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Association of Sociodemographic Factors with Health Protocol Compliance and Metabolic Profile Among Patients with Diabetic Retinopathy

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ABSTRACT

Diabetic retinopathy is a major microvascular complication of diabetes mellitus and is closely related to metabolic disturbances and sociodemographic factors. This study aimed to analyze the association between sociodemographic characteristics, health protocol compliance, and metabolic profile parameters among patients with diabetic retinopathy. An analytical observational study with a cross-sectional design was conducted among 45 diabetic retinopathy patients at two hospitals in Samarinda, Indonesia, during November 2020. Sociodemographic data, serological status, mask types, health protocol compliance scores, and metabolic profile parameters were collected. Female participants slightly predominated (53.3%), and most participants were aged <60 years (71.1%). Educational level was significantly associated with health protocol compliance score ($p = 0.008$), with higher educational attainment related to better health protocol compliance. Age was significantly associated with HbA1c ($p = 0.006$), FBG ($p = 0.008$), and 2hPPBG ($p = 0.045$). Occupation was significantly associated with TC/HDL ($p = 0.008$) and LDL/HDL ratios ($p = 0.019$), while gender was associated with the TC/HDL ratio ($p = 0.048$). No significant associations were identified between serological status or mask types and metabolic profile parameters. These findings suggest that sociodemographic characteristics, particularly educational level, age, and occupation, may be associated with differences in health behavior and metabolic profiles among patients with diabetic retinopathy.

Keywords
Diabetic Retinopathy
Health Protocol Compliance
Metabolic Profile
Sociodemographic Factors

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Introduction

Diabetes mellitus (DM) remains one of the most significant global public health challenges, with rapidly increasing prevalence and substantial long-term complications. A recent global analysis reported that approximately 12% of adults worldwide were living with diabetes, while a considerable proportion remained undiagnosed. The prevalence of diabetes continues to rise, particularly in low- and middle-income countries, contributing to increased morbidity, mortality, and healthcare burden [1], [2].

Diabetic retinopathy (DR) is one of the most common microvascular complications of diabetes and represents a leading cause of visual impairment and blindness among working-age adults worldwide. Recent global estimates demonstrated a continuous increase in the number of individuals experiencing vision impairment due to DR between 2000 and 2020 [1], [3]. In addition, a systematic review conducted in 2024 reported a high prevalence of DR among patients with diabetes and emphasized the growing epidemiological burden of DR globally [4].

Poor glycemic control remains one of the major risk factors associated with the development and progression of DR. Hemoglobin A1c (HbA1c), fasting blood glucose (FBG), and 2-hour postprandial blood glucose (2hPPBG) are commonly used indicators to evaluate metabolic control in diabetic patients. Several recent studies have demonstrated that elevated HbA1c levels are significantly associated with increased severity of DR [5], [6]. Furthermore, lipid abnormalities, including elevated low-density lipoprotein (LDL), triglycerides (TG), and atherogenic lipid ratios such as TG/HDL and LDL/HDL ratios, have also been implicated in retinal vascular damage and worsening diabetic complications [7], [8].

In addition to metabolic factors, sociodemographic characteristics may be associated with differences in health-related behaviors and clinical outcomes among patients with diabetes. Age, gender, educational level, and occupation have been reported to affect diabetes management, health literacy, treatment adherence, and healthcare utilization. Higher educational attainment has been associated with better adherence to DR screening and preventive health behaviors [9]. Similarly, occupational and socioeconomic factors may contribute to differences in lifestyle, physical activity, dietary patterns, and metabolic profiles among patients with chronic diseases [9], [10].

During the COVID-19 pandemic, adherence to health protocols such as mask use, hand hygiene, and physical distancing became particularly important among patients with chronic

diseases, including DM, due to their increased vulnerability to severe infection outcomes. However, health protocol compliance may vary according to sociodemographic and clinical characteristics. Patients with better educational backgrounds and health literacy may demonstrate higher health protocol compliance with preventive measures [11]–[13]. Nevertheless, limited studies have explored the relationship between sociodemographic factors, metabolic profile, and health protocol compliance specifically among patients with DR.

Because this study was conducted during the COVID-19 pandemic, COVID-19-related variables were also considered as contextual factors reflecting the health and healthcare environment in which patients with DR managed their disease. Serological status and mask type were not considered direct determinants of DR or metabolic control. Rather, these variables were included to describe pandemic-related circumstances and to explore whether indicators of COVID-19 exposure or preventive behavior were associated with health protocol compliance or metabolic profile. This contextual approach was intended to provide a more complete description of the behavioral and metabolic characteristics of patients with DR during the pandemic, while recognizing that the primary focus of the study remained the relationship between sociodemographic characteristics, health protocol compliance, and metabolic parameters.

Considering the increasing burden of DR and the importance of both metabolic control and preventive health behaviors, this study aimed to analyze the association of sociodemographic factors with health protocol compliance and metabolic profile among patients with DR. Understanding these associations may provide useful information for informing targeted educational and preventive strategies aimed at supporting health behaviors and metabolic outcomes among patients with DR.

Material and Methods

This study employed an analytical observational design with a cross-sectional approach. The study was conducted at two hospitals in Samarinda, Indonesia, namely SMEC Eye Hospital Samarinda and Siaga Al-Munawwarah Hospital. Data collection was carried out in November 2020. The study population consisted of patients diagnosed with DR who visited the ophthalmology outpatient clinics during the study period. Total sampling was applied by including all eligible patients who attended the clinics in November 2020. Patients with incomplete clinical or laboratory data were excluded from the analysis.

Sociodemographic variables collected included gender, age, educational level, and occupation. Educational level was categorized into low (no formal education-junior high school), medium (senior high school), and high (diploma-doctoral degree). Occupation was classified as unemployed, informal occupation, or formal occupation. Clinical and laboratory

data included FBG, 2hPPBG, total cholesterol (TC), high-density lipoprotein (HDL), LDL, TG, urea (Ur), creatinine (Cr), and HbA1c. Lipid ratios, including the LDL/HDL ratio, TG/HDL ratio, and total cholesterol/HDL ratio, were also calculated. In addition, the urea-to-creatinine ratio was analyzed.

COVID-19 transmission-related characteristics and health protocol compliance was assessed using a structured questionnaire adapted from guidelines issued by the Ministry of Health of the Republic of Indonesia and the World Health Organization (WHO) [14]–[17]. The questionnaire consisted of 14 items divided into two domains: COVID-19 transmission-related characteristics (items 1–5) and health protocol compliance (items 6–14). The transmission-related domain assessed symptoms, history of close contact with COVID-19 patients, previous rapid or swab testing, and history of confirmed COVID-19. The health protocol compliance domain assessed mask use, appropriate mask use, physical distancing, disinfection of frequently touched objects, hand hygiene, carrying hand sanitizer, avoiding touching the face, increased handwashing frequency, and implementation of the six-step handwashing technique. The nine health protocol compliance items were scored using three response options: “always”, “sometimes”, and “never”. The total health protocol compliance score ranged from 9 to 27, with higher scores indicating better health protocol compliance.

COVID-19 serological status was assessed using IgM and IgG antibody results and categorized as seropositive or seronegative. Types of masks used by participants were additionally categorized into non-medical masks, medical-based masks, and combined mask use. Data analysis was performed using IBM SPSS Statistics Version 25. Descriptive analysis was used to summarize participant characteristics and study variables. Numerical variables were presented as mean $\pm$ standard deviation (SD), while categorical variables were presented as frequencies and percentages.

COVID-19 serological status and mask type were included as contextual pandemic-related variables because the study was conducted during the COVID-19 pandemic. Serological status was used to describe evidence of previous or recent exposure based on the available IgM/IgG testing, while mask type was used as an indicator of preventive health behavior. These variables were exploratory and were not considered primary determinants of DR or metabolic control. Their inclusion was intended to assess whether pandemic-related exposure and preventive behavior were associated with health protocol compliance or metabolic profile during the study period.

Normality testing was performed using the Shapiro-Wilk test. Variables with normal distribution were analyzed using the independent t-test for comparisons between two groups and one-way ANOVA for comparisons involving more than two groups. Variables that were not normally distributed were analyzed using non-parametric statistical tests. The Mann-Whitney

U test was used to compare two independent groups, while the Kruskal-Wallis test was used for comparisons involving more than two groups. Given the number of statistical comparisons, analyses of associations between sociodemographic factors and metabolic parameters were considered exploratory. A p-value of <0.05 was considered statistically significant. This study was approved by the Health Research Ethics Committee of the Faculty of Medicine, Mulawarman University under Ethical Clearance Number 69/KEPK-FK/V/2020. All data were collected and analyzed confidentially in accordance with research ethics principles.

Results and Discussions

Table 1 presents the baseline characteristics of patients with DR included in this study. Female participants slightly predominated, accounting for 53.3% of the study population, while males represented 46.7%. Most participants were younger than 60 years old (71.1%), indicating that DR was more frequently observed among middle-aged adults in this population. Regarding educational attainment, participants with low and high education levels each accounted for 40.0% of the sample, whereas only 20.0% had a medium educational level. More than half of the participants were unemployed (51.1%), while 35.6% had formal occupations and 13.3% worked in informal sectors.

Most participants were seronegative for COVID-19 antibodies (86.7%), with only 13.3% categorized as seropositive. Non-medical masks were the most commonly used type of mask (60.0%), followed by combined mask use (22.2%) and medical-grade masks (17.8%). The mean health protocol compliance score was 21.0±2.6, indicating generally good compliance with health protocols among participants.

Table 1. Sociodemographic characteristics, serological status, mask types, and health protocol compliance score of patients with DR (n = 45).

Variables	Characteristics	Number	Percentage (%)	Cumulative Percentage (%)
Gender	Male	21	46.7	46.7
	Female	24	53.3	100.0
Age (years)	<60	32	71.1	71.1
	≥60	13	28.9	100.0
Education Level	Low	18	40.0	40.0
	Medium	9	20.0	60.0
	High	18	40.0	100.0
Occupation	Unemployed	23	51.1	51.1
	Informal Occupation	6	13.3	64.4
	Formal Occupation	16	35.6	100.0
Serological Status	Seropositive	6	13.3	13.3
	Seronegative	39	86.7	100.0
Types of Masks	Non-Medical Mask	27	60.0	60.0
	Medical-Based Mask	8	17.8	77.8
	Combined Mask	10	22.2	100.0
Health Protocol Compliance Score			21.0±2.6	

The metabolic characteristics of the study participants are presented in Table 2. The mean TC level was 227.0±65.3 mg/dL, while the mean LDL level was 150.4±63.8 mg/dL, indicating relatively elevated lipid levels among participants. The mean HDL level was 43.3±12.2 mg/dL and the mean TG level was 138.3±63.3 mg/dL. Lipid ratio analysis showed mean TC/HDL, LDL/HDL, and TG/HDL ratios of 5.6±2.2, 3.8±2.0, and 3.6±2.2, respectively. These findings suggest the presence of unfavorable lipid profiles that may contribute to vascular complications in DR patients.

Renal function parameters demonstrated a mean Ur level of 31.2±15.2 mg/dL and Cr level of 1.1±0.6 mg/dL, with a mean Ur/Cr ratio of 32.2±13.7. In addition, glycemic control parameters showed elevated mean HbA1c, FBG, and 2hPPBG levels at 8.4±2.8%, 148.2±62.9 mg/dL, and 200.6±88.4 mg/dL, respectively, indicating suboptimal metabolic control among the study participants.

Table 2. Metabolic profile of patients with DR (n = 45).

Metabolic Profile	Mean	SD
TC	227.0	65.3
HDL	43.3	12.2
LDL	150.4	63.8
TG	138.3	63.3
TC/HDL	5.6	2.2
LDL/HDL	3.8	2.0
TG/HDL	3.6	2.2
Ur	31.2	15.2
Cr	1.1	0.6
Ur/Cr	32.2	13.7
HbA1c	8.4	2.8
FBG	148.2	62.9
2hPPBG	200.6	88.4

After that, Table 3 presents the association between participant characteristics and health protocol compliance scores among patients with DR. Female and male participants demonstrated nearly identical mean health protocol compliance scores (21.04 ± 2.49 vs 21.05±2.73), with no statistically significant difference observed (p = 0.994). Similarly, no significant association was found between age group and health protocol compliance score, although participants aged <60 years showed slightly higher health protocol compliance scores compared with those aged ≥60 years (21.34±2.61 vs 20.31±2.43; p = 0.225).

Educational level demonstrated a statistically significant association with health protocol compliance score (p = 0.008). Participants with higher educational attainment had progressively higher mean health protocol compliance scores, with the highest score observed among participants with high education levels (22.22 ± 2.73), followed by medium (21.44±2.60) and low education groups (19.67±1.71). This finding suggests that educational background was associated with differences in improving adherence to health protocols.

Although occupation was not significantly associated with health protocol compliance score (p = 0.068), participants with formal occupations tended to have higher health protocol compliance scores compared with unemployed and informal workers. In addition, no statistically significant associations were identified between serological status or types of masks used and health protocol compliance scores (p > 0.05). Nevertheless, participants using medical-based masks demonstrated slightly higher mean health protocol compliance scores than those using non-medical or combined masks.

Table 3. Association between sociodemographic characteristics and health protocol compliance among patients with DR.

Variables	Categories	Mean	SD	Statistical Test	df	P Value
Gender	Male	21.05	2.73	Independent T-Test	43	.994
	Female	21.04	2.49			
Age	<60	21.34	2.61	Independent T-Test	43	.225
	≥60	20.31	2.43			
Education Level	Low	19.67	1.71	One-Way ANOVA	2	.008
	Medium	21.44	2.60			
	High	22.22	2.73			
Occupation	Unemployed	20.57	2.39	One-Way ANOVA	2	.068
	Informal Occupation	19.83	1.33			
	Formal Occupation	22.19	2.86			
Serological Status	Seropositive	20.67	2.66	Mann-Whitney	-	.449
	Seronegative	21.10	2.59			
Types of Masks	Non-Medical Mask	20.70	2.46	Kruskal-Wallis	2	.286
	Medical-Based Mask	22.13	3.00			
	Combined Mask	21.10	2.56			

In addition, this study also identified associations between sociodemographic characteristics and metabolic profile parameters among patients with DR, as presented in Table 4. Gender demonstrated a statistically significant association with the TC/HDL ratio (p = 0.048), while no significant associations were observed between gender and other metabolic parameters. Age was significantly associated with glycemic control parameters, including HbA1c (p = 0.006), FBG (p = 0.008) and 2hPPBG (p = 0.045). These findings suggest that age may be associated with differences in glucose metabolism and glycemic control among patients with DR.

Occupation also demonstrated significant associations with lipid profile indicators, specifically the TC/HDL ratio (p = 0.008) and LDL/HDL ratio (p = 0.019). Participants with different occupational backgrounds may have varying lifestyle patterns, physical activity levels, and dietary behaviors that could affect lipid metabolism. In contrast, educational level, serological status, and types of masks used were not significantly associated with metabolic profile parameters (p > 0.05). Overall, the findings indicate that certain sociodemographic factors, particularly age and occupation, may contribute to differences in metabolic characteristics among patients with DR.

The present study demonstrated that educational level was significantly associated with health protocol compliance among patients with DR. Participants with higher educational attainment showed progressively better health protocol compliance scores compared with those with lower educational backgrounds. This finding suggests that differences in educational attainment may be associated with variations in health literacy, awareness, and preventive health behaviors, particularly during the COVID-19 pandemic. Individuals with higher educational levels are generally more capable of understanding public health recommendations, accessing reliable health information, and adopting appropriate preventive measures consistently. Recent studies have similarly reported that health literacy and patient education are strongly associated with better adherence to diabetes-related screening and preventive healthcare behaviors [18], [19].

Although age was not significantly associated with health protocol compliance scores in this study, younger participants tended to demonstrate slightly better adherence to health protocols compared with older participants. This trend may reflect differences in access to information, adaptability to behavioral changes, and digital literacy. Elderly patients with chronic diseases often face greater barriers in obtaining healthcare information and implementing preventive recommendations consistently [20], [21]. Nevertheless, the lack of statistical significance may partly reflect the relatively small sample size of this study, which may have limited the statistical power to detect associations.

Although health protocol compliance scores differed across occupational groups, the observed association did not reach statistical significance. Participants with formal occupations demonstrated higher health protocol compliance scores than unemployed and informal workers. Formal working environments may encourage stricter implementation of health regulations and increase exposure to workplace health education programs. Occupational status has previously been linked to disparities in healthcare utilization, lifestyle behaviors, and preventive practices among individuals with chronic diseases [22], [23].

An important consideration in interpreting these findings is the conceptual relationship between COVID-19 health protocol compliance and metabolic profiles. In the present study, these two domains were examined as separate outcomes rather than assuming a direct causal pathway from health protocol compliance to metabolic regulation. The findings suggest that sociodemographic characteristics may contribute to both behavioral and metabolic differences among patients with DR.

Table 4. Association between sociodemographic characteristics and metabolic profile among patients DR

Variables	Categories	TC/HDL	LDL/HDL	TG/HDL	Ur/Cr	HbA1c	FBG	2hPPBG	Statistical Test	P Value
Gender	Male	6.03±2.13	4.08±1.85	4.18±2.61	30.05±16.75	8.45± 3.13	149.29±74.20	199.57±88.20	Mann-Whitney U	.048 / .088 / .101 / .099 / .794 / .707 / .927
	Female	5.27±2.30	3.47±2.18	3.01±1.72	34.03±10.45	8.43±2.56	147.17±52.71	201.46±90.52		
Age	<60 years	5.77±2.28	3.88±2.14	3.47±2.00	33.61±15.35	9.14±2.91	163.59±65.43	217.34±87.07	Mann-Whitney U	.548 / .793 / .689 / .210 / **.006** / **.008** / **.045**
	≥60 years	5.28±2.16	3.45±1.77	3.76±2.80	28.63±8.01	6.71±1.57	110.15±35.13	159.31±80.54		
Education Level	Low	4.97±1.69	3.27±1.45	2.85±1.52	32.70±16.93	8.63±2.47	148.83±59.54	203.72±85.81	Kruskal-Wallis	.325 / .380 / .234 / .830 / .718 / .992 / .825
	Medium	6.28±2.19	4.34±1.97	4.35±2.35	33.24±10.23	8.00±2.47	145.78±44.05	213.00±89.93		
	High	5.95±2.64	3.94±2.50	3.86±2.66	31.11±12.27	8.47±3.36	148.67±75.96	191.22±94.24		
Occupation	Unemployed	4.80±1.54	3.02±1.21	3.16±2.19	30.11±9.10	7.70±2.14	134.39±52.05	186.91±91.08	One-way ANOVA / Kruskal-Wallis	**.008** / **.019** / .079 / .072 / .069 / .234 / .515
	Informal Occupation	5.25±1.68	3.67±1.47	2.93±1.78	44.02±23.92	7.85±1.48	130.50±24.67	199.67±58.20		
	Formal Occupation	6.95±2.68	4.84±2.67	4.37±2.33	30.68±13.28	9.73±3.59	174.56±79.12	220.56±94.47		
Serological Status	Seropositive	4.96±1.95	3.29±1.80	3.33±1.26	30.80±11.83	8.28±1.95	126.67±50.75	176.50±101.70	Mann-Whitney U	.423 / .559 / .764 / .652 / .764 / .413 / .480
	Seronegative	5.73±2.28	3.83±2.08	3.59±2.36	32.38±14.13	8.46±2.94	151.46±64.45	204.28±87.10		
Types of Masks	Non-Medical Mask	5.43±1.78	3.52±1.47	3.70±2.33	31.64±14.95	8.26±2.51	140.85±60.32	198.96±91.83	One-way ANOVA / Kruskal-Wallis	.163 / .260 / .406 / .753 / .732 / .353 / .989
	Medical-Based Mask	4.87±1.45	3.37±1.24	2.55±1.38	32.43±15.12	9.16±3.84	177.38±81.93	202.38±81.16		
	Combined Mask	6.75±3.40	4.69±3.38	3.96±2.47	33.39±9.83	8.34±2.87	144.50±51.57	203.50±93.37		

Educational level was significantly associated with health protocol compliance, whereas age, occupation, and gender were associated with selected metabolic parameters. Thus, the observed associations may reflect differences in health-related behaviors and metabolic conditions across sociodemographic groups. Because of the cross-sectional design and the absence of a direct analysis between health protocol compliance scores and metabolic parameters, this study cannot determine whether better health protocol compliance is associated with improved metabolic control. Further studies using longitudinal designs and multivariable analyses are needed to clarify whether health-related behaviors during infectious disease outbreaks have an independent relationship with metabolic regulation in patients with DR.

In addition to behavioral outcomes, this study identified several significant associations between sociodemographic characteristics and metabolic profile parameters. Age was significantly associated with HbA1c, FBG, and 2hPPBG, indicating that glycemic control may worsen with increasing age. Aging is commonly associated with decreased insulin sensitivity, progressive pancreatic β-cell dysfunction, and longer duration of diabetes, all of which contribute to impaired glucose regulation [24]. Persistent hyperglycemia has been widely recognized as a major contributor to the development and progression of DR through mechanisms involving oxidative stress, chronic inflammation, and retinal microvascular damage [25], [26].

The present study also demonstrated significant associations between occupation and lipid profile indicators, specifically TC/HDL and LDL/HDL ratios. The observed differences in lipid profiles across occupational groups may reflect variations in dietary patterns, stress exposure, socioeconomic circumstances, and physical activity levels, although these factors were not directly assessed in the present study. Dyslipidemia is considered an important risk factor in DR progression because abnormal lipid accumulation contributes to endothelial dysfunction and retinal vascular injury [27]. Elevated atherogenic lipid ratios, particularly TC/HDL and LDL/HDL, have been associated with increased cardiovascular and microvascular complications among diabetic patients [7], [28].

Gender was significantly associated with the TC/HDL ratio, although no significant associations were observed with other metabolic parameters. Biological differences in fat distribution, hormonal regulation, and lifestyle-related factors between males and females may partially explain these findings [29]–[31]. However, given that this was the only significant association observed for gender, further studies with larger sample sizes are needed to determine whether these findings are consistent across different populations of patients with DR.

Interestingly, serological status and types of masks used were not significantly associated with either health protocol compliance scores or metabolic profile parameters. Interestingly, serological status and types of masks were not significantly associated with either health protocol compliance scores or metabolic profile parameters. These findings suggest that, within this study population, COVID-19-related characteristics measured by serological status and mask type were not significantly associated with the metabolic parameters examined. However, these variables should be interpreted separately from the broader concept of health protocol compliance, as mask type and serological status do not fully capture the range of preventive behaviors or their potential relationship with metabolic regulation [11], [13]. Furthermore, the high overall health protocol compliance score observed among participants may have reduced variability between groups.

Conclusion

This study demonstrated that educational level was significantly associated with health protocol compliance among patients with DR, while age, occupation, and gender were associated with selected metabolic profile parameters. Age was associated with HbA1c, FBG, and 2hPPBG, while occupation was associated with TC/HDL and LDL/HDL ratios, and gender with the TC/HDL ratio.

Health protocol compliance and metabolic profiles represent distinct but potentially interconnected aspects of health. In this study, both were evaluated as separate outcomes, and no direct causal or associative relationship between health protocol compliance and metabolic control was established. The findings suggest that sociodemographic characteristics may be associated with these domains in different ways. These findings support the importance of targeted education and routine metabolic monitoring in patients with DR. Further longitudinal studies with larger samples are needed to clarify the potential relationship between health-related behaviors, metabolic control, and DR outcomes.

Limitation and Suggestions

This study has several limitations that should be considered. First, the cross-sectional design limits the ability to establish causal relationships between sociodemographic characteristics, health protocol compliance, and metabolic profile parameters. Second, the relatively small sample size and the use of total sampling from two hospitals may limit the generalizability of the findings to broader populations. Third, health protocol compliance assessment was based on self-reported data, which may be subject to recall bias and response bias. Fourth, the relatively small sample size (n = 45) precluded multivariable analysis to adequately control for potential confounding among sociodemographic characteristics. Although age, gender, education, and occupation may be interrelated, including multiple

predictors in regression models with this sample size could result in unstable estimates and overfitting. Consequently, the associations identified in this study are based on unadjusted analyses and should be interpreted cautiously as exploratory findings. Fifth, multiple statistical comparisons were performed to examine the associations between several sociodemographic factors and multiple outcomes, particularly in Tables 3 and 4, without adjustment for multiple testing, such as the Bonferroni correction. Therefore, the possibility of inflated Type I error and chance findings cannot be excluded, particularly given the relatively small sample size. The statistically significant findings should consequently be interpreted with caution and considered exploratory.

Despite these limitations, the study provides important preliminary data regarding behavioral and metabolic characteristics among patients with DR during the COVID-19 pandemic. Future studies are encouraged to involve larger multicenter populations, longitudinal follow-up, and additional variables such as duration of diabetes, severity of DR, socioeconomic status, and lifestyle-related factors to obtain a more comprehensive understanding of the determinants affecting DR outcomes. Larger studies should also incorporate appropriately powered multivariable analyses to account for potential confounding among sociodemographic characteristics and consider appropriate adjustment for multiple comparisons to reduce the risk of Type I error.

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Conflict of Interest

The authors declare no conflict of interest.

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