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Longitudinal Trends and Disparities in Diabetic Retinopathy Within an Aggregate Health Care Network

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IMPORTANCE Diabetic retinopathy (DR) is a leading cause of blindness in the US, warranting updates on its prevalence and incidence in the setting of advancements in diabetic care over recent years.

OBJECTIVE To determine recent trends in DR prevalence stratified by baseline demographics to identify those populations at greater risk.

DESIGN, SETTING, AND PARTICIPANTS This was a cross-sectional epidemiologic evaluation conducted using deidentified data from the large federated TriNetX Analytics health research network composed of 56 health care organizations in the US. Patients from 2015 to 2022 who had an *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* code of type 1 DR (T1DR) or type 2 DR (T2DR) were included in this analysis. Patients were further stratified by age cohorts (20-29 years, 30-39 years, 40-49 years, 50-59 years, 60-69 years, and 70 years or older), race and ethnicity, and sex.

MAIN OUTCOMES AND MEASURES Prevalence per 100 000 patients and prevalence odds ratios (ORs) were calculated in Microsoft Excel and Posit (formerly RStudio).

RESULTS A total of 359 126 patients with T1DR or T2DR (mean [SD] age, 67 [14] years; 52% female) were included in this study between January 1, 2015, and December 21, 2022. T1DR increased in prevalence from 2015 to 2022, with T1DR increasing 1.15-fold affecting 70.4 patients per 100 000 in 2022. T2DR increased 1.07-fold affecting 461.7 patients per 100 000 in 2022. For T1DR, the cohort aged 20 to 39 years had the most substantial increase at 4.7 and 1.96 fold. Overall, White males had the largest prevalence ORs of T1DR at 1.41 (95% CI, 1.36-1.47) compared with White females (reference group). In T2DR, patients aged 20 to 39 years again had a 2.5- and 1.6-fold prevalence increase from 2015 to 2022. Regardless of age group, Hispanic males demonstrated larger prevalence OR at 4.08 (95% CI, 3.97-4.19) compared with White females followed by Hispanic females at 2.49 (95% CI, 2.42-2.56), Black males at 2.23 (95% CI, 2.17-2.29), and Black females at 2.00 (95% CI, 1.95-2.05).

CONCLUSION AND RELEVANCE The prevalence of both T1DR and T2DR increased in this network from 2015 to 2022, with individuals aged 20 to 39 years showing large increases. Additionally, T2DR was associated with greater increases in both Hispanic and Black communities. These findings support DR screening in young adults and for T2DR interventions specifically designed for racial and ethnic minoritized patients most affected by disease. Future investigations are warranted to further investigate these trends among young adults.

Invited Commentary
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Supplemental content

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Diabetic retinopathy (DR), a retinal vascular disorder that arises as a complication of diabetes (DM), is a leading cause of blindness in the US. DR is characterized by signs of retinal ischemia, such as microaneurysms, hemorrhages, and neovascularization, or signs of increased vascular permeability. The presence of retinopathy suggests diabetes-related microcirculatory dysfunction in other organ systems, making DR a crucial indicator of systemic diabetes impact.[1] DR is most commonly observed in individuals with longstanding DM, as evidenced by its higher prevalence in patients with type 1 DM (T1DM) compared with patients with type 2 DM (T2DM).[2-4] Consequently, effective management of serum glucose level, along with early detection and timely treatment, on average, can substantially reduce the risk of vision loss secondary to DR.[5]

Diabetes and its associated complications pose a pervasive health care and public health challenge in the US, displaying a disproportionately higher association with racial and ethnic minoritized populations.[6] Globally, the prevalence of diabetes, especially T2DM, is on the rise and expected to affect nearly 600 million people by the year 2035.[7] According to estimates by the American Diabetes Association, the total economic burden of diabetes amounts to $327 billion, including $237 billion in direct medical expenses. Notably, approximately 30% of this financial burden is attributed to prescription medications required to treat diabetes complications.[8] Significant pharmaceutical innovation has occurred in response to this rise, with the majority of glucagonlike peptide 1 (GLP-1) receptor agonists approved since 2014.[9]

Substantial socioeconomic risk factors and racial disparities have been associated with the development and progression of DR. The disparities in DR prevalence are likely linked to delayed diagnosis, limited access to care, and comorbidities such as hypertension.[5] In the Salisbury Eye Evaluation, 17% of vision loss in Black patients was attributed to DR, compared with 8% in non-Hispanic White patients. Multiple studies report a significantly higher prevalence of severe vision-threatening DR in Hispanic or Latino patients compared with non-Hispanic White patients.[5,9-11] Given the projected increase in the minoritized population, the burden of treatment for Black and Hispanic patients will likely increase, but the magnitude of growth is currently unknown.[5]

Recent epidemiology studies evaluating DR and associated sex and racial and ethnicity trends in the US include the most recent National Health and Nutrition Examination Survey evaluation conducted in 2008.[12] In 2021, the prevalence of DR in the US was estimated using meta-analytic approaches, regardless of diabetes diagnosis, but did not evaluate the trends of DR over multiple years.[13] Another 2022 study examined 10-year trends (2009-2018) in vision-threatening DR among a Medicare fee-for-service population diagnosed and treated in the US, thus evaluating Americans 65 years and older in a generalizable population. They identified an increase in prevalence throughout the study period, along with significant racial disparities in both Black and Hispanic populations.[14] Regardless, the majority of these prevalence evaluations are limited to regional cohorts and do not necessarily encompass the entire US population and age distribution, especially among young adults.[15-18]

Key Points

Question How has the prevalence of diabetic retinopathy (DR) changed from 2015 to 2022 among 93 million patients in the TriNetX platform?

Findings In this cross-sectional study including 359 126 patients within the TriNetX Analytics population, type 1 DR had a 15% increase in prevalence, and type 2 DR had a 7% increase in prevalence. Prevalence increases were greater among those aged 20 to 39 years; among Hispanic males, the prevalence odds ratio of type 2 DR was 4-fold greater, followed by Hispanic females, Black males, and Black females.

Meaning These results suggest substantial increases of DR among those aged 20 to 39 years, with DR disproportionately associated with Hispanic and Black race compared with White race.

Further investigation is needed to determine the growth, as well as the magnitude of age, sex, and racial differences in both type 1 DR (T1DR) and type 2 DR (T2DR) prevalence. Evolutions in diabetic care such as the aforementioned GLP-1 inhibitors, as well as the increasing prevalence of obesity, also may influence the prevalence of DR. Thus, the objective of this study was to evaluate the prevalence of DR in a single health system network, encompassing 56 health care organizations, in the US from 2015 to 2022, while stratifying by age, sex, and race. Furthermore, we aimed to delineate how trends in DR prevalence differ between patients with T1DM and T2DM within this single health system network.

Methods

The US Collaborative Network within the TriNetX Analytics platform is a federated health research network that aggregates deidentified electronic health record data of more than 93 million patients among 56 US health care organizations (HCOs). These HCOs include hospitals, primary care offices, and specialist offices providing data from a variety of settings and include both uninsured and insured patients. These data have been deemed exempt by the Western and MetroHealth institutional review boards by a qualified expert as defined in Section §164.514(b)(1) of the Health Insurance Portability and Accountability Act Privacy Rule. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.

The *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (*ICD-10*) codes of E10 (T1DM) and E11 (T2DM) were used to define DM type status at time of data extraction. Data were collected from February through April of 2023 and in December of 2023. T1DR was defined by *ICD-10* codes E10.31 to E10.35, and T2DR was defined by *ICD-10* codes E11.31 to E11.35 (eTable 1 in Supplement 1). The prevalence of T1DR and T2DR was determined for the years 2015 to 2022 through querying these codes and obtaining counts by age groups, sex (male and female), and race and ethnicity combinations (Black, Hispanic or Latino, and White). A year was defined as a calendar year, eg, January 1

through December 31. The age cohorts of this study were defined as 20 to 29 years, 30 to 39 years, 40 to 49 years, 50 to 59 years, 60 to 69 years, and then 70 years or older. Patients younger than 20 years were not included due to the small numbers present in TriNetX platform. To protect patient identity, TriNetX uses a rounding feature for small patient samples of 10 or less. Therefore, the data present for patients younger than 20 years were too small to provide an accurate count.

TriNetX is comparable to the US census regarding percentages of Black and White individuals, and there is a slightly lower prevalence of Hispanic or Latino individuals.[19] The other minoritized populations included in TriNetX are American Indian or Alaska Native and Asian; however, these populations were not reported in this study as these cohorts are small within the US Census and in the TriNetX platform, which also rounds small data counts causing inaccurate evaluations.

Statistical Analysis

Prevalence was calculated by dividing the number of patients with DR within a group by the total amount of patients in the TriNetX platform within that group (eg, White male patients with T1DR divided by all White male patients in the TriNetX platform). All prevalence data were presented as the number of patients with DR per 100 000. Prevalence odds ratios (ORs) were calculated with 95% CIs, and forest plots of outcomes were developed with White females serving as the reference group.

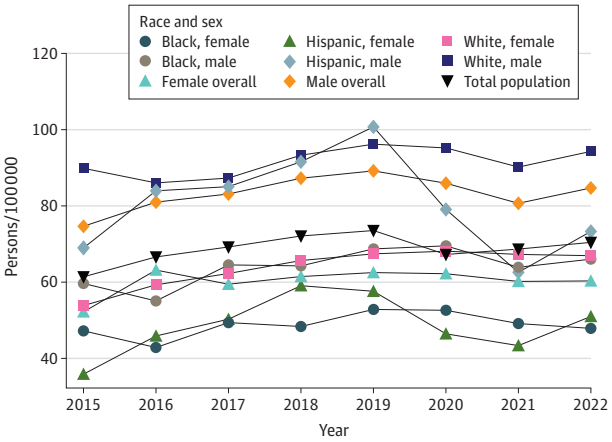
To better understand the generalizability of diabetes data within TriNetX compared with the entire US, diabetes prevalence was calculated and compared with the US Centers for Disease Control and Prevention (CDC) National Diabetes Statistics Report.[20] For this analysis, type of diabetes was not stratified as this was not possible within the National Diabetes Statistics Report. Patients 18 years and older were only included in this analysis as to best emulate this CDC report.[21] All statistics and figures were completed through Microsoft Excel and Posit (formerly RStudio), version 2021.09.0.

Results

Generalizability of TriNetX Diabetes Records

A total of 359 126 patients with T1DR or T2DR (mean [SD] age, 67 [14] years; 52% female; 48% male) were included in this study between January 1, 2015, and December 21, 2022. The TriNetX platform is comparable to the US census with 14 332 371 Black individuals (13%), 9 922 411 Hispanic or Latino individuals (9%), and 59 534 465 White individuals (54%). To evaluate if TriNetX has comparable prevalence and population diversity within its diabetes population, TriNetX prevalence data were calculated within this study period: January 1, 2015, to December 31, 2022 (eTable 2 in Supplement 1). Patients 18 years or older were included, and any patient with a diabetes code (*ICD-10*: E08-E11, E13) were included to have comparable methodology with the National Diabetes Statistics Report.[20,21] Characterization of the entire TriNetX T1DR and T2DR cohorts was provided in eTables 3 and 4 in Supplement 1. Compared with the National Diabetes Statistics Report,[20,21] which observed

Figure 1. Prevalence of Type 1 Diabetic Retinopathy From 2015 to 2022 Stratified by Race and Ethnicity and Sex (per 100 000)



prevalence between 2017 and 2020, the total population of diagnosed diabetes had a prevalence of 10.1%. This was higher than our reported value of 8.67. Overall, the TriNetX White and female prevalence rates were comparable with this CDC report, but the Black, Hispanic, and male results had approximately a 2% decrease in prevalence compared with the CDC.

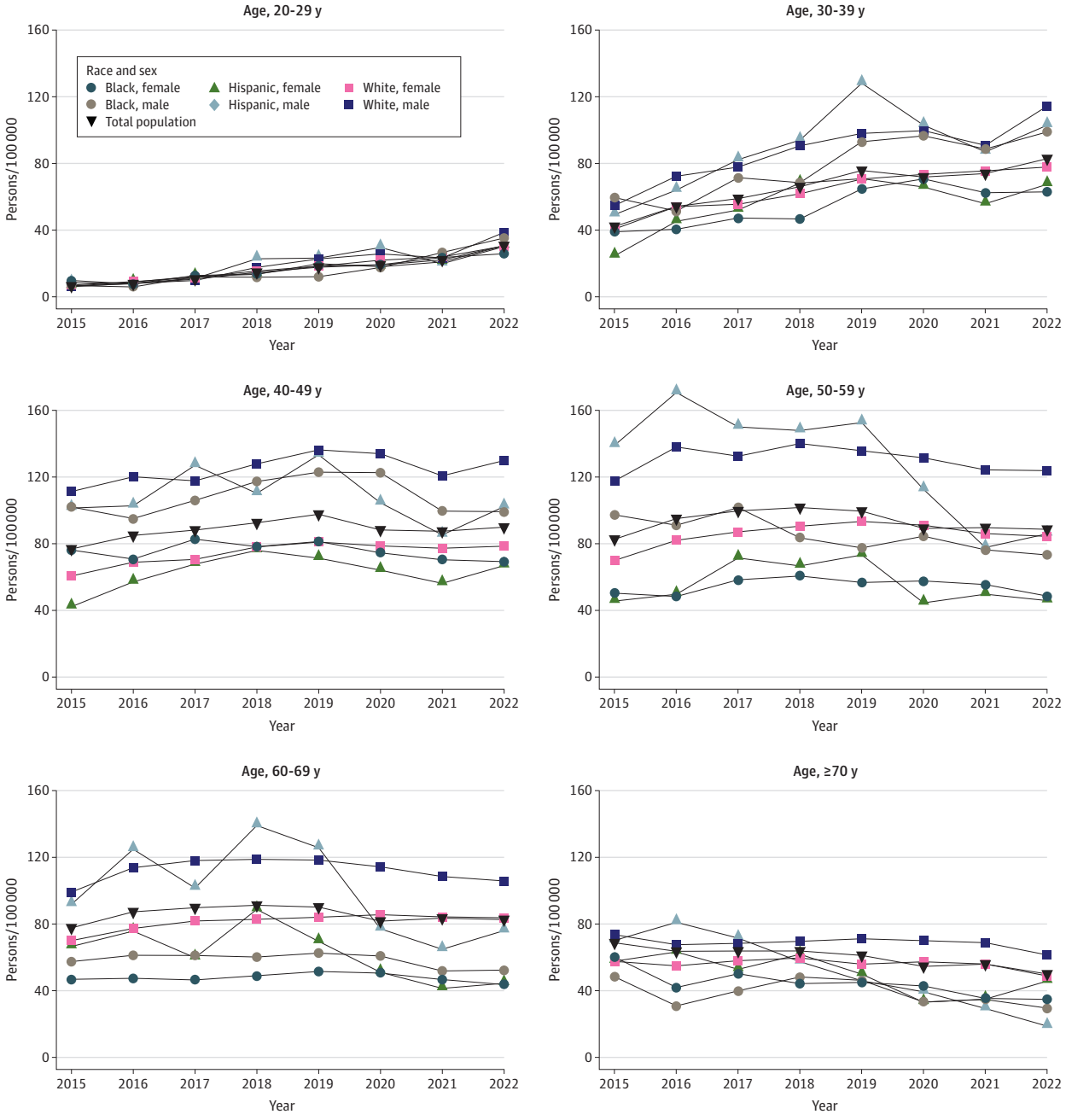
The prevalence of T1DM and T2DM within the population from 2015 to 2022 was calculated and stratified by race and ethnicity and sex within the eFigure in Supplement 1. Distinct from T2DR, Black males and females had a higher prevalence of diabetes at all years at 8271 and 8539 patients per 100 000, respectively. White males and females had the second largest prevalence, with Hispanic males and females having the lowest prevalence (eFigure in Supplement 1).

T1DR

Within the entire TriNetX Collaborative Network, there were 69 039 patients with T1DR, of which 14 923 were represented in 2022. The mean (SD) age was 60.0 (18.0) years with the average body mass index (BMI; calculated as weight in kilograms divided by height in meters squared) being 29.0 (6.7) (eTable 3 in Supplement 1). The prevalence of T1DR increased in patients 20 to 70 years or older with 61.4 patients per 100 000 having T1DR in 2015 compared with 70.4 patients per 100 000 in 2022, or a 1.15-fold increase in prevalence (**Figure 1**).

When stratified by age cohorts, a multitude of trends were found. All cohorts except the cohort 70 years or older displayed prevalence increases. The cohort aged 20 to 29 years had a 4.7-fold increase in T1DR in 2022 compared with 2015, equating to 6.5 persons per 100 000 in 2015 to 30.7 persons per 100 000 in 2022 (**Figure 2**). The cohort aged 30 to 39 years also displayed a substantial increase in T1DR prevalence, with a 1.96-fold increase in prevalence over the study period (Figure 2). The cohorts aged 40 to 49 years, 50 to 59 years, and 60 to 69 years displayed 1.17-, 1.07-, and 1.06-fold increases in T1DR prevalence, respectively (Figure 2). The cohort aged 70 years or older was found to have decreased prevalence of T1DR in 2022 compared with 2015, with a 0.72-fold decrease (Figure 2).

Figure 2. Prevalence of Type 1 Diabetic Retinopathy From 2015 to 2022 Stratified by Age, Race and Ethnicity, and Sex (per 100 000)



Within T1DR, similar trends were noted when accounting for sex and race and ethnicity. The cohort aged 20 to 29 years across all cohorts displayed substantial increases in prevalence with 3.8-, 7.6-, and 5.1-fold increases, respectively, for Black, Hispanic, and White populations (Figure 2). Males displayed greater increases than females between ages 20 and 49 years with Black, Hispanic, and White males showcasing the highest prevalence (Figure 2) and with White males having the greatest prevalence affecting 38.6 persons per 100 000 in 2022. For cohorts of 40 to 49 years and older, no increase in prevalence was documented (Figure 2).

T2DR

Within the TriNetX Collaborative Network, 430 128 patients had T2DR with 94 309 of them being represented in 2022. Among these patients with T2DR, the mean (SD) age was 68 (14) years, and BMI was 30.8 (7) (eTable 4 in Supplement 1). T2DR demonstrated a 1.07-fold increase within the total population from 2015 to 2022, from 432.7 persons per 100 000 to 461.7 per 100 000 in 2022 (**Figure 3**). Similar to T1DR, patients with T2DR aged 20 to 29 years and 30 to 39 years exhibited a 2.5-fold increase and 1.6-fold increase, respectively, in prevalence from 2015 to 2022 within the entire popula-

tion. This was an increase from 9.6 to 23.6 persons per 100 000 for the cohort aged 20 to 29 years and 59.3 to 92.1 persons per 100 000 for the cohort aged 30 to 39 years (**Figure 4**). The cohorts aged 40 to 49 years, 50 to 59 years, and 60 to 69 years also displayed prevalence increases of 1.5, 1.4, and 1.2 fold, respectively. A 0.9-fold decrease of T2DR prevalence in patients 70 years or older was noted.

Substantial race and ethnicity trends were also observed within the age cohorts. Among those aged 20 to 29 years, Hispanic males had a 5.1-fold increase in T2DR prevalence since 2015, whereas those aged 30 to 39 years had a 2.5-fold increase in the same population. For Hispanic males aged 20 to 29 years, this equated to 9.3 patients in 2015 to 47.8 per 100 000 in 2022 (Figure 4). By 30 years and older, the prevalence began to differentiate by racial and ethnicity groups with Hispanic males and females having the largest prevalence followed by Black males and females, and then White males and females; White females were least affected across all age groups by 2022 (Figure 4). In the cohort aged 40 to 49 years, Hispanic males displayed a 1.6-fold increase since 2015 and had a 3.5-fold higher prevalence compared with the total population in 2022. Hispanic males continued to have the highest prevalence among those aged 50 to 59 years and aged 60 to 69 years in 2022, with a 3.9-fold higher prevalence compared with the total population in both age groups. Hispanic females also had a high prevalence of T2DR, with the cohort aged 60 to 79 years affected the most. In 2022, 2215.20 per 100 000 Hispanic females 70 years or older had T2DR. Hispanic males and females aged 70 years and older had a 3.1-fold and 2.8-fold, respectively, higher prevalence compared with the total population (Figure 4).

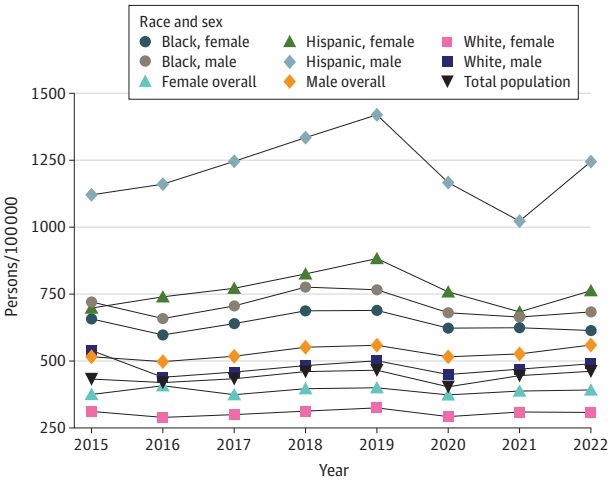
Prevalence ORs

The prevalence ORs of having T1DR in 2022 by sex and race and ethnicity combinations were calculated and presented in **Figure 5**A. Compared with White females, White males had the largest prevalence OR of having T1DR at 1.41 (95% CI, 1.36-1.47), whereas Hispanic males and Black males did not differ significantly from White females. Black females and Hispanic females were found to have a decreased association compared with White females at 0.72 (95% CI, 0.67-0.77) and 0.76 (95% CI, 0.69-0.84), respectively. The prevalence of T1DM within the population from 2015 to 2022 was also calculated and stratified by race and ethnicity and sex within eFigure 1A in Supplement 1. This representation showed a distinct decrease in T1DM after 2015 followed by a normalized trend afterward. This is likely due to *ICD-10* coding changes discussed in the limitations section.

The prevalence ORs of having T2DR in 2022 by sex and race and ethnicity combinations were calculated and presented in Figure 5B. Compared with White females, all other races and ethnicities and sexes demonstrated an increased association. Specifically, Hispanic males had the largest prevalence OR at 4.08 (95% CI, 3.97-4.19) followed by Hispanic females at 2.49 (95% CI, 2.42-2.56). Black males were next at 2.23 (95% CI, 2.17-2.29), followed by Black females at 2.00 (95% CI, 1.95-2.05).

The prevalence of T1DM and T2DM within the population from 2015 to 2022 was calculated and stratified by race and ethnicity and sex within eFigure in Supplement 1. Distinct from T2DR, Black males and females had a higher prevalence of diabetes at all years at 8271 and 8539 patients per 100 000, respectively. White males and females had the second largest prevalence with Hispanic males and females having the lowest prevalence (eFigure in Supplement 1). The raw data for all analyses in this study are available in eTables 5 and 6 in Supplement 2.

Figure 3. Prevalence of Type 2 Diabetic Retinopathy From 2015 to 2022 Stratified by Race and Ethnicity and Sex (per 100 000)



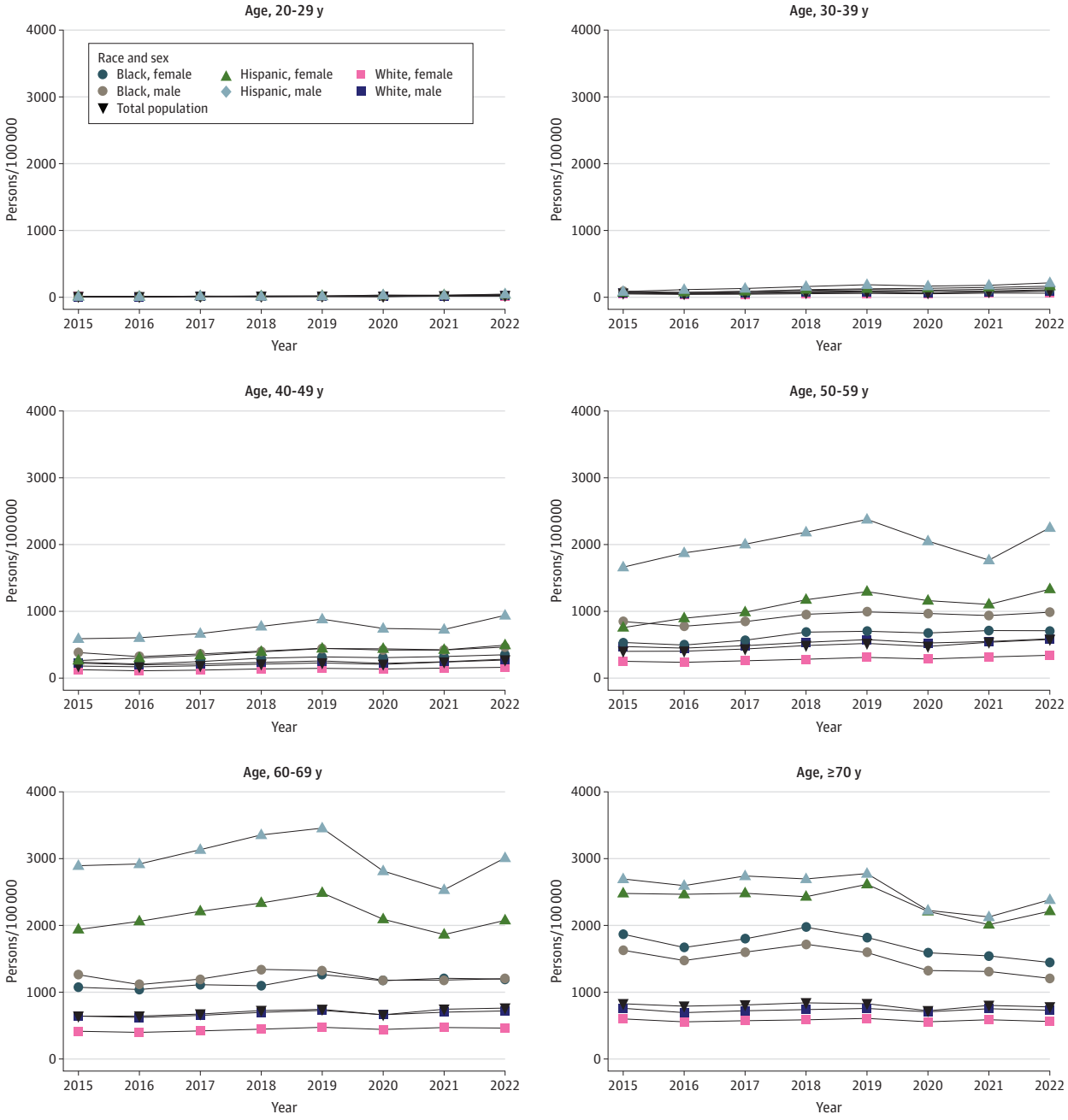
Discussion

This analysis provided insights into recent trends in the prevalence of DR in the US. With an overall 1.15-fold increase in T1DR prevalence and a 1.07-fold increase in T2DR prevalence from 2015 to 2022, the prevalence of DR appears to have increased in recent years within this single health system network. Moreover, persons aged 20 to 39 years had a substantial increase in cases since 2015, with a 4.7-fold increase for T1DR and 2.5-fold increase in T2DR. Of note, TriNetX had slightly decreased prevalence of Black, Hispanic, and male populations compared with the CDC diabetes report.[20]

As this study is one of the few analyses that stratified by T1DR and T2DR,[12,13] we were able to provide updated insights into this health system's differences specifically for these 2 conditions. The prevalence of T1DR did not exhibit substantial racial or ethnic population differences within the Black and Hispanic populations. Our analysis revealed that White males had the highest prevalence OR of T1DR compared with White females, whereas Black females exhibited the lowest POR. Furthermore, across all racial groups, male patients demonstrated higher rates of T1DR compared with female patients.

Among the age groups examined, the category aged 20 to 29 years displayed the greatest increase in T1DR prevalence over the study period with a 4.7-fold increase in the total population prevalence from 2015 to 2022. White males within this age group exhibited a 6.3-fold increase in prevalence over this time. Similarly, an upward trend was seen among the category aged 30 to 39 years, which demonstrated a 1.96-fold increase.

Figure 4. Prevalence of Type 2 Diabetic Retinopathy From 2015 to 2022 Stratified by Age, Race and Ethnicity, and Sex (per 100 000)



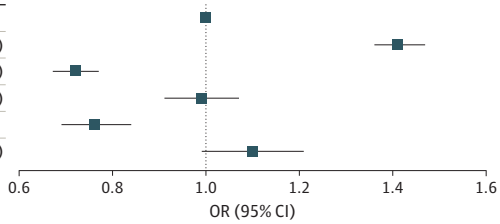
Like the T1DR findings, our analysis demonstrated upward trends in the prevalence of T2DR among younger age groups, specifically, the age categories 20 to 29 years and 30 to 39 years from 2015 through 2022. An earlier age at diagnosis of DM is associated with DR, and reports of early onset DR have been recorded in the literature.[2-4] Although prior studies have either not had the ability to include this age group[12,14] or did not stratify by a younger age,[22] making identifying this trend challenging, Lundeen et al[13] did evaluate individuals 20 years and older and also observed concerning increases in DR among young adults. Further, Wagenknecht et al[23] specifically evaluated pediatric diabetes and found increasing rates regardless of diabetes status while also disproportionately impacting minoritized patients. Likely, an increase in diabetes could also be the reason DR is increasing in this young adult TriNetX population. Further, this may be associated with increasing rates of obesity[24,25] likely compounded by the COVID-19 pandemic[26] within this health system network.

Consistent with prior studies, our findings affirmed that the Hispanic ethnicity was most associated with T2DR compared with White race.[5,9-11] Previously, T2DR was found to be associated with 2-fold greater increases in Hispanic patients

Figure 5. Prevalence Odds Ratios (ORs) of Having Type 1 or Type 2 Diabetic Retinopathy in 2022

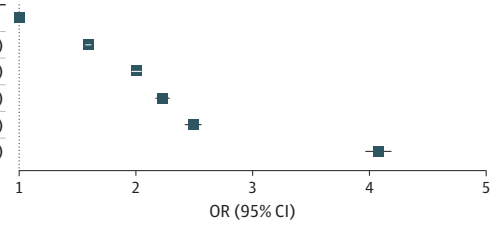
A Type 1 diabetic retinopathy

Race and sex	Participants, No.	OR (95% CI)
White female	4926	1 [Reference]
White male	5057	1.41 (1.36-1.47)
Black female	855	0.72 (0.67-0.77)
Black male	744	0.99 (0.91-1.07)
Hispanic female	441	0.76 (0.69-084)
Hispanic male	406	1.10 (0.99-1.21)



B Type 2 diabetic retinopathy

Race and sex	Participants, No.	OR (95% CI)
White female	22 657	1 [Reference]
White male	26 260	1.59 (1.57-1.62)
Black female	10 963	2.00 (1.96-2.05)
Black male	7701	2.23 (2.17-2.29)
Hispanic female	6595	2.49 (2.42-2.56)
Hispanic male	6895	4.08 (3.97-4.19)



compared with White patients.[5,9] Our study indicated that the current prevalence may be increased compared with prior reports as the Hispanic male cohort in this study had a 3.3-fold increase in DR compared with White males. Among individuals 40 years and older, Hispanic males and females showcased the highest prevalence rate followed by Black males and females, which aligns with prior literature that Black and Hispanic individuals have the highest prevalence of T2DR.[10,12-14]

The substantial racial and ethnicity population differences observed among Black and Hispanic or Latino patients with T2DR can likely be traced back to established factors, such as socioeconomic risk factors,[5,27] lack of insurance, education,[28] access to care, and comorbidities such as obesity and hypertension.[5] Additionally, these minoritized groups are less likely to be screened and, therefore, treated for DR, further compounding this disparity. This also supports the notion that our study might be underreporting the severity of this population difference.[5,29]

For both T1DR and T2DR, a decrease in overall prevalence was noted in 2020, followed by a resumption of the overall trend to increase in 2021. This may be due to COVID-19 pandemic decreasing patient screening for these conditions within this health system network. Substantial decreases in patient visit volume during the early stages of the COVID-19 pandemic were reported by ophthalmologic practitioners.[27]

Limitations

There were limitations to this study design. To protect patient identities, TriNetX has a rounding feature where small numbers of patients for a particular search query are rounded as to protect a patient's health information from being identifiable. Therefore, we were not able to accurately evaluate patients 19 years or younger due to the small, rounded counts that these queries yielded. In addition, this rounding features sometimes caused a minute discrepancy in our raw data sheet (eTables 5 and 6 in Supplement 2), especially for minoritized patients with smaller patient counts. The exact way sex and race and ethnicity data were recorded in TriNetX (eg, self-reported) is unknown as this data are composed from 56 health care organizations. Additionally, because our study used *ICD-10* coding, our estimates are likely an underrepresentation of the actual number of DR cases, as they only account for patients who sought ophthalmologic care, and therefore, we cannot determine if this is generalizable to untreated or undiagnosed patients. Based on eTable 2 in Supplement 1 comparing TriNetX patients with diabetes to the National Diabetes Statistics Report, we were able to identify that Black, Hispanic or Latino, and male populations were approximately 2% underreported within the TriNetX platform; thus, DR was likely underdiagnosed within this analysis. Also, eFigure 1A in Supplement 1 showcased decreasing diabetes trends after 2015. As *ICD-10* codes went live on October 1, 2015, this may have caused this distinct and unified trend shown in this figure. This decrease may also be related to publishing of codes that should never co-occur with T1DM codes,[30] as well as guidance from specialty societies such as the American Academy of Ophthalmology about situations where it would be inappropriate for specialists to use these codes.[31]

Conclusions

In conclusion, in this cross-sectional study, the prevalence of T1DR and T2DR in this large single system health network demonstrated an increase from 2015 to 2022. Importantly, the prevalence among individuals aged 20 to 39 years had large prevalence increases independent of diabetes type. T1DR was

found to be associated with greater increases in White males, whereas T2DR was found to be associated with greater increases in Hispanic males. Overall, T2DR appeared to be associated with greater increases in Hispanic and Black communities compared with White communities. Overall, this research suggests DR screening is needed for young adults and for the development of T2DM interventions for Hispanic and Black patients to limit progression to T2DR. Future investigations are warranted to further investigate these trends, especially among young adults.

ARTICLE INFORMATION

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Author Contributions: Ms Shaia had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Dr Markle and Ms Shaia are considered co–first authors.
Concept and design: Shaia, Araich, Sharma, Talcott, Singh.
Acquisition, analysis, or interpretation of data: Markle, Shaia, Araich, Sharma.
Drafting of the manuscript: Markle, Shaia, Araich, Sharma.
Critical review of the manuscript for important intellectual content: All authors.
Statistical analysis: Markle, Shaia, Araich, Talcott.
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Supervision: Shaia, Sharma, Talcott, Singh.

Conflict of Interest Disclosures: Dr Talcott reported receiving consultant fees from Alimera, Apellis, Bausch and Lomb, Eyepoint, and Genentech; speaker's fees from Iveric Bio and Genentech; and research fees from Regeneron, Regenxbio, and Zeiss research. Dr Singh reported receiving personal fees from Genentech/Roche, Alcon, Novartis, Regeneron, Asclepix, Gyroscope, Bausch and Lomb, and Apellis during the conduct of the study. No other disclosures were reported.

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