Public Health in Practice 9 (2025) 100577

Contents lists available at ScienceDirect

Public Health in Practice

journal homepage: www.sciencedirect.com/journal/public-health-in-practice

Examining the reach of a diabetes screening program in an urban emergency department☆

Ruth A. Pobee [a,*], Kirstie K. Danielson [b], Angela Kong [c], Yuval Eisenberg [b], Brian T. Layden [b,d], Janet Lin [a]

[a] UI Health/University of Illinois Chicago College of Medicine, Department of Emergency Medicine Chicago, Illinois, USA
[b] UI Health/University of Illinois Chicago College of Medicine, Division of Endocrinology, Diabetes, and Metabolism Chicago, Illinois, USA
[c] UI Health/University of Illinois Chicago College of Medicine, College of Pharmacy, Department of Pharmacy Systems, Outcomes, and Policy Chicago, Illinois, USA
[d] Jesse Brown VA medical center, Chicago, IL, USA

ARTICLE INFO

Keywords:
Race
Ethnicity
Diabetes
Prediabetes
ED
Reach

ABSTRACT

Background: Screening for diabetes in non-traditional settings like emergency departments (ED) can enhance early detection among patients at higher risk for diabetes. This study aims to assess the reach of an ED-based screening program by examining the characteristics of patients screen-detected for diabetes or prediabetes.
Study design: Retrospective cross-sectional study.
Methods: Sociodemographic characteristics (age, gender, race and ethnicity, insurance, zip code) of patients who were screened for diabetes using hemoglobin A1c test (A1c) were examined. The distribution of prediabetes and diabetes within each race/ethnicity, age, and gender groups were determined. ArcGIS Pro 2.9.0 was used to geocode patient zip codes, to generate heat maps of high occurrences of prediabetes and diabetes.
Results: Of the 5997 individuals screened in the ED, 49 % were non-Hispanic Black, 27 % Hispanic, 15 % non-Hispanic White, 5 % non-Hispanic Asian, and 4 % non-Hispanic Other/unknown. Almost half (47 %, n = 2808) had elevated A1c levels indicative of prediabetes (n = 2070; A1c: 5.7–6.4 %) or diabetes (n = 738; A1c: ≥6.5 %). Non-Hispanic Black females had a higher prevalence of both prediabetes (54 %) and diabetes (55 %) diagnoses as compared to other race/ethnic or gender categories; whereas non-Hispanic Asians had a lower prevalence of both prediabetes and diabetes except for those ≥65 years or older. Furthermore, most patients screened for prediabetes and diabetes reside in resource poor neighborhoods on the west and south sides of Chicago.
Conclusion: The burden of prediabetes and diabetes were greater among non-Hispanic Black females, with a high prevalence of prediabetes observed among younger individuals, particularly those residing in resource poor neighborhoods in the west and south sides of Chicago. More investment in resources for diabetes prevention and management for these groups may be warranted.

1. Introduction

The prevalence of prediabetes and type 2 diabetes (referred to as diabetes in this manuscript) is a global public health concern [1]. In the United States, individuals from racially and ethnically minoritized backgrounds as well as those with low-income bear a disproportionate burden of prediabetes and diabetes [2]. These populations experience delays in diagnosis and are more susceptible to diabetes related complications such as renal disease, retinopathy, and cardiovascular disease; therefore, highlighting the increased need for early detection and management [3]. Furthermore, gender differences exist in diabetes diagnoses, disproportionately affecting more men than women [4,5]. Although the burden of diabetes increases with age, more and more young adults are developing diabetes with increased complications and mortality [6,7]. In addition, geographical data, particularly zip codes, play a crucial role in identifying disparities in care for groups

☆ **Name and Location of Institute work was conducted:** UI Health/University of Illinois Chicago College of Medicine, Department of Emergency Medicine Chicago, and Division of Endocrinology, Diabetes, and Metabolism Chicago, Illinois.

* Corresponding author.
E-mail addresses: rpobee@uic.edu (R.A. Pobee), kdaniel@uic.edu (K.K. Danielson), akong@uic.edu (A. Kong), eisenbe1@uic.edu (Y. Eisenberg), blayde1@uic.edu (B.T. Layden), jlin7@uic.edu (J. Lin).

https://doi.org/10.1016/j.puhip.2024.100577
Received 25 March 2024; Received in revised form 17 December 2024; Accepted 19 December 2024
Available online 27 December 2024

disproportionately affected by diabetes [8]. There is an urgent need for increased attention to the health burdens of undiagnosed diabetes in these populations. As such, there is a need to extend the reach of diabetes screening to those at potentially greater risk for developing diabetes.

The emergency department (ED) is increasingly recognized as a vital access point for preventive care services, serving as a safety net for many patients who may have limited access to primary care, are uninsured, homeless, or with lower income. Studies have demonstrated that routine glycated hemoglobin (A1c) testing in the ED identified undiagnosed prediabetes and diabetes and provides an opportunity to improved care [9–12]. This suggests that the ED may be an important venue particularly to capture groups disproportionately affected by prediabetes and diabetes who may otherwise be unreached.

In an effort to decrease diabetes-related morbidity and mortality, the Innovating Diabetes screening in Emergency department And Linkage services (IDEAL) program was established at University of Illinois Hospital and Clinics (UI Health) with the aim of identifying individuals with undiagnosed diabetes who seek care in the ED and linking them to education, primary and specialty care. This innovative A1c screening program has the potential to reach groups who could benefit from diabetes screening but may not otherwise have access to it. The purpose of this study is to examine the characteristics of patients detected with diabetes or prediabetes through an ED-based routine screening program.

2. Methods

Study Design and Population: A retrospective cross-sectional electronic abstraction of data was conducted from February to November 2021. Patients who were eligible for diabetes screening as part of the IDEAL program were included. Details of the program and screening cascade have been described elsewhere [13]. In brief, a best practice alert algorithm (BPA) based on the ADA (American Diabetes Association) screening guidelines [14] was integrated into the electronic health record (EHR) – Epic System Corporation (EPIC) to screen for diabetes. The screening algorithm was limited to the UI Health system EHR identifying unique adult patients (≥18 yrs) with a body mass index (BMI) of 25 or above, or were 45 years or above without a documented diabetes diagnosis or an A1c value within the past 3 years in the EHR. If a blood-based lab-test is ordered for the patient, the EHR algorithm generates a pop-up that informs the provider of patient eligibility for an A1c test. Upon the provider accepting the prompt, an order for the A1c test is automatically placed. A1c levels were measured in the hospital laboratories using the D-100 Hemoglobin Testing System. A1c is used for screening as it does not require fasting and is a measurement of long-term blood-glucose concentration that is not affected by stress or illness [15,16]. Data monitoring and staff verification took place each week for quality checks.

The outcome was detection of prediabetes and diabetes based on A1c values, and further classified by sociodemographic variables of age, race, ethnicity, gender, ZIP code, and insurance status. Both outcomes and predictors were obtained from electronic abstraction of data from the EHR in EPIC. Gender for this sample was categorized as male or female based on reported legal sex in patients' medical records. Patients' age was categorized into 3 groups (18–44, 45–64, and >65 years) based on CDC cutoff for age [17]. The EHR contains separate race (American Indian, Alaska Native, Asian, Black, White, Other, Unknown) and ethnicity (Hispanic, Non-Hispanic, and unknown); therefore, data were combined as the following race and ethnicity categories: Hispanic, Non-Hispanic Black, Non-Hispanic Asian, Non-Hispanic white, Non-Hispanic other/unknown (including other and unknown race with non-Hispanic ethnicity). Patients were excluded if they had missing or unknown race and ethnicity and no A1c value.

Statistical Analysis: Analyses were conducted using SAS 9.4. Sample size used for analyses was based on A1c results and race/ethnicity information for screening between January to November 2024. A total sample size of 5997 was used to examine the sociodemographic characteristics of patients based on diabetes status, using A1c levels [normal (A1c: <5.7 %), prediabetes (A1c: 5.7–6.4 %), and diabetes (A1C: ≥6.5 %)]. Pearson's chi-square was used to determine differences between diabetes status by age, gender, race and ethnicity, and insurance status. Mean age was compared using ANOVA. The frequency of diabetes and prediabetes diagnoses and proportion of cases among those screened were estimated to examine trends in positive cases over a 10-month period. ArcGIS Pro 2.9.0 was used to geocode patient zip codes, to generate heat maps of high occurrence of prediabetes and diabetes within Chicago.

3. Results

Between February and November 2021, 41,726 patients visited the ED, with 7480 patients triggering the BPA. Of these, 6709 patients had an A1c order placed. A total of 771 patients had an A1c order declined. Declined orders were attributed to a prior diabetes diagnosis or an unrecorded A1c within the past 3 years (both not previously documented in the EHR), or someone closing the BPA without ordering the test. Of the 6709 orders placed, 6249 patients had an A1c order collected. The remaining 460 patients did not have blood collected which were due to reasons such as patients leaving without being seen or no blood drawn for these patients. 6231 specimens were received by the laboratory. Ninety-four lab processing errors and 8 lab value errors were noted, which resulted in 6129 valid A1c results. Out of the 6129 A1c results, 132 samples had no records on race and/or ethnicity information. A sample size of 5997 patients was used for data analyses. 3189 patients had A1c values in the normal range (A1c <5.7 %), 2070 in the prediabetes range (A1c ≥ 5.7 % - 6.4 %) and 738 in the diabetes range (A1c ≥ 6.5 %).

3.1. Demographic characteristics

Demographic characteristics of patients screened positive for prediabetes or diabetes (n = 5997) from February to November 2021 are shown in Table 1. The average age of all patients screened was 51.4 ± 17.7 years. In those patients who screened positive (n = 2808), those with diabetes were older (58.9 ± 15.3 years) than those with prediabetes (55.7 ± 16.0 years) (overall age effect $p < 0.0001$). There was a small but significant difference in the results of diabetes screening by gender (overall gender effect $p = 0.031$). Over half of the patients screened were females (53.2 % vs. 46.8 % males), with more females having a normal A1c (54.4 % vs. 45.6 % males), and more females positive for prediabetes (52.9 % vs. 47.1 % males). There was a small gender difference in patients screened positive for diabetes (49.1 % females vs. 50.9 % males). Patients aged 45–64 years made up a greater proportion of those with prediabetes (47.3 %; with 24.1 % aged 18–44 years and 28.6 % aged ≥65 years), and diabetes (52.7 %; with 14.1 % aged 18–44 years and 33.2 % aged ≥65 years).

Nearly half of the patients screened were of non-Hispanic Black race and ethnicity (49.4 %); with the rest of the screened population as 26.8 % Hispanic, 15 % non-Hispanic White, 5 % non-Hispanic Asian, and 3.8 % non-Hispanic other. Despite non-Hispanic Blacks comprising almost half of those screened, they comprised a greater proportion of those who screened positive for prediabetes (55.6 %). Whereas, compared to those screened overall, Hispanics (30.5 %) comprised a greater proportion of those who screened positive for diabetes (overall race and ethnic effect $p < 0.0001$).

Thirty-nine percent of all patients screened had Medicaid insurance, 26 % had private insurance, 24 % had Medicare, 2 % had Workers' compensation, and 8.8 % had no documented insurance in their medical records. Most patients who screened positive for prediabetes (37 %, 27 %) and diabetes (32 % and 34 %) were on Medicaid and Medicare respectively (see Fig. 1).

Table 1
Demographic characteristics of patients screened positive for prediabetes or diabetes from February–November 2021.

Variables	Total Analytic Sample	Normal A1c <5.7 %	Prediabetes A1c 5.7–6.4 %	Diabetes A1c ≥ 6.5 %	p-value
N (%)	5997 (100.0)	3189 (53.2)	2070 (34.5)	738 (12.3)	
A1c, median [IQR] %	5.6 [5.3–6.0]	5.3 [5.0–5.5]	5.9 [5.8–6.1]	7.3 [6.7–9.1]	
Age (mean ± SD) years	51.4 ± 17.7	47.0 ± 18.0	55.7 ± 16.0	58.9 ± 15.3	<0.0001
Gender					
Male	2806 (46.8)	1455 (45.6)	975 (47.1)	376 (50.9)	0.031
Female	3191 (53.2)	1734 (54.4)	1095 (52.9)	362 (49.1)	
Age					
18–44	2082 (34.7)	1480 (46.4)	498 (24.1)	104 (14.1)	<0.0001
45–64	2506 (41.8)	1138 (35.7)	979 (47.3)	389 (52.7)	
≥65	1409 (23.5)	571 (17.9)	593 (28.6)	245 (33.2)	
Race and Ethnicity					
Hispanic	1609 (26.8)	903 (28.3)	481 (23.2)	225 (30.5)	<0.0001
Non-Hispanic White	899 (15.0)	590 (18.5)	240 (11.6)	69 (9.3)	
Non-Hispanic Black	2962 (49.4)	1448 (45.4)	1150 (55.6)	364 (49.3)	
Non-Hispanic Asian	300 (5.0)	121 (3.8)	129 (6.2)	50 (6.8)	
Non-Hispanic Other/Unknown	227 (3.8)	127 (4.0)	70 (3.4)	30 (4.1)	
Insurance status					
Private	1589 (26.5)	866 (27.2)	525 (25.4)	198 (26.8)	0.0001
Medicaid	2316 (38.6)	1325 (41.5)	758 (36.6)	233 (31.6)	
Medicare	1467 (24.5)	652 (20.4)	567 (27.4)	248 (33.6)	
Worker's Compensation	95 (1.6)	53 (1.7)	33 (1.6)	9 (1.2)	
No insurance indicated on EMR	530 (8.8)	293 (9.2)	187 (9.0)	50 (6.8)	

HbA1C (A1c): Glycated Hemoglobin. Public insurance includes Medicaid, Medicare, other Governmental, and workers compensation.

3.2. Prediabetes and diabetes diagnoses by gender and age within each race/ethnicity group

The overall prevalence of normal, prediabetes, and diabetes range A1c values categorized by gender within race/ethnicity groups are shown in Fig. 2, Panels A, B, and C, respectively. Among all race/ethnicity groups, females had a higher prevalence of prediabetes compared to males except for non-Hispanic Whites, where more males had a higher prevalence of prediabetes. However, diabetes prevalence was higher in male Hispanics (57 % vs. 43 % females), male non-Hispanic White (61 % vs. 39 % females), and male non-Hispanic Asian (56 % vs. 44 % females), except for non-Hispanic Blacks, where females had higher prevalence of diabetes diagnoses than males (55 % vs. 45 %). In general, non-Hispanic Black females had a higher prevalence of both prediabetes (54 %) and diabetes (55 %) compared to non-Hispanic Black males.

The proportion of normal, prediabetes and diabetes range A1c values categorized by age within each race/ethnic group are shown in Fig. 3, Panel A, B, and C respectively. Among all race/ethnicity groups, patients aged 45–64 years had the highest prevalence of prediabetes and diabetes except for non-Hispanic Asians where patients aged ≥65 years had the highest prevalence of both prediabetes (60 %) and diabetes (70 %)

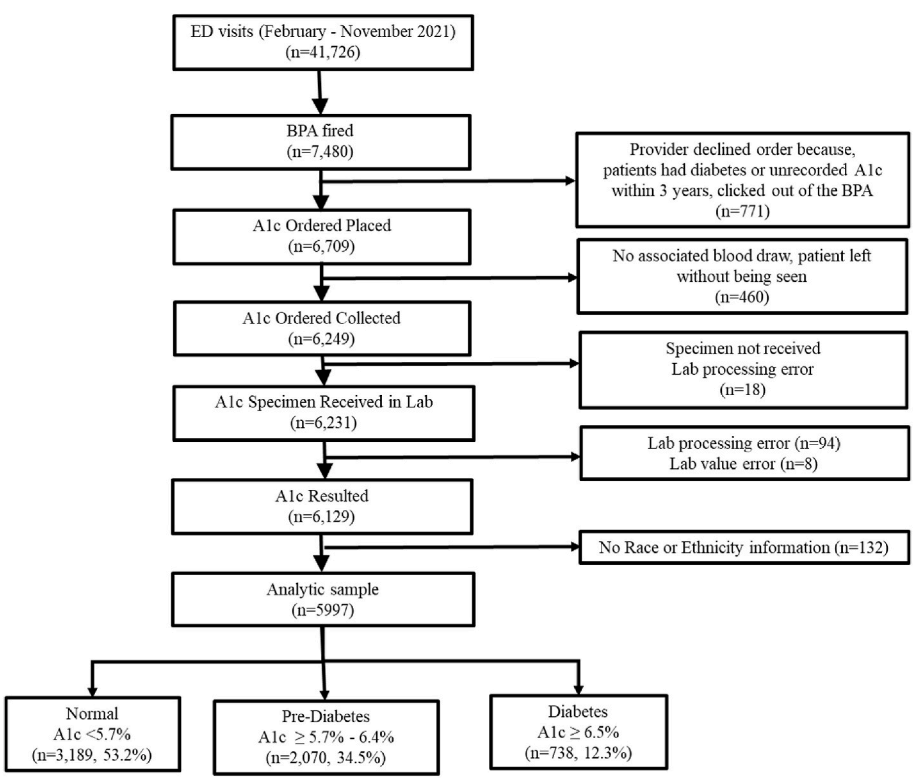

Fig. 1. Flow Chart for screening and diagnosis of Pre(Diabetes) in the emergency department.

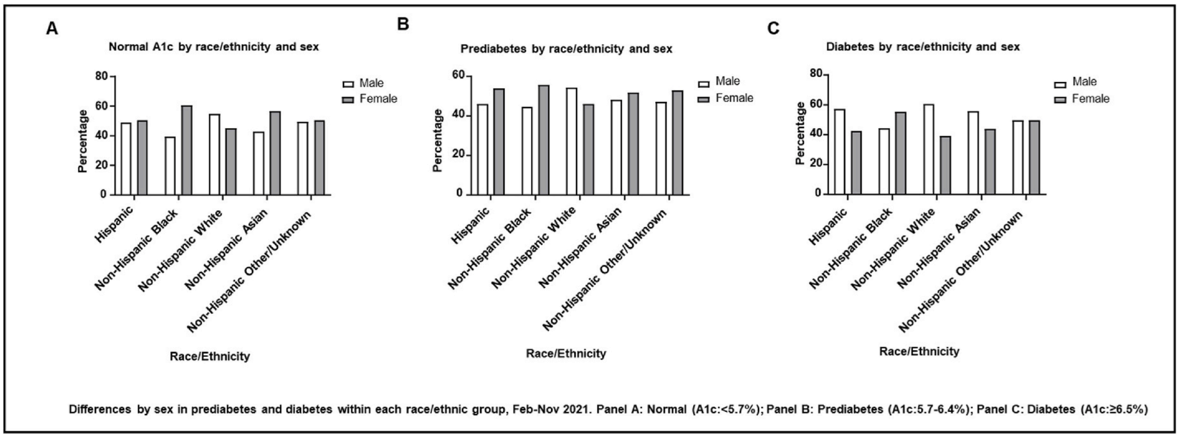

Fig. 2. Differences by sex in prediabetes and diabetes within each race/ethnic group, Feb–Nov 2021. Panel A: Normal (A1c:<5.7 %); Panel B: Prediabetes (A1c:5.7–6.4 %); Panel C: Diabetes (A1c:≥6.5 %).

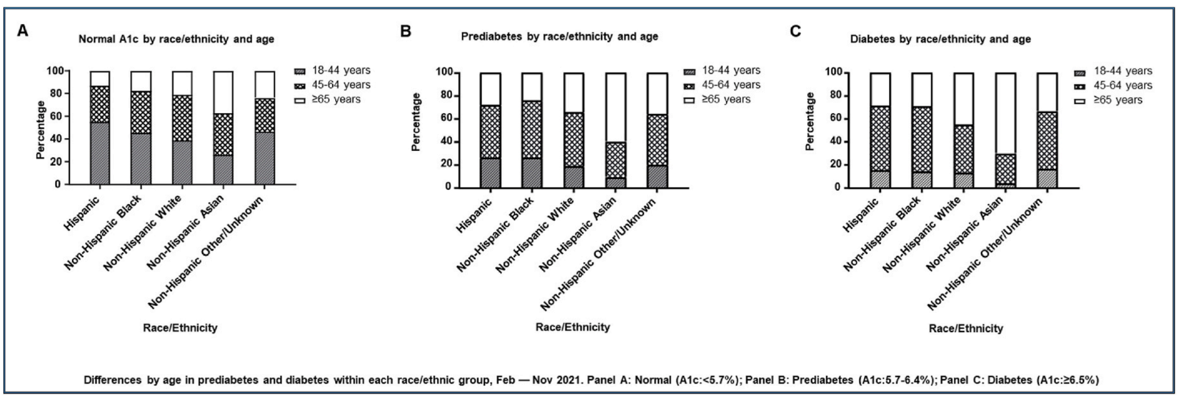

Fig. 3. Differences by age in prediabetes and diabetes within each race/ethnic group, Feb–Nov 2021. Panel A: Normal (A1c:<5.7 %); Panel B: Prediabetes (A1c:5.7–6.4 %); Panel C: Diabetes (A1c:≥6.5 %).

diagnoses.

3.3. Trends in prediabetes and diabetes over ten months

We further examined the total number (Fig. 4 Panel A) and the proportion (Fig. 4, Panel B) of prediabetes and diabetes diagnoses by month from February to November 2021. There was a decline in the number of prediabetes and diabetes diagnoses early in the period and then a plateau from May to November 2021 (Fig. 4, Panel A). However, between February to November 2021, the proportion of prediabetes increased while diabetes decreased over the ten-month period (Fig. 4, Panel B), with the highest proportion of prediabetes recorded in November (78.4 %) and highest diabetes recorded in February (34.1 %) (Fig. 4, Panel B).

3.4. Geographical areas identified for prediabetes and diabetes in our sample

Fig. 5 shows maps of the zip codes for those with screen-detected prediabetes and diabetes in our ED. Both prediabetes and diabetes were highly concentrated in neighborhoods on the west and south sides of Chicago (Fig. 5, Panels A and B).

4. Discussion

Diabetes screening in the ED has the potential to reach high risk groups who may not have access to it. Our goal was to examine the sociodemographic characteristics of patients detected for diabetes or prediabetes through an ED-based screening program. Our study found that the burden of both prediabetes and diabetes was highest among patients who were Hispanic and Non-Hispanic Black, who reside in the west and south of Chicago where the zip codes are associated with elevated poverty levels. Specifically, in this ED sample, non-Hispanic Black females had the highest burden of both prediabetes and diabetes across racial ethnic groups and gender. Irrespective of race and ethnicity, the prevalence of prediabetes consistently remained high over the period studied (from February to November 2021) without reaching saturation, indicating a major health concern, as a consistent number of patients tested positive for either prediabetes or diabetes each month. We also observed a high number of young individuals with prediabetes which could signal a public health concern that requires attention.

Our findings are consistent with other screening programs in the ED that have indicated high risk of diabetes in the ED, particularly among racially and ethnically minoritized groups [18–21]. Despite the similarity in findings, different approaches have been deployed for screening in the ED. A study by Lee et al. conducted a multi-site ED diabetes screening in New York. They based their screening criteria on the USPSTF recommendations screening for A1c in patients 40–70 years old, with a body mass index ≥25, and no prior history of diabetes [18]. The ADA screening criteria includes adult patients (≥18 years) with a body mass index (BMI) of 25 or above, or are 45 years or above without a diabetes diagnosis or an A1c value within the past three years. Though there is no single recommended criteria for diabetes screening and we acknowledge that there are limitations to any of the criteria recommended, we selected the ADA screening criteria because it is the most inclusive and simpler to structure the EHR algorithm logic. Additionally,

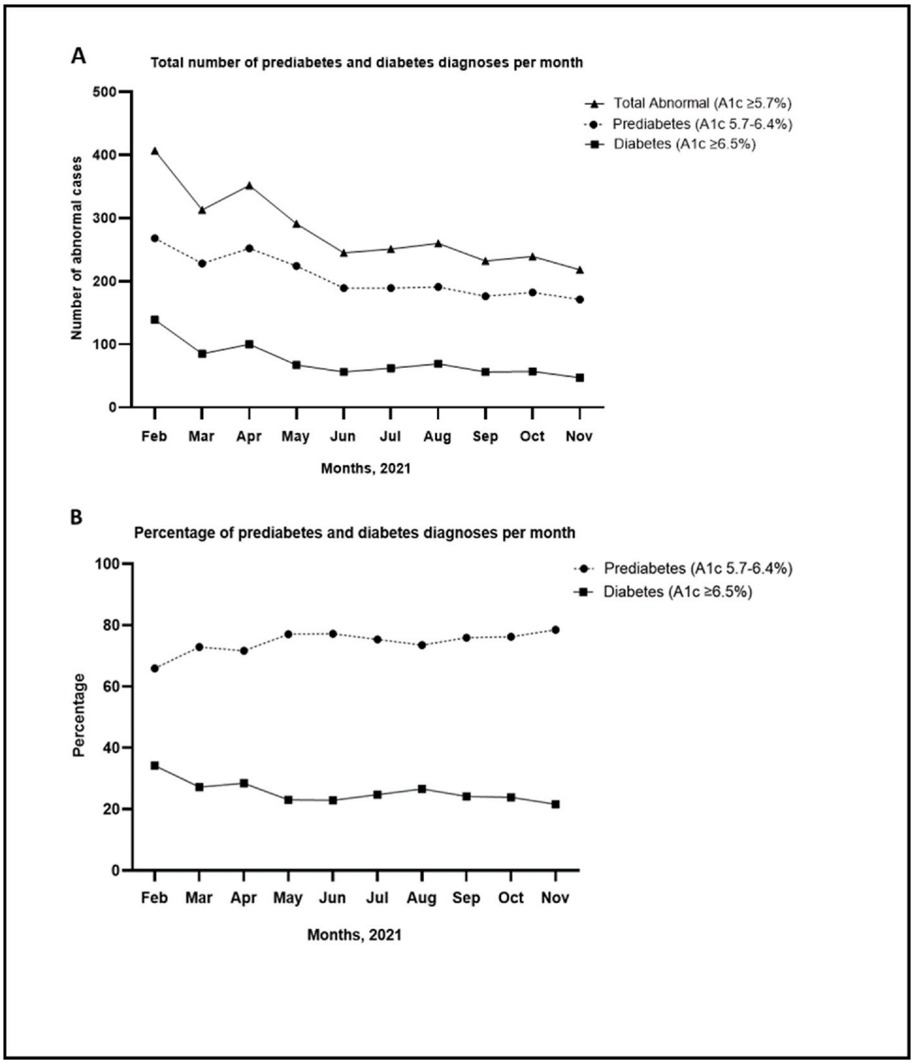

Fig. 4. Prediabetes and diabetes diagnoses per month, February–November 2021. Panel A: Numbers per month; Panel B: Percentages per month.

we purposely designed a program that is completely integrated into the normal clinical workflow of an emergency department. Our aim was not to alter the demands of an emergency department for prevention screening, nor introduce additional process steps that are not typically part of the clinical workflow but do so in an evidence-informed and responsive way.

Other approaches have tested unselected sampling using a point-of-care test device and found 14 % of undiagnosed diabetes and 42 % sub optimally controlled diabetes [12]. Another non-targeted testing approach reported by Anderson et al. also identified undiagnosed prediabetes and diabetes in the ED. While screening criteria may vary between studies, multiple studies agree that emergency departments could be an ideal setting for diabetes screening particularly patients who represent minoritized groups, whether using targeted or non-targeted approaches.

Screened and detected prediabetes and diabetes were less prevalent in non-Hispanic Asians compared to other groups in our study. Evidence indicates that Asians tend to develop diabetes at lower body weights (BMI $<$25 kg/m^2) [22]. The BMI threshold recommended by the ADA screening criteria could mean that our screening criteria may miss Asians under 45 years with lower BMI who presented to the ED. Furthermore, the U.S. Preventive Services Task Force states that 1 in 3 Asians have diabetes and this high prevalence could be due to their body composition; however, they are less likely to be screened and detected for diabetes and prediabetes [23]. In our study, the total number of Asians screened was low (n = 300; 5 %) compared with other race and ethnic groups. Among the 300 Asians screened, though, about 60 % (n = 179) had either prediabetes or diabetes. This highlights the fact that Asians may miss screening for prediabetes and diabetes by our program possibly due to the current established BMI screening criteria. Future studies may consider screening Asian patients 30–70 years with lower BMI (≥23kg/m2) as suggested by the U.S. Preventive Services Task Force [23].

Our study showed a high prevalence of prediabetes (24 %) among younger individuals, between 18 and 44 years, which signals a potential public health concern. Our findings agree with studies from Centers for Disease Control and Prevention (CDC) which shows that 1 in 4 young adults are living with prediabetes [24]. The hidden burden of diabetes among young individuals in our community must be addressed with an intentional focus and effort to address interventions that reach and impact younger populations. The CDC has heavily invested in the National Diabetes Prevention Program (for prediabetes) and has supported efforts to improve patient engagement in Diabetes Self-Management Education and Support [25–28], however, the uptake for these programs is very low [29]. We need innovative strategies to improve our ability to link younger patients to existing prediabetes and diabetes care. Literature suggests that the age of diabetes diagnosis may vary across racial and ethnic groups, with Hispanic and Black individuals being diagnosed at an earlier age compared to non-Hispanic Whites [6]. Considering this, screening at an earlier age may be important in persons

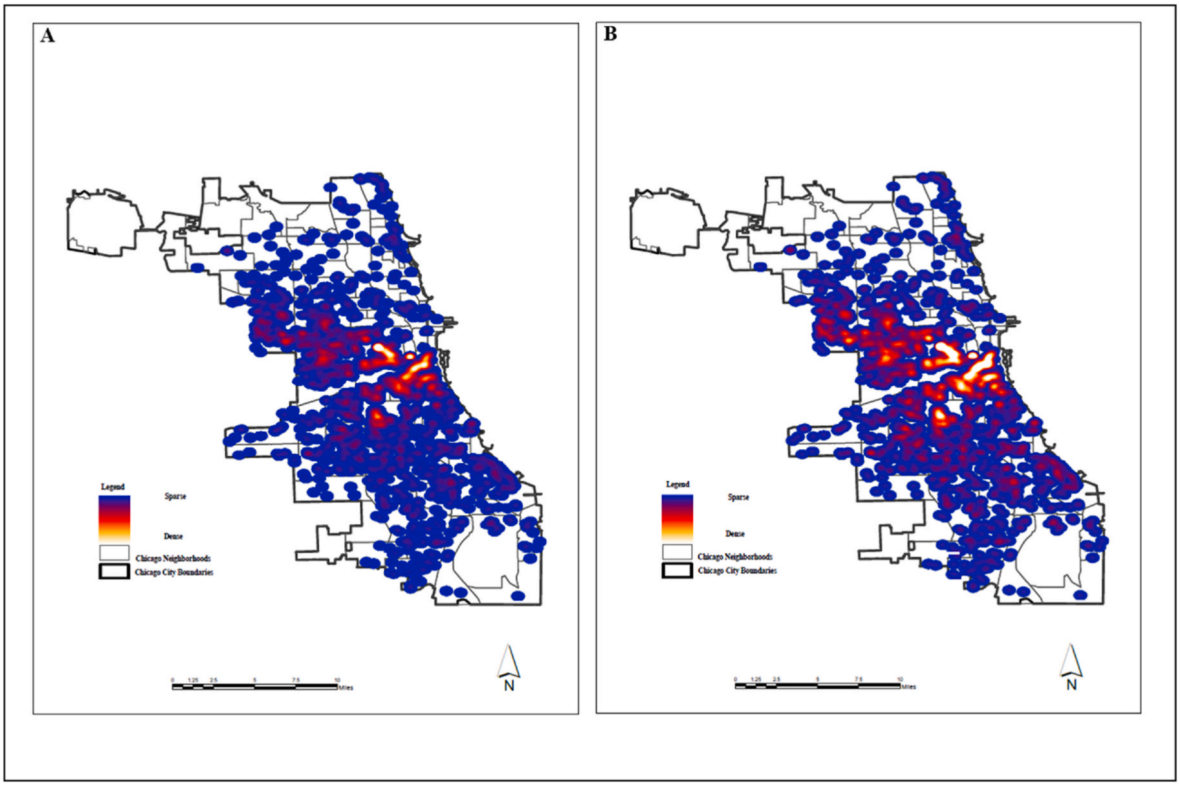

Fig. 5. Heatmaps for prediabetes and diabetes in Chicago Neighborhoods. Panel A: Prediabetes (A1c:5.7–6.4 %); Panel B: Diabetes (A1c:≥6.5 %). Density increases from blue to red to white.

from racially and ethnically minoritized groups.

Importantly, we found that the burden of prediabetes was higher among women across race and ethnicity compared to their male counterparts except for non-Hispanic white women. For diabetes, the burden was higher among men compared to women across race and ethnicity except for non-Hispanic Black males. Sex differences reported in the diagnoses of diabetes showed that men are at a higher risk compared to women [30]. Hormonal factors mainly contribute to the sex differences in the prevalence of diabetes. It is hypothesized that estrogen protects beta cells, and this protection prevents women from developing diabetes as fast as men with similar weight and diet [31]. This could partly explain why more men were identified with diabetes and more women were identified with prediabetes in this study. Surprisingly however, we found that non-Hispanic Black women have higher rates of diabetes compared with non-Hispanic Black men. This could mean that other factors including genetic, environment, diet, weight gain, stress which are known to affect diabetes, may play an important role in the difference observed among non-Hispanic Black race, and this warrants further investigation. Another factor could be systemic issues such as political, social, and structural inequities within the non-Hispanic Black communities. One other important factor that should not be overlooked in this explanation is the COVID-19 pandemic. Diabetes diagnoses in our study population occurred from January to November of 2021, a time when the COVID pandemic was omnipresent, affecting many people of racial and ethnic minoritized groups particularly in Chicago. During this period, women reported high stress, burnout at work, as well as home-related stress [32]. As stress can affect both the onset and exacerbation of diabetes, this could partially explain why black women were more likely to be diagnosed with both prediabetes and diabetes in our study [33]. More study would be required to better understand the interplay between diabetes, stress, and COVID, and how it impacts sex differences.

Despite the overall high burden of prediabetes and diabetes among patients who are Hispanic and non-Hispanic Black women, we also found that the geographic dense areas for our population were located mainly in the west and south sides of Chicago. This covers a large portion of UI Health's patient service area; however, it serves many people who are high-risk for diabetes. The identified areas are known to be among the poorest neighborhoods in Chicago with extremely large population density, lowest median household income, and high rates of unemployment [34].

Disparities in access to healthcare, lack of health insurance, and transportation challenges may also explain the pre(diabetes) burden in these areas. Limited availability of healthcare facilities can hinder regular check-ups and screenings, leading to delayed diabetes diagnoses [20]. In addition, financial constraints may decrease healthcare utilization, preventing timely access to necessary healthcare services [21]. Understanding how these conditions impede care and what can be done to mitigate them is crucial to ensure early diabetes diagnoses, especially in high-risk populations. Screening for preventive conditions when patients seek care whether for related or unrelated conditions, in an ED could help mitigate some of these disparities.

In addition, other conditions like obesity, hypertension, stroke, cardiac arrest, heart attack, asthma, cancer, HIV, and COVID-19 infections geographically co-occur with diabetes in these areas [35]. This indicates that multiple factors could be involved in the overall disease burden including individual level factors, structural, political, and social inequities. Community-based strategies that focus on the local needs to address not only diabetes prevention, but co-occurring conditions are needed. Current efforts are underway to better understand how best to improve linkage to comprehensive models of care that address multi-faceted.

4.1. *Strengths and limitations*

A strength of our study is that we have been able to establish an innovative diabetes screening program in an ED contributing within a larger comprehensive continuum of care and leveraging research to improve programmatic delivery. Multiple stakeholders, from the health care delivery system (care coordination, diabetes education, physicians from emergency medicine and endocrinology), and research scientists were involved to troubleshoot and establish an effective program. Through this study, we see that the screening program has identified a younger age group and a diverse racial and ethnic population who may be at higher risk of developing pre(diabetes).

Our study also had some limitations. Firstly, not all potentially eligible patients who visited the ED may have been screened due to ADA inclusion criteria used. While we based our screening on the ADA guideline, we did simplify it to ensure the workflow in the ED was not burdensome to providers and the organizational system. Secondly, we only tested patients in the ED who had blood tests ordered. As a result, the screening criteria did not capture everyone that the ADA screening criteria recommends. Therefore, patients who may have undiagnosed diabetes but did not meet our screening criteria were not captured. Also, non-overweight patients aged less than 45 years were not captured by our program. Given that Asians tend to develop diabetes at lower body weights (i.e. BMI <25kg/m2), our screening criteria may miss Asians under 45 years with lower BMI who present in the ED. As a result, this study may not be generalizable to every ED patient. Fourthly, the algorithm may screen patients who have already been classified as pre (diabetes) by other hospitals or primary care providers, if they have never been registered as a patient at UI Health. In addition, there could be potential misclassification by race/ethnicity, as the intake nurse may sometimes make assumptions, or patients may choose to identify themselves in a way not necessarily fitting into any category, or that the available options did not "fit" how the patient identifies themselves. Also, the COVID-19 pandemic may have impacted the volume and types of patients visiting the ED during the study period. A separate study is validating the accuracy and effectiveness of the algorithm used for our screening program in the ED.

5. Conclusions

We identified a high burden of prediabetes and diabetes among patients who are Hispanic and non-Hispanic Black, with a growing concern about prediabetes in younger individuals, especially those residing in resource poor neighborhoods in the west and south sides of Chicago, that demonstrates likely disparities in diabetes screening in these areas. Nevertheless, it is essential to acknowledge that our program may miss certain populations who did not meet our screening criteria especially those from Asian race. Non-Hispanic Black females and patients aged 18–44 years were at risk for diabetes. The persistence of high prediabetes diagnoses each month indicates a significant public health concern in our community. The areas and populations identified with high prevalence of prediabetes and diabetes diagnoses may help target diabetes prevention resources, and outreach programs, thus reducing health disparities experienced in specific neighborhoods and demographic groups.

Ongoing research is needed to improve linkages to diabetes prevention and management, both at the primary care and community level, to prevent or delay type 2 diabetes and other associated serious health problems among groups that are affected.

What this study adds

- Integrating diabetes screening in ED may reach groups at greater risk for diabetes residing in resource poor neighborhoods.
- Diabetes screening in the ED may capture younger individuals at risk of prediabetes.
- The high volume of prediabetes diagnoses each month highlights a public health concern within the Chicago community.

Implication for Policy and practice

- Identifying areas and demographics with high prediabetes and diabetes prevalence can guide targeted allocation of preventive resources and outreach programs for diabetes prevention, mitigating health disparities in specific communities and demographic cohorts.

Ethical Approval

The study was approved by the University of Illinois Chicago, Institutional Review Board.

Financial Support

This independent investigator-initiated study received funding support from Novo Nordisk Inc. (grant number ISS-001235, Principal Investigators JL and BTL).

Conflict of interest Disclosure

RAP, YE, and AK report no conflict of interest. KD reports funding as salary support. BTL and JL reports grant money from Novo Nordisk to conduct research conceived and written by Brian Layden and Janet Lin from the University of Illinois Chicago.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Kirstie Danielson reports funding as salary support. Brian Layden and Janet Lin reports grant money from Novo Nordisk to conduct research conceived and written by Brian Layden and Janet Lin from the University of Illinois Chicago.

Acknowledgement

We acknowledge the University of Illinois Hospital & Health Sciences System care coordination team for the support with this project and Anjana Maheswaran for her contribution with data acquisition.

References

[1] National Diabetes Statistics Report | Diabetes, CDC, 2022 [Internet], https://www.cdc.gov/diabetes/data/statistics-report/index.html. (Accessed 2 May 2022).
[2] D.J. Gaskin, R.J. Thorpe, E.E. McGinty, et al., Disparities in diabetes: the Nexus of race, poverty, and place, Am J Public Health 104 (11) (2014), 2147–55. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4021012/. (Accessed 30 January 2024).
[3] CDC, National Diabetes Statistics Report | Diabetes, CDC, 2023 [Internet], https://www.cdc.gov/diabetes/data/statistics-report/index.html. (Accessed 30 January 2024).
[4] S.A.E. Peters, P. Muntner, M. Woodward, Sex differences in the prevalence of, and trends in, cardiovascular risk factors, Treatment, and control in the United States, 2001 to 2016, Circulation 139 (8) (2019) 1025–1035 [Internet], https://www.ahajournals.org/doi/10.1161/CIRCULATIONAHA.118.035550. (Accessed 24 August 2022).
[5] B. Tramunt, S. Smati, N. Grandgeorge, et al., Sex differences in metabolic regulation and diabetes susceptibility, Diabetologia 63 (3) (2020) 453–461, https://doi.org/10.1007/s00125-019-05040-3 [Internet]. (Accessed 24 August 2022).
[6] N. Nanayakkara, A.J. Curtis, S. Heritier, et al., Impact of age at type 2 diabetes mellitus diagnosis on mortality and vascular complications: systematic review and meta-analyses, Diabetologia 64 (2) (2021) 275–287, https://doi.org/10.1007/s00125-020-05319-w [Internet]. (Accessed 27 June 2022).
[7] CDC. National Diabetes Statistics Report, 2020. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Dept of Health and Human Services, 2020.
[8] J. Lord, A. Odoi, Determinants of disparities of diabetes-related hospitalization rates in Florida: a retrospective ecological study using a multiscale geographically weighted regression approach, Int. J. Health Geogr. 23 (2024).
[9] J. Albu, N. Sohler, B. Matti-Orozco, et al., Expansion of electronic health record-based screening, prevention, and management of diabetes in New York City, Prev Chronic Dis [Internet] (2013), 10:E13. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3562173/. (Accessed 15 April 2022).

[10] T.-M. Hng, A. Hor, S. Ravi, et al., Diabetes case finding in the emergency department, using HbA1c: an opportunity to improve diabetes detection, prevention, and care, BMJ Open Diab Res Care 4 (1) (2016) e000191 [Internet], https://drc.bmj.com/lookup/doi/10.1136/bmjdrc-2015-000191. (Accessed 15 April 2022).
[11] E.S. Anderson, D.A. Dworkis, T. DeFries, E. Emery, C. Deegala, K. Mohs, Nontargeted diabetes screening in a Navajo Nation emergency department, Am J Public Health 109 (2) (2019) 270–272 [Internet], https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6336041/. (Accessed 24 April 2023).
[12] M.D. Menchine, S. Arora, C.A. Camargo, A.A. Ginde, Prevalence of undiagnosed and Suboptimally controlled diabetes by point-of-care HbA1C in unselected emergency department patients, Acad. Emerg. Med. 18 (3) (2011) 326–329 [Internet], https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3529908/. (Accessed 24 April 2023).
[13] K.K. Danielson, B. Rydzon, M. Nicosia, et al., Prevalence of undiagnosed diabetes identified by a Novel electronic medical record diabetes screening program in an Urban emergency department in the US, JAMA Netw. Open 6 (1) (2023) e2253275, https://doi.org/10.1001/jamanetworkopen.2022.53275 [Internet]. (Accessed 13 April 2023).
[14] American Diabetes Association, 2. Classification and diagnosis of diabetes: Standards of medical care in diabetes—2021, Diabetes Care 44 (Supplement_1) (2020) S15–S33, https://doi.org/10.2337/dc21-S002 [Internet]. (Accessed 29 June 2022).
[15] American Diabetes Association, Classification and diagnosis of diabetes: Standards of medical care in diabetes—2019, Diabetes Care 42 (Supplement_1) (2018) S13–S28, https://doi.org/10.2337/dc19-S002 [Internet]. (Accessed 28 June 2022).
[16] Professional Practice Committee, Standards of medical care in diabetes—2018, Diabetes Care 41 (Supplement_1) (2018). S3–S3, https://diabetesjournals.org/care/article/41/Supplement_1/S3/30078/Professional-Practice-Committee-Standards-of. (Accessed 15 April 2022).
[17] Centers for Disease Control and Prevention, National Diabetes Statistics Report | Diabetes, CDC, 2023 [Internet], https://www.cdc.gov/diabetes/data/statistics-report/index.html. (Accessed 20 March 2024).
[18] D.C. Lee, H. Reddy, C.A. Koziatek, et al., Expanding diabetes screening to identify undiagnosed cases among emergency department patients, WestJEM 24 (5) (2023) [Internet], https://escholarship.org/uc/item/8fn9h7hd. (Accessed 14 February 2024).
[19] W.H. Herman, Y. Ma, G. Uwaifo, et al., Differences in A1C by race and ethnicity among patients with Impaired glucose Tolerance in the diabetes prevention program, Diabetes Care 30 (10) (2007), https://doi.org/10.2337/dc06-2003, 2453–7. (Accessed 2 May 2022).
[20] S.P. Fisher-Hoch, K.P. Vatcheva, M.H. Rahbar, J.B. McCormick, Undiagnosed diabetes and pre-diabetes in health disparities, PLOS ONE [Internet] 10 (7) (2015) e0133135. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0133135. (Accessed 2 May 2022).
[21] E.J. Kim, T. Kim, J. Conigliaro, J.M. Liebschutz, M.K. Paasche-Orlow, A. D. Hanchate, Racial and ethnic disparities in diagnosis of Chronic medical conditions in the USA, J. Gen. Intern. Med. 33 (7) (2018) 1116–1123, https://doi.org/10.1007/s11606-018-4471-1 [Internet]. (Accessed 2 May 2022).
[22] J.W.R. Lee, F.L. Brancati, H.-C. Yeh, Trends in the prevalence of type 2 diabetes in Asians versus whites: results from the United States National health Interview Survey, 1997–2008, Diabetes Care 34 (2) (2011) 353–357, https://doi.org/10.2337/dc10-0746 [Internet]. (Accessed 3 February 2023).
[23] US Preventive Services Task Force, K.W. Davidson, M.J. Barry, et al., Screening for prediabetes and type 2 diabetes: US preventive services Task Force recommendation Statement, JAMA 326 (8) (2021) 736 [Internet], https://jamanetwork.com/journals/jama/fullarticle/2783414. (Accessed 15 April 2022).
[24] CDC, Diabetes Infographic [Internet], Centers for Disease Control and Prevention, 2024. https://www.cdc.gov/diabetes/library/socialmedia/infographics.html. (Accessed 31 January 2024).
[25] E.K. Ely, S.M. Gruss, E.T. Luman, et al., A National effort to prevent type 2 diabetes: Participant-level Evaluation of CDC's National diabetes prevention program, Diabetes Care 40 (10) (2017) 1331–1341.
[26] D.L. Hall, E.G. Lattie, J.R. McCalla, P.G. Saab, Translation of the diabetes prevention program to ethnic communities in the United States, J Immigr Minor Health 18 (2) (2016) 479–489.
[27] S.C. Sepah, L. Jiang, A.L. Peters, Translating the diabetes prevention program into an online social Network: Validation against CDC Standards, Diabetes Educ 40 (4) (2014) 435–443.
[28] K. Nhim, S.M. Gruss, D.S. Porterfield, et al., Using a RE-AIM framework to identify promising practices in National Diabetes Prevention Program implementation, Implement. Sci. 14 (1) (2019) 81.
[29] M.J. Cannon, S. Masalovich, B.P. Ng, et al., Retention among Participants in the National diabetes prevention program Lifestyle Change program, 2012–2017, Diabetes Care 43 (9) (2020), https://doi.org/10.2337/dc19-2366, 2042–9. (Accessed 3 February 2023).
[30] B. Tramunt, S. Smati, N. Grandgeorge, et al., Sex differences in metabolic regulation and diabetes susceptibility, Diabetologia 63 (3) (2020) 453–461, https://doi.org/10.1007/s00125-019-05040-3 [Internet]. (Accessed 24 August 2022).
[31] A.M. Kanaya, D. Herrington, E. Vittinghoff, et al., Glycemic effects of Postmenopausal Hormone Therapy: the heart and estrogen/progestin Replacement study: a Randomized, Double-Blind, Placebo-controlled trial, Ann. Intern. Med. 138 (1) (2003) 1–9 [Internet], https://www.acpjournals.org/doi/10.7326/0003-4819-138-1-200301070-00005. (Accessed 26 August 2022).
[32] M.M. Ruissen, H. Regeer, C.P. Landstra, et al., Increased stress, weight gain and less exercise in relation to glycemic control in people with type 1 and type 2 diabetes during the COVID-19 pandemic, BMJ Open Diabetes Research and Care 9 (1) (2021) e002035 [Internet], https://drc.bmj.com/content/9/1/e002035. (Accessed 26 August 2022).
[33] A. Mitra, Diabetes and stress: a review, Stud. Ethno-Med. 2 (2) (2008) 131–135, https://doi.org/10.1080/09735070.2008.11886324 [Internet]. (Accessed 26 August 2022).
[34] In Chicago, Neighborhoods Have Stark Differences in Economic Opportunity [Internet]. Urban Institute. [cited 2022 October 25];Available from: https://www.urban.org/urban-wire/chicago-neighborhoods-have-stark-differences-economic-opportunity.
[35] S.J. Kim, W. Bostwick, Social Vulnerability and racial Inequality in COVID-19 Deaths in Chicago, Health Educ. Behav. 47 (4) (2020) 509–513, https://doi.org/10.1177/1090198120929677 [Internet]. (Accessed 25 January 2023).