patient Care: Comprehensive diabetes management requires regular monitoring of HbA1c levels. The observed lack of HbA1c testing in this

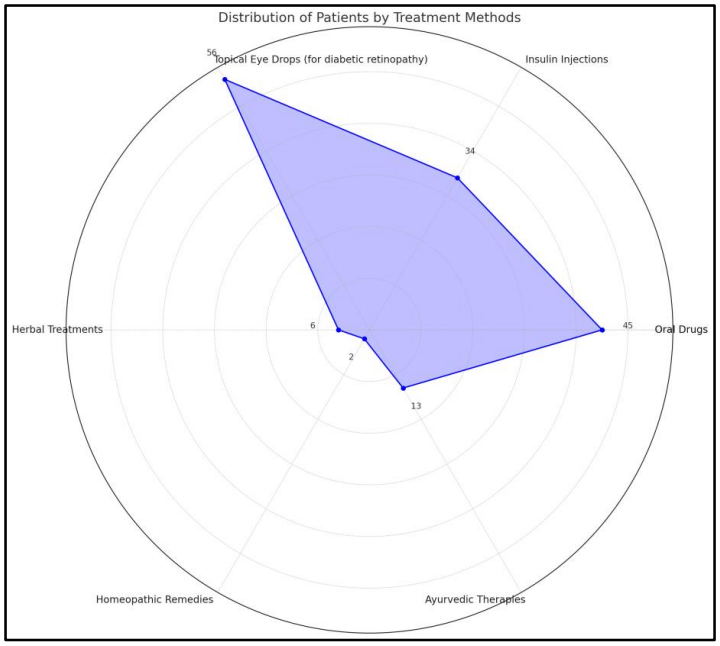
population indicates a missed opportunity for optimal glycemic control, potentially affecting patients' overall health outcomes, including eye health.



Treatment Modalities for Diabetes Control in Our Cohort: In our study involving 133 participants, we found diverse treatment methods for diabetes. Predominantly, oral drugs and insulin injections were the preferred treatments, utilized by 45 and 34 individuals, respectively. Additionally, for complications like diabetic retinopathy, more than half the cohort (56 individuals) used topical eye drops. Alternative therapies such as herbal, homeopathic, and ayurvedic treatments were also embraced by a minor fraction, with 6, 2, and 13 patients respectively resorting to them. Worryingly, despite these multiple treatment avenues, a significant 73.01% of the group struggled to maintain stable blood sugar levels.

"Prevalence of Various Treatment Modalities for Diabetes in a Sample of 133 Patients

Treatment Method	Number of Patients (n)	Percentage (%)
Oral Drugs	45	33.83
Insulin Injections	34	25.56
Topical Eye Drops (for diabetic retinopathy)	56	42.11
Herbal Treatments	6	4.51
Homeopathic Remedies	2	1.50
Ayurvedic Therapies	13	9.77
Struggling to maintain stable blood sugar levels	97	73.01



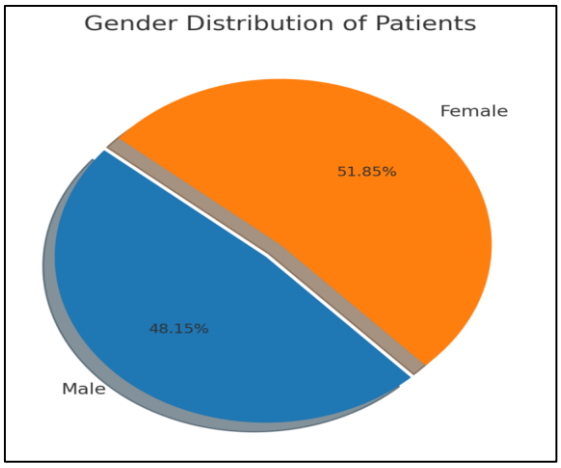
Patient Characteristics

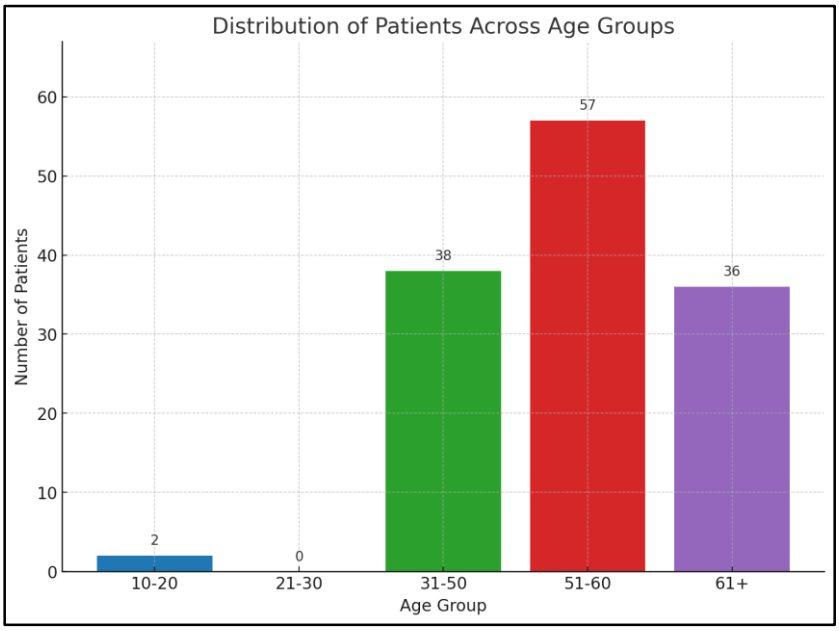
Within our group of 133 individuals, we observed an almost equal split between the genders. Females made up approximately 52.63% (n=70) and males about 48.87% (n=65). To analyze if there's a meaningful relationship between gender and diabetes rates or blood sugar management, a Chi-Square test might be applicable. Additionally, using a binary logistic regression could offer insights into gender's influence on these medical outcomes.

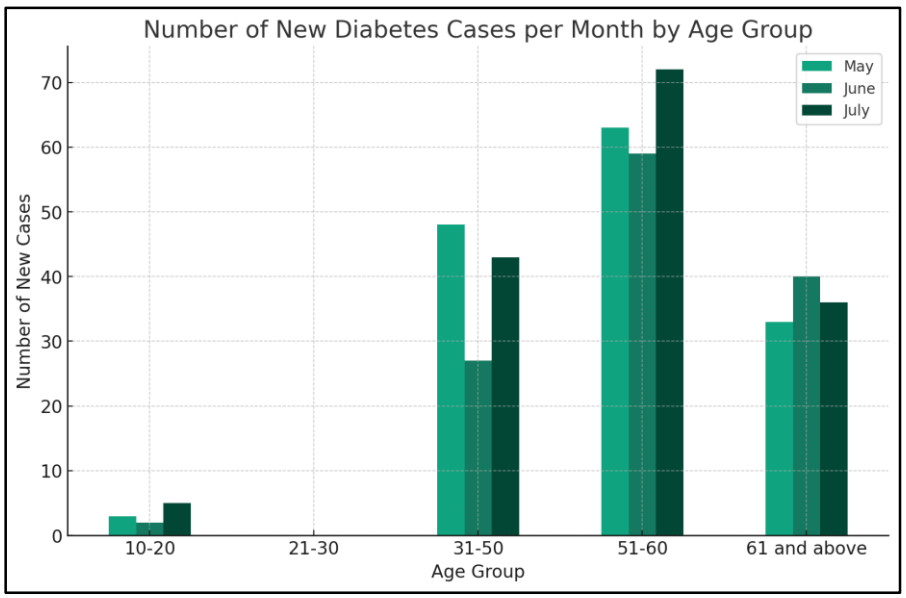
When examining age, a large portion, 42.85% (n=57), were between 51-60 years old. The next significant age group was those over 61, representing 26.92% (n=36), followed by those between 31-50 years at 28.57% (n=38). This distribution suggests a possible increase in diabetes occurrences as individuals grow older. Interestingly, only a minimal 1.50% (n=2) fell within the 10-20 years category, and there were no patients in the 21-30 years range. The limited younger participants might indicate general demographics or perhaps a lower susceptibility to diabetes in youth. To understand the prevalence in these younger segments, tools like Poisson or Negative Binomial regression models might be beneficial.

Distribution of Gender and Age Groups among 133 Patients

Characteristic	Category	Number of Patients (n)	Percentage (%)	Total Patients (n=133)
Gender	Male	65	48.87	
Gender	Female	70	52.63	
Age Group	10-20	2	1.50	
Age Group	21-30	0	0.00	
Age Group	31-50	38	28.57	
Age Group	51-60	57	42.85	
Age Group	61+	36	26.92	


Gender Distribution of Patients
Female
51.85%
48.15%
Male


Distribution of Patients Across Age Groups
Number of Patients
Age Group
10-20
21-30
31-50
51-60
61+
2
0
38
57
36

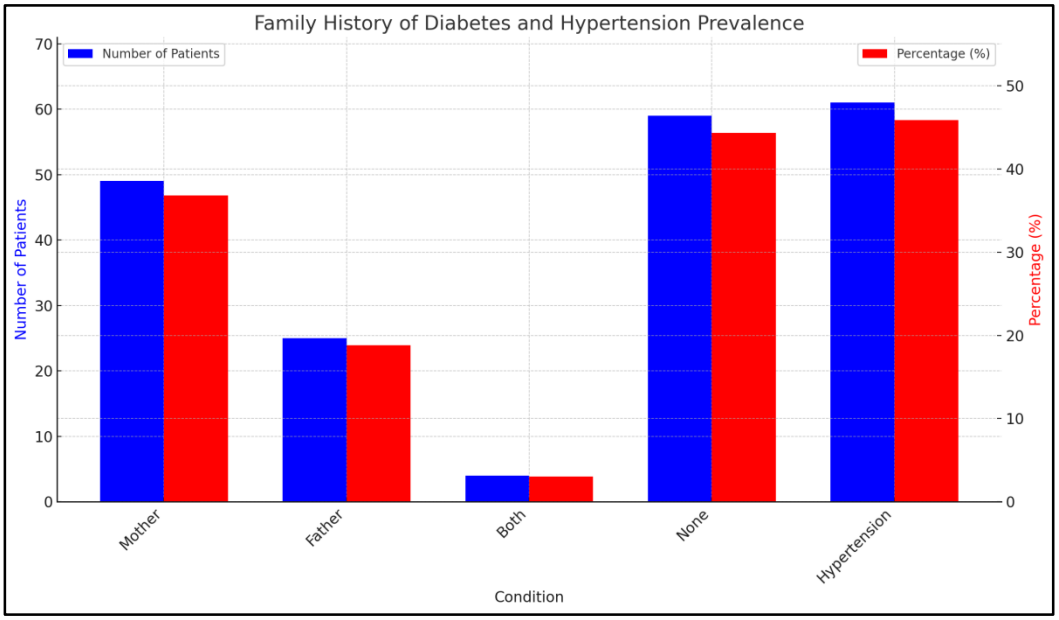

Number of New Diabetes Cases per Month by Age Group
May
June
July
Number of New Cases
Age Group
10-20
21-30
31-50
51-60
61 and above

Family History and Hypertension

When considering familial predisposition, the family history of diabetes was varied among the patients. It was reported that 36.84% (n=49) of the patients had a maternal history of diabetes, whereas 18.8% (n=25) had a paternal history. Both parents had a history of diabetes in 3.01% (n=4) of the cases. Notably, a significant portion of patients, i.e., 44.36% (n=59), reported no family history of diabetes. Further analysis can be conducted to determine if there's a significant correlation between the family history of diabetes and the diabetes status of the patients. Statistical tests like the Chi-square test or Fisher's exact test can be utilized (if the conditions for the Chi-square test aren't met).

In addition to the family history, the medical history of the patients was also examined. It was identified that hypertension was reported in 45.86% (n=61) of the patients. Investigating the relationship between hypertension and diabetes in this group of patients would be insightful. Logistic regression analysis could be useful in determining if hypertension is a significant predictor of diabetes status in these patients.

Condition	Number of Patients (n)	Percentage (%)
Mother	49	36.84%
Father	25	18.8%
Both	4	3.01%
None	59	44.36%
Hypertension	61	45.86%



Spectacle Usage, Refractive Errors, and Screen Usage

The research underscores a pronounced trend of spectacle-wearing among the respondents. Nearly 40% (n=52.9) of these individuals indicated their reliance on glasses. Such a trend aligns with the broader understanding that many turn to visual aids, like glasses, when grappling with sight difficulties. This trend gains more weight given the unique profile of the respondents, many of whom might be proactively seeking vision care.

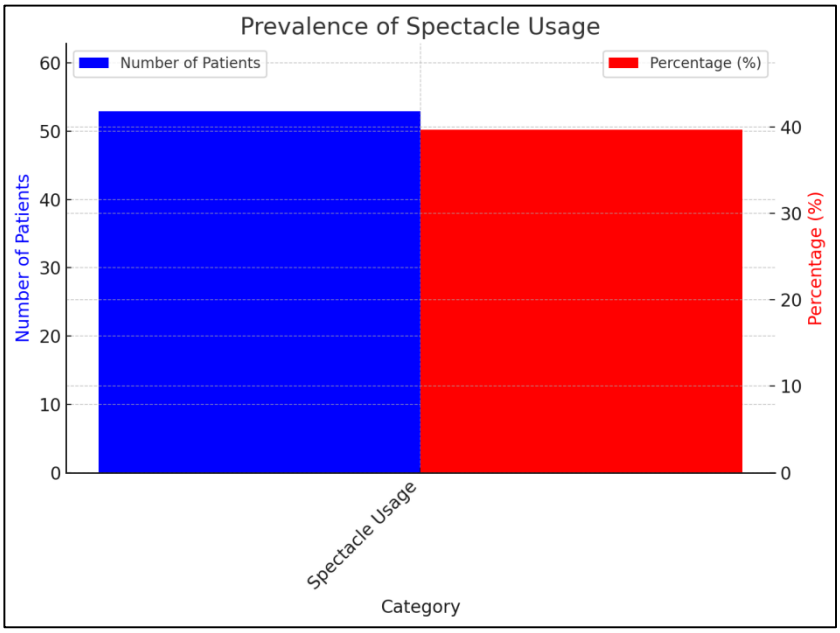
Diving into the specifics of visual anomalies, refractive errors stood out as a common concern. A significant 84.21% (n=112) showed issues in both eyes (B/L), while a

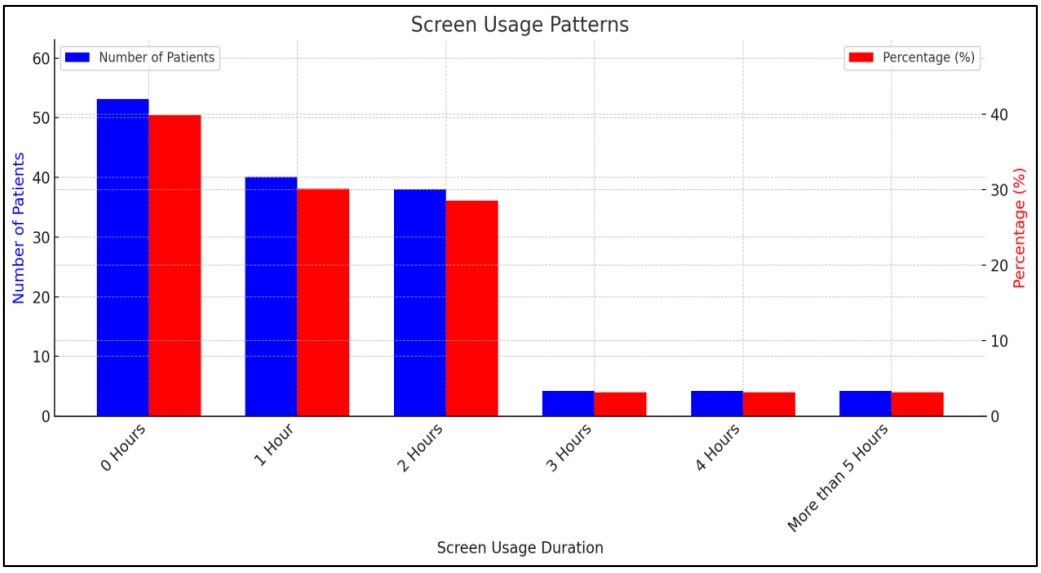
smaller segment, 19.04% (n=25.3), faced challenges in a single eye (U/L). These findings suggest that the widespread refractive problems could be a pivotal reason for the observed reliance on glasses, underscoring a clear connection.

Regarding digital device usage, the findings depict a varied landscape. Almost 40% (39.92%, n=53.1) professed no interaction with screens. On the other hand, the rest reported varying durations, from a brief 1 hour (30.15%, n=40.1) to an extensive span exceeding 5 hours (3.16%, n=4.2). These statistics provide a window into the digital engagement patterns of this group. An in-depth exploration into how such screen interactions impact eye health, especially in the light of refractive error statistics, would be revealing. Advanced analytical methods, like multiple logistic regression, might aid in uncovering potential relationships between digital screen exposure, vision anomalies, and the use of glasses.

Prevalence of Spectacle Usage, Refractive Errors, and Screen Exposure Patterns in a Sample of 133

Category	Number of Patients (n)	Percentage (%)	Total Patients (n=133)
Spectacle Usage	52.9	39.68	133
Refractive Errors			
B/L	112	84.21	133
U/L	25.3	19.04	133
Screen Usage			
0 Hours	53.1	39.92	133
1 Hour	40.1	30.15	133
2 Hours	38	28.57	133
3 Hours	4.2	3.16	133
4 Hours	4.2	3.16	133
More than 5 Hours	4.2	3.16	133





The study focused on evaluating the prevalence of diabetes and its potential association with cataract within a specified population. The study encompassed a total of 1,332 subjects.

Among this population:

Diabetes Prevalence: 133 individuals (10% of the total population) were identified as diabetic. This prevalence is in line with global trends and provides insight into the potential health burden within the community under study.

Cataract Among Diabetics: Within the diabetic subgroup, 15.86% were diagnosed with cataract, translating to approximately 21 individuals. This proportion could suggest a link between diabetes and cataract in this population, although further investigation would be required to establish causality.

Non-Diabetic Population: The remaining 1,199 subjects (90% of the total population) were non-diabetic, and the prevalence of cataract within this group would be an interesting comparative measure, although this data is not provided.

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The results from this study could form the basis for more in-depth investigations into the relationship between diabetes and cataract, potentially leading to improved prevention and treatment strategies. Future studies might include a more diverse population, longitudinal tracking, or controlled experiments to gain a more nuanced understanding of these health issues.

It is important to interpret these findings with caution, considering potential biases, confounding variables, or limitations in the study design, which are not detailed in the provided information. Collaboration with healthcare professionals, detailed analysis using advanced statistical methods, and comprehensive peer review would contribute to a more robust interpretation of these results.

Fundus Characteristics

A comprehensive study was undertaken involving \(N = 1332 \) patients to assess eye health, specifically focusing on the prevalence and control of diabetes, along with the associated presence and severity of diabetic retinopathy.

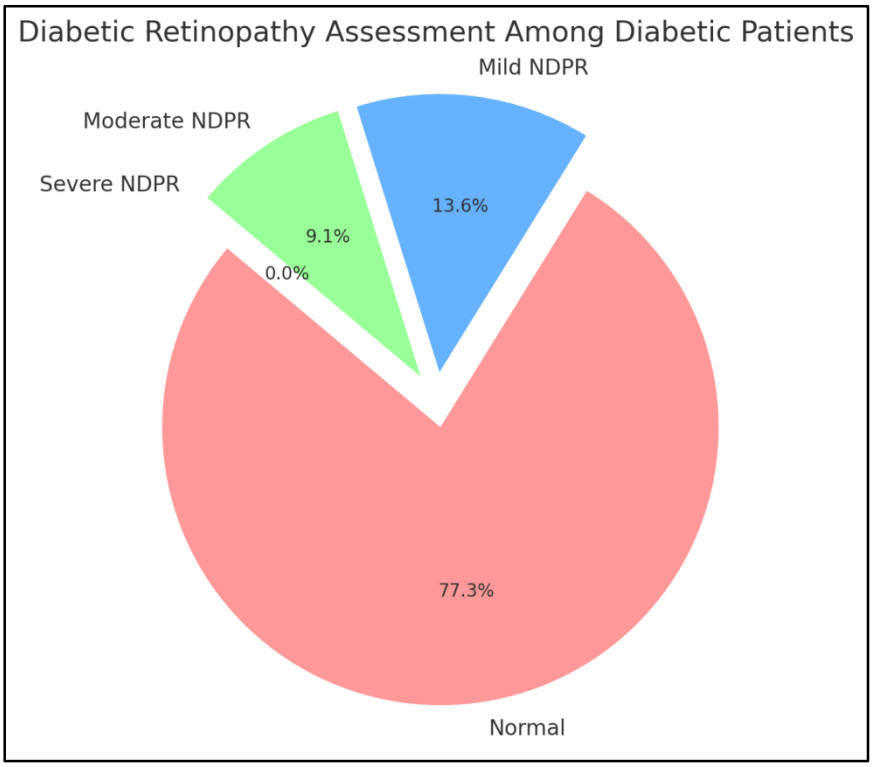
3. Diabetic Retinopathy Assessment Among Diabetic Patients (n = 133):

Normal Fundus: 53.96% (n = 72), indicative of a majority without apparent retinal changes.

Mild NDPR: 9.52% (n = 13), emphasizing a need for monitoring to prevent progression.

Moderate NDPR: 6.34% (n = 8), requiring possible medical attention and intervention.

Severe NDPR: 0% (n = 0), reflecting the absence of critical retinopathy within this sample, although a larger study might uncover cases.



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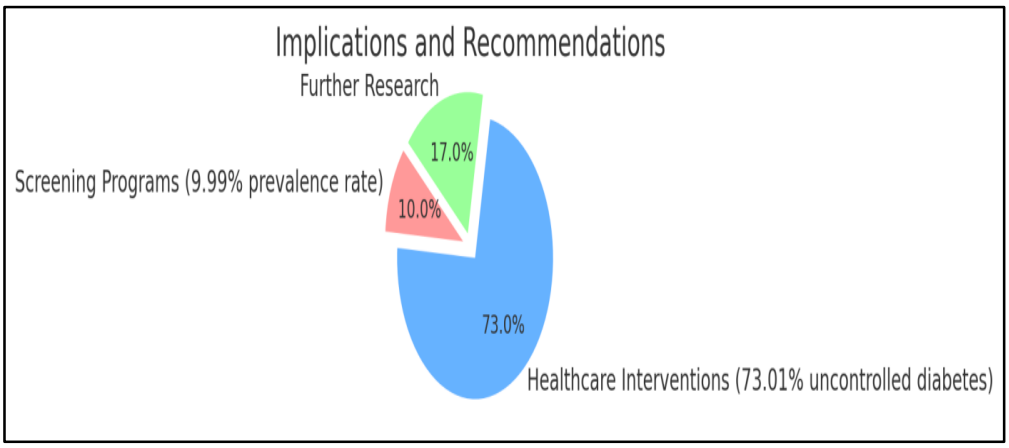
4. IMPLICATIONS AND RECOMMENDATIONS

Screening Programs: The results accentuate the importance of regular diabetes screening and eye examinations, given the 9.99% prevalence rate.

Healthcare Interventions: Targeted efforts to enhance glycemic control among the 73.01% with uncontrolled diabetes could diminish the progression of retinopathy.

Further Research: Prospective studies might consider exploring the underlying causes and risk factors influencing the distribution of glycemic control and retinopathy severity.



The insights from this study furnish vital statistics for healthcare policymakers, clinicians, and researchers in devising strategies and interventions tailored to this population's specific needs and risks.

Education, Weight, Height, and Location

A vast majority of patients (80.95%) had no formal education. Higher education was pursued by 14.28% of the patients, with a graduate degree reported by 7.93% of patients. Very few patients reported having completed primary (0%), middle (3.17%), or secondary education (1.78%).

In terms of geographical distribution, a higher proportion of patients resided in rural areas (65.07%) compared to urban areas (38.09%).

Body weight and height of patients were reported as average values within a given range, with most patients falling in the 71-80% range (38.09%) and the lowest in the 40-50% range (1.58%).

Other Ocular Observations

The Cup Disc ratio (CD), a crucial clinical parameter for the diagnosis of optic nerve diseases such as glaucoma, was reported in 4.76% of the patients studied. This percentage can be interpreted as a proportion of the population under study exhibiting a clinically significant CD ratio. Therefore, it might suggest that a potentially large group of patients could be at risk of developing optic nerve-related disorders.

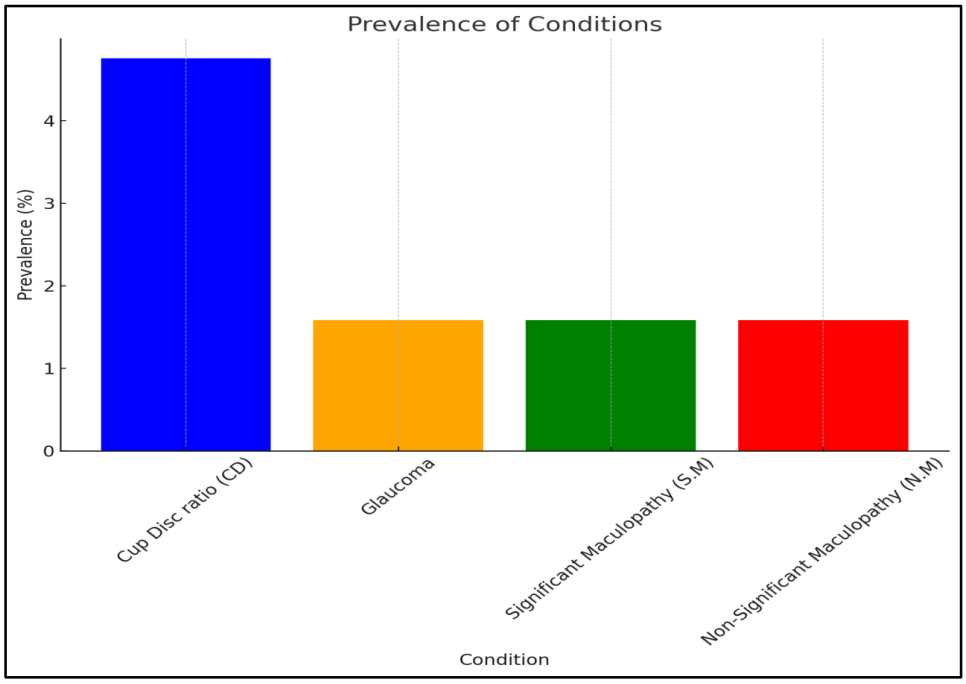
In addition, a prevalence of 1.58% was reported for glaucoma amongst patients. This indicates that within the studied population, approximately 1.58 out of every 100 patients were diagnosed with glaucoma. This is of notable concern given the irreversible damage this disease can cause to the optic nerve, potentially leading to loss of vision if not timely managed.

The study also recorded the presence of both significant (S.M) and non-significant (N.M) maculopathy in 1.58% of patients each. These are conditions affecting the macula, the part of the retina responsible for central vision, and may lead to a significant decline in vision quality.

While both significant and non-significant maculopathy were found in equal proportions (1.58% each), it's important to note that the potential impacts on patients' vision can be quite distinct. Patients with significant maculopathy are likely to experience more profound vision impairments as compared to those with non-significant maculopathy.

Below is a summary of the reported prevalence for each of the conditions in tabular form.

Condition	Prevalence (%)
Cup Disc ratio (CD)	4.76
Glaucoma	1.58
Significant Maculopathy (S.M)	1.58
Non-Significant Maculopathy (N.M)	1.58



5. DISCUSSION

Our findings reveal critical insights into the prevalence of diabetes and associated ocular conditions in the patient cohort presenting for an eye examination from May-August 2023. With a high prevalence of diabetes at 10% and a concerning percentage of these patients demonstrating uncontrolled glycemia (73.01%), our study underlines the imperative need for effective diabetes management strategies within this population. These outcomes concur with global data, reflecting an escalating trend of diabetes prevalence and the subsequent challenges in its management. Interestingly, our results showed a high incidence of refractive errors, with 84.12% and 19.04% of patients diagnosed with bilateral and unilateral errors, respectively. The considerable

spectacle usage (39.68%) may have been necessitated by these refractive conditions. These results align with global trends, confirming that refractive errors are a significant cause of visual impairment.

Furthermore, we noted a high percentage of patients with undetectable HbA1c levels (8.88%) and a lack of patients in the optimal HbA1c range (4-6%). These findings could suggest a possible underdiagnosis or over-control of diabetes within our patient population and highlight the necessity of regular and accurate screening to ensure effective glycemic control.Screen time and its association with ocular health is a much-debated topic in recent years. Our study showed a significant proportion of patients with zero hours of screen usage (39.88%), while others varied in their screen usage duration. This data provides a foundation to explore further correlations between screen usage and ocular conditions. An intriguing aspect of our study was the varied family history of diabetes. Despite the well-known genetic component of diabetes, a substantial number of patients (44.44%) reported no family history of the condition. This suggests a possible role of lifestyle and environmental factors in the disease's manifestation and indicates the need for comprehensive research encompassing both genetic and non-genetic factors.

In terms of ocular conditions, our study highlighted a 1.58% prevalence of glaucoma and a 4.76% frequency of clinically significant Cup Disc ratios. Both findings underline the significance of routine eye examinations for early detection and management of ocular conditions, especially in the diabetic population.

Moreover, our study documented the presence of both significant and non-significant maculopathy in 1.58% of patients each. While these percentages may seem low, they reflect a significant burden considering the detrimental impact of macular diseases on central vision, and therefore, quality of life.

Overall, our study sheds light on the multifaceted challenges encountered in the detection, diagnosis, and management of diabetes and associated ocular conditions in a diverse patient population. It emphasizes the need for regular screening, early diagnosis, comprehensive management strategies, and patient education to effectively control diabetes and prevent subsequent complications. Future research should focus on identifying risk factors, improving early detection, and developing personalized management strategies to reduce the diabetes burden and improve patient outcomes.

Future studies might also aim to validate these results in larger and more diverse populations to ensure their generalizability. As with any research, our study has limitations. The single-center, retrospective nature of our study could limit the generalizability of our findings to a broader population. Further prospective, multi-center studies are necessary to confirm these findings and derive robust conclusions.

6. CONCLUSION

Our observational study revealed alarming patterns in the prevalence and management of diabetes in the investigated patient population. A 10% prevalence rate of diabetes was identified, underscoring the significant public health challenge that diabetes poses. The fact that over 73% of these diabetic patients had uncontrolled glycemia highlights the urgent need for more effective management strategies and improved access to quality diabetes care.

This high percentage of uncontrolled diabetes is particularly concerning given the potential health complications associated with poor glycemic control.

We noted that none of the patients fell within the optimal HbA1c range of 4-6%, a level typically linked with lower risks of complications, pointing towards a critical gap in diabetes management. This underlines the necessity for targeted interventions aimed at encouraging and enabling optimal glycemic control.

Further, our analysis indicated that a significant proportion of patients were not following optimal health habits, as evidenced by the extensive use of spectacles and refractive errors, and the varying degrees of screen usage.

These findings demonstrate the importance of promoting a healthier lifestyle among patients, including regular eye examinations and appropriate screen time.

Age, gender, family history, and hypertension were identified as potential factors contributing to the risk of developing diabetes, reinforcing the importance of considering these factors in future preventative strategies.

Furthermore, the distribution of patients across rural and urban areas emphasizes the need for tailored approaches to healthcare that consider geographical differences in access, lifestyle, and culture.

Our study also highlights other ocular conditions, like glaucoma and maculopathy, that can coexist or result from chronic conditions like diabetes. The presence of significant and non-significant maculopathy, although equal in proportion, should not be underestimated. Both conditions, particularly significant maculopathy, can considerably impact a patient's quality of life.

In-depth examination of diabetes medication strategies underscores the need to explore diverse treatment avenues and consult medical experts. Though oral medications and insulin are cornerstone therapies, integrating alternative treatments like herbal, homeopathic, and Ayurvedic methods into an individualized diabetes care plan can be beneficial.

This tailored approach can pave the way for better diabetes management, promoting holistic health and wellness.

The findings of this study should serve as a wake-up call for public health authorities, healthcare providers, and the community. There is an undeniable need to fortify efforts towards the prevention, early detection, and comprehensive management of diabetes. This requires a collective response that includes education, awareness programs, lifestyle interventions, and targeted healthcare services.

Additionally, given the high prevalence of refractive errors, spectacle usage, and the impact of screen time, it is essential to implement strategies to minimize these risk factors, such as education on eye care and regular vision checks.

Our study is an urgent call to action. By improving our understanding of the challenges faced by this patient population, we are better equipped to develop effective strategies to prevent and manage diabetes and its associated complications. The time to act is now; the health of our community depends on it.

Refrences

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