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Demographic variation in continuous glucose monitoring utilisation among patients with type 1 diabetes from a US regional academic medical centre: a retrospective cohort study, 2018–2021

Omer Atac ,[1,2] Kory R Heier,[3] Daniela Moga ,[4,5] John Fowlkes,[6] Min-Woong Sohn,[1] Aaron J Kruse-Diehr,[7] Teresa M Waters,[8] Mary E Lacy [5]

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For numbered affiliations see end of article.

Correspondence to
Omer Atac;
oatac@medipol.edu.tr

ABSTRACT

Objective While continuous glucose monitoring (CGM) utilisation has been increasing among patients with type 1 diabetes (T1D), few studies have examined patterns of use across age, race/ethnicity and insurance status together. In this study, we examine CGM utilisation among patients with T1D from a regional academic medical centre across all insurance types.

Design and setting This is a retrospective cohort study including both paediatric and adult patients with T1D who visited a regional academic medical centre between 1 January 2018 and 31 December 2021.

Methods Patients were followed from the date of their first T1D encounter during the study period until the first of the following: CGM use was documented, ≥730 days with no encounters at this centre or the end of the study period. We compared CGM use across demographic and clinical characteristics and used logistic regression models to assess the association between demographic variables and CGM utilisation.

Results Among 3311 eligible patients with T1D, CGM utilisation was 51.22%. The highest utilisation rates were among patients <18 years old while the lowest rates were among those in the 65+ years age group. Patients with private insurance and those who attended diabetes self-management education and support (DSMES) programmes had significantly higher CGM utilisation than those with public insurance and those who did not attend DSMES, respectively. In models stratified by age, we examined patterns of CGM use across insurance categories and found that CGM rates were persistently low among those with public versus private insurance.

Conclusions In this retrospective review of patients with T1D receiving care at a regional academic medical centre from 2018 to 2021, nearly half of our sample used CGM. However, we found substantial variation in CGM utilisation with lower rates among older versus younger adults and individuals covered by public versus private insurance. Enhancing CGM access is important to mitigate diabetes-related complications for all patients with T1D.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Our study design allows us to examine continuous glucose monitoring (CGM) utilisation trends among patients with type 1 diabetes (T1D) across all age groups.
⇒ The study data were obtained from a regional academic medical centre serving a population with a range of insurance coverage.
⇒ Identifying patients with T1D solely based on diagnosis codes might have led to misclassification.
⇒ It is unknown how many patients might have declined offered CGM use.
⇒ As the study period coincided with the COVID-19 pandemic, disruptions in healthcare-seeking behaviour during the early part of the pandemic might have influenced healthcare access and CGM utilisation patterns.

INTRODUCTION

In the past decade, remarkable progress in type 1 diabetes (T1D) management has been made through technological advancements, with continuous glucose monitoring (CGM) emerging as a pivotal tool among these innovations.[1] CGM provides real-time monitoring of glucose levels, allowing for timely adjustments to insulin dosages and improved glycaemic control.[2] Studies show that CGM usage lowers HbA1c levels and reduces complications like hypoglycaemia and diabetic ketoacidosis while improving patients' quality of life.[3–6] Aligned with these advancements, prominent professional organisations, including the American Diabetes Association, have advocated CGM utilisation by patients with T1D.[7–9]

Despite the clinical benefits of CGM and the guidance from professional organisations recommending its use in T1D management, CGM utilisation is still underused.[10] A number

of barriers to CGM utilisation have been identified in prior studies, including user preferences, high costs, provider barriers and limited insurance coverage.[10–13] Factors such as age, race/ethnicity and socioeconomic status (SES) are associated with reduced utilisation of CGM.[10 14] Studies have reported racial/ethnic disparities in CGM use, with higher utilisation among non-Hispanic whites (NHWs) compared with other racial/ethnic minority groups, even when controlling for SES and insurance.[15–23] Additionally, while CGM use was initially higher in adults than in children, CGM usage has shifted over time, and children and young individuals now have higher CGM utilisation than adults.[16 24] Of note, despite their elevated risk of acute hypoglycaemic events and other diabetes complications, patients aged 65 years and older have the lowest CGM utilisation among adults.[16] Insurance status plays an important role in CGM utilisation. Differences in Medicaid coverage across states, along with a lack of clear eligibility criteria across many insurance plans, create barriers for patients.[25–27] Moreover, individuals with private insurance are more likely to access an endocrinologist than individuals with public insurance, and studies have shown that endocrinologists are more likely to recommend CGM compared with primary care physicians.[26 28]

Existing studies have demonstrated the separate impacts of age, race/ethnicity and insurance status on CGM utilisation, but only a few studies have addressed all three together across all age groups.[16 18 29 30] Recent studies, including those from the T1D Exchange Quality Improvement Collaborative, underscore persistent disparities in diabetes technology use by race/ethnicity and insurance type across all age groups, with variations on equity trends.[31] Therefore, in the current study, we investigate the influence of demographic and clinical characteristics on the utilisation of CGM among patients with T1D across all age groups, receiving care at a regional academic medical centre from 1 January 2018 to 31 December 2021.

MATERIALS AND METHODS

Data source and study sample

We conducted a retrospective cohort study using electronic health record data containing de-identified patient data extracted from the medical centre's data warehouse to examine CGM utilisation in patients with T1D who received care between 1 January 2018 and 31 December 2021. The analytical sample included all patients who visited the medical centre during the study time frame with T1D, ascertained using diagnosis codes (ICD-10 (International Statistical Classification of Diseases and Related Health Problems 10th Revision): E.10). To identify eligible patients, both inpatient and outpatient encounters were included. To confirm the diagnosis of T1D among patients included in our study, we followed established algorithms and only included individuals with a higher number of encounters related to T1D compared with type 2 diabetes (T2D).[32 33] The date of their first T1D diagnosis during the study period served as their index date; patients were followed from their index date until the first documented CGM use, ≥730 days with no encounters at this centre or the end of the study period (31 December 2021).

CGM ascertainment

CGM utilisation was defined as inclusive of both prescription and use. It was identified using National Drug Codes and Current Procedural Terminology codes listed in online supplemental table 1.

Covariate identification

Demographic information was extracted from each patient's index encounter, including age, sex, race/ethnicity and insurance type. Race/ethnicity was documented in the medical records based on patient self-identification and categorised as Hispanic, non-Hispanic black (NHB), NHW and other. The 'other' category includes groups with smaller representation, such as Asian, American Indian/Alaskan Native and Native Hawaiian/other Pacific Islander. Insurance type was classified as private, public (Medicaid or Medicare coverage) or other (self-pay, TRICARE, Third Party Liability insurance and other). The following covariates were extracted from a baseline period defined as the 365 days prior to and including the index date: body mass index (BMI), diabetes self-management education and support (DSMES) attendance, severe diabetic ketoacidosis, severe hypoglycaemia and diabetes-related complications that are included in the calculation of the adjusted Diabetes Complication Severity Index (aDCSI). DSMES is a standardised, evidence-based programme in the United States, delivered by a credentialed diabetes educator who teaches patients with diabetes how to effectively manage the disease. It covers medication adherence, lifestyle adjustments, monitoring techniques and is linked to better glycaemic control, a reduction in mortality and improved quality of life.[34 35] Diagnosis codes from the inpatient setting were used to ascertain severe diabetic ketoacidosis (DKA; E10.1) and severe hypoglycaemia (E11.641, E11.649) during baseline.[36] Ascertainment of severe hypoglycaemic events was based on validated algorithms[36 37] and, while we are not aware of a validated algorithm to ascertain severe DKA, we based ascertainment on prior studies to verify the accuracy/completeness of our list of ICD-10 codes for this condition.[38 39]

The aDCSI is an index that uses claims and lab data to predict the long-term effects of diabetes on seven prominent body systems: ocular, renal, neurological, cerebrovascular, cardiovascular, peripheral vascular and metabolic. Diagnosis codes from inpatient and outpatient claims were used to ascertain the presence of diabetes-related complications that are included in the calculation of the aDCSI. These complications were pulled from the baseline period. The ICD-10 codes that were used in this calculation are listed in online supplemental table 2.

Statistical analysis

First, we calculated summary statistics on the overall sample. Continuous variables were reported as median (Q1, Q3), while categorical variables were reported as frequency and percentage in each category. Next, we compared rates of CGM utilisation across demographic and clinical characteristics. We also compared demographic characteristics based on endocrinology visit status. We used Wilcoxon rank sum tests and χ^2 tests to compare continuous and categorical variables, respectively.

A series of logistic regression models were used to assess the association between demographic variables and CGM utilisation in the study period. Model 1 included only demographic variables, while Model 2 additionally adjusted for prior acute diabetes complications (severe DKA and severe hypoglycaemia) and aDCSI. Subgroup analyses using Model 2 were performed among those aged <18 years and 18–64 years to evaluate the relationship between insurance status and CGM usage within specific age groups. Since 88.3% of the 65+ years age group had Medicare, we did not perform a subgroup analysis examining the association between insurance coverage and CGM in the 65+ years age group. We conducted a sensitivity analysis in which we restricted the sample to patients who received care from an endocrinologist and examined CGM utilisation among this subgroup using Model 2. Analyses were performed in SAS V.9.4 (Cary, NC). A two-sided p value <0.05 was considered statistically significant.

RESULTS

Our study sample consisted of a total of 3311 patients with T1D who received care at our regional academic medical centre between 1 January 2018 and 31 December 2021. Overall utilisation of CGM was 51.22% (n=1696). Demographic and clinical characteristics are presented in table 1. The median age of the sample was 24.0 years; approximately half of the sample were female (n=1633, 50.33%); the majority were NHWs (n=2740, 82.93%) and nearly one-quarter were classified as having obesity (n=768, 23.91%). Approximately half of the sample (49.33%) had public insurance (Medicaid or Medicare); 21.10% of individuals attended DSMES and 77.51% visited an endocrinologist. During the 1-year baseline period, 17.62% of the sample had a diagnosis of severe DKA, and 2.39% had a diagnosis of severe hypoglycaemia.

CGM utilisation followed a decreasing pattern as age increased; use was highest among individuals in the youngest age group (74.40% for those 0–12 years) and lowest among those aged 65+ years (24.26%) (p<0.0001; table 2). While no difference in CGM usage was found based on sex, there were significant differences in CGM utilisation across racial and ethnic groups. CGM usage was significantly lower among Hispanic (30.23%) and NHB patients (39.04%) than NHW (52.23%) (p=0.0001). Compared with individuals covered by public insurance, CGM utilisation was higher among those with private insurance (40.74% vs 63.07%, p<0.0001). CGM usage was

Table 1 Characteristics of patients with type 1 diabetes from the academic medical centre database 2018–2021

	Overall n=3304
Demographic	
Age category, years, n (%)	
0–12	621 (18.84%)
13–17	529 (16.05%)
18–25	606 (18.39%)
26–49	1050 (31.86%)
50–64	354 (10.74%)
65+	136 (4.13%)
Missing	8 (0.24%)
Sex, n (%)	
Female, n (%)	1663 (50.33%)
Race/ethnicity, n (%)	
Hispanic	43 (1.30%)
Non-Hispanic black	187 (5.66%)
Non-Hispanic white	2740 (82.93%)
Other	334 (10.11%)
Insurance type, n (%)	
Public	1630 (49.33%)
Private	1587 (48.03%)
Other	87 (2.63%)
Attended DSMES, n (%)	
No	2607 (78.90%)
Yes	697 (21.10%)
Endocrinology visit, n (%)	
No	743 (22.49%)
Yes	2561 (77.51%)
Clinical	
Age, median (Q1, Q3)	24.0 (14.0, 39.0)
BMI, n (%)	
Not having obesity	2444 (76.09%)
Having obesity	768 (23.91%)
Missing	92 (2.78%)
BMI, median (Q1, Q3)	24.9 (21.0, 29.7)
HbA1c, median (Q1, Q3)	8.6 (7.5, 10.5)
Severe DKA, n (%)	582 (17.62%)
Severe hypoglycaemia, n (%)	79 (2.39%)
Diabetic complications, n (%)	
Ocular	301 (9.11%)
Renal	351 (10.62%)
Neurological	469 (14.19%)
Cerebrovascular	64 (1.94%)
Cardiovascular	320 (9.69%)
Peripheral vascular	109 (3.30%)

Continued

Table 1 Continued

	Overall n=3304
Metabolic	1016 (30.75%)
Sum of diabetic complications, median (Q1, Q3)	0.0 (0.0, 1.0)
CGM utilisation, n (%)	1696 (51.22%)

BMI, body mass index; CGM, continuous glucose monitoring; DKA, diabetic ketoacidosis; DSMES, diabetes self-management education and support.

higher among individuals classified as not having obesity (53.76%) than those classified as having obesity (46.24%). In addition, CGM users exhibited lower BMI (25.17±7.22) and HbA1c (8.98±2.08) levels compared with non-users (p<0.0001 and p=0.0017, respectively). The use of CGM was higher among individuals who attended DSMES (61.98%) than those who did not (48.48%; p<0.001) and was higher among those who had visited an endocrinologist (64.35%) compared with those who did not (6.46%; p<0.001). There was no difference in CGM use in those with severe DKA or severe hypoglycaemia, but CGM users had lower aDCSI scores compared with non-users (median of aDCSI score in CGM users 0.0 vs 1.0 in non-users; p<0.0001).

While comparing sociodemographic characteristics between patients who visited an endocrinologist and those who did not, those who visited endocrinology were generally younger and more likely to have private insurance (p<0.0001; online supplemental table 3). DSMES attendance was also significantly higher among patients who visited endocrinology compared with those who did not (26.90% vs 1.08%, p<0.0001).

In Model 1, which adjusts only for demographic characteristics as shown in figure 1a, individuals aged 65+ years (OR=0.14, 95% CI: 0.09, 0.22) had the lowest likelihood of CGM use compared with their younger counterparts (reference group= 0–12 years of age). Hispanics (OR=0.42, 95% CI: 0.21, 0.85) and NHBs (OR=0.72, 95% CI: 0.52, 1.00) had lower odds of CGM use compared with NHWs (reference). Individuals with private insurance (OR=2.60, 95% CI: 2.23, 3.03) were more likely to use CGM than those with public insurance (reference). In Model 2, which additionally adjusts for clinical characteristics, similar odds were observed (figure 1b). Compared with individuals in the 0–12 year age group (reference group), those in the 65+ years age group (OR=0.16, 95% CI: 0.10, 0.27) had the lowest odds of CGM use. Compared with NHWs (reference group), Hispanics (OR=0.44, 95% CI: 0.21, 0.91) and NHBs (OR=0.79, 95% CI: 0.57, 1.10) had lower odds of CGM use. Individuals with private insurance (OR=2.27, 95% CI: 2.02, 2.78) were almost two and a half times more likely than individuals with public insurance to use CGM (reference group). CGM use was not significantly associated with sex or DSMES attendance in either model. In our sensitivity analysis restricting to individuals who received care from an endocrinologist, similar trends were observed (online supplemental figure 1).

In fully adjusted models (Model 2 above) stratified by age group (<18 and 18–64 years), individuals with private insurance were more likely to use CGM than those with public insurance (figure 2). Among those <18 years, the odds of CGM utilisation for those with private insurance were nearly three times higher compared with those with public insurance (OR=2.86, 95% CI: 2.18, 3.75). Similarly, among those aged 18–64 years, CGM use was significantly higher in those with private versus public insurance (OR=2.12, 95% CI: 1.73, 2.61).

DISCUSSION

In this study, we examined the association between demographic and clinical characteristics and CGM use among patients with T1D seen at an academic medical centre from 2018 to 2021. Slightly more than half of the participants (51.2%) used CGM during the study period. Rates of CGM utilisation were higher in younger versus older patients and higher among patients with private versus public insurance. These differences remained even after adjusting for clinical characteristics (BMI and HbA1c), prior acute diabetes complications (severe diabetic ketoacidosis and severe hypoglycaemia) and the Diabetes Complications Severity Index.

Our findings were consistent with previous literature, including our study using data from Merative MarketScan Commercial Claims, which included nationwide de-identified patient-level data for geographically diverse patients of all ages with T1D.[40] In that study, CGM utilisation was 49.78% over the 2016–2019 timeframe, up from 20.12% in the 2010–2013 timeframe. Individuals under 18 years old had the highest rate of utilisation, and CGM utilisation declined with increasing age. While the current study includes a smaller population compared with the MarketScan study, we extended the scope by exploring factors that may influence access to CGM, including race/ethnicity and insurance status. Despite the substantial increase in CGM utilisation observed in recent years, reports continue to underscore disparities in CGM adoption among various ages and population subgroups.[15 16 18 19 21 30 41 42] For example, in Bailey *et al*.'s study, CGM usage was 31.4% and was lower among older individuals, males, NHBs and those with public insurance.[16] Similarly, in Fantasia *et al*.'s study, CGM usage was 30.0% overall, but the use of diabetes technology was significantly lower in NHB patients than in NHW patients and was significantly lower in those with public versus private insurance.[18] These disparities may be influenced by structural barriers, such as socioeconomic status, healthcare access and inequalities that disproportionately impact NHB and Hispanic patients. The observed disparities in CGM use across diverse groups are important because substantial evidence suggests that CGM utilisation leads to improved clinical outcomes and enhanced

Table 2 Comparison of CGM utilisation status among patients with type 1 diabetes across subgroups defined by demographic and clinical characteristics from the academic medical centre database 2018–2021

	No CGM use N=1608	CGM use N=1696	P value
Demographic			
Age category, years, n (%)			<0.0001
0–12	159 (25.60%)	462 (74.40%)	
13–17	193 (36.48%)	338 (63.52%)	
18–25	283 (46.70%)	323 (53.30%)	
26–49	654 (62.29%)	396 (37.71%)	
50–64	212 (59.89%)	142 (40.11%)	
65+	103 (75.74%)	33 (24.26%)	
Sex, n (%)			
Female	785 (47.20%)	878 (52.80%)	0.09
Male	823 (50.15%)	818 (49.85%)	
Race/ethnicity, n (%)			0.0001
Hispanic	30 (69.77%)	13 (30.23%)	
Non-Hispanic black	114 (60.96%)	73 (39.04%)	
Non-Hispanic white	1309 (47.77%)	1431 (52.23%)	
Other	155 (46.41%)	179 (53.59%)	
Insurance type, n (%)			<0.0001
Public	966 (59.26%)	664 (40.74%)	
Private	589 (36.93%)	1001 (63.07%)	
Other	56 (64.37%)	31 (35.63%)	
Attended DSMES, n (%)			<0.0001
No	1343 (51.52%)	1264 (48.48%)	
Yes	265 (38.02%)	432 (61.98%)	
Endocrinology visit, n (%)			<0.0001
No	695 (93.54%)	48 (6.46%)	
Yes	913 (35.65%)	1648 (64.35%)	
Clinical			
Age, median (Q1, Q3)	30.0 (19.0, 46.0)	19.0 (12.0, 32.0)	<0.0001
BMI, n (%)			0.0009
Not having obesity	1130 (46.24%)	1314 (53.76%)	
Having obesity	408 (53.13%)	360 (46.88%)	
BMI, median (Q1, Q3)	26.4 (21.7, 30.4)	24.4 (20.1, 29.0)	<0.0001
HbA1c, median (Q1, Q3)	8.8 (7.4, 10.8)	8.5 (7.5, 10.0)	0.0017
Severe DKA, n (%)	304 (52.23%)	278 (47.77%)	0.058
Severe hypoglycaemia, n (%)	42 (53.16%)	37 (46.84%)	0.4183
Diabetic complications, n (%)			
Ocular	182 (60.47%)	119 (39.53%)	<0.0001
Renal	279 (79.49%)	72 (20.51%)	<0.0001
Neurological	320 (68.23%)	149 (31.77%)	<0.0001
Cerebrovascular	55 (85.94%)	9 (14.06%)	<0.0001
Cardiovascular	264 (82.50%)	56 (17.50%)	<0.0001
Peripheral vascular	95 (87.16%)	14 (12.84%)	<0.0001
Metabolic	506 (49.80%)	510 (50.20%)	0.3845
Sum of diabetic complications, median (Q1, Q3)	1.0 (0.0, 2.0)	0.0 (0.0, 1.0)	<0.0001

BMI, body mass index; CGM, continuous glucose monitoring; DKA, diabetic ketoacidosis; DSMES, diabetes self-management education and support.

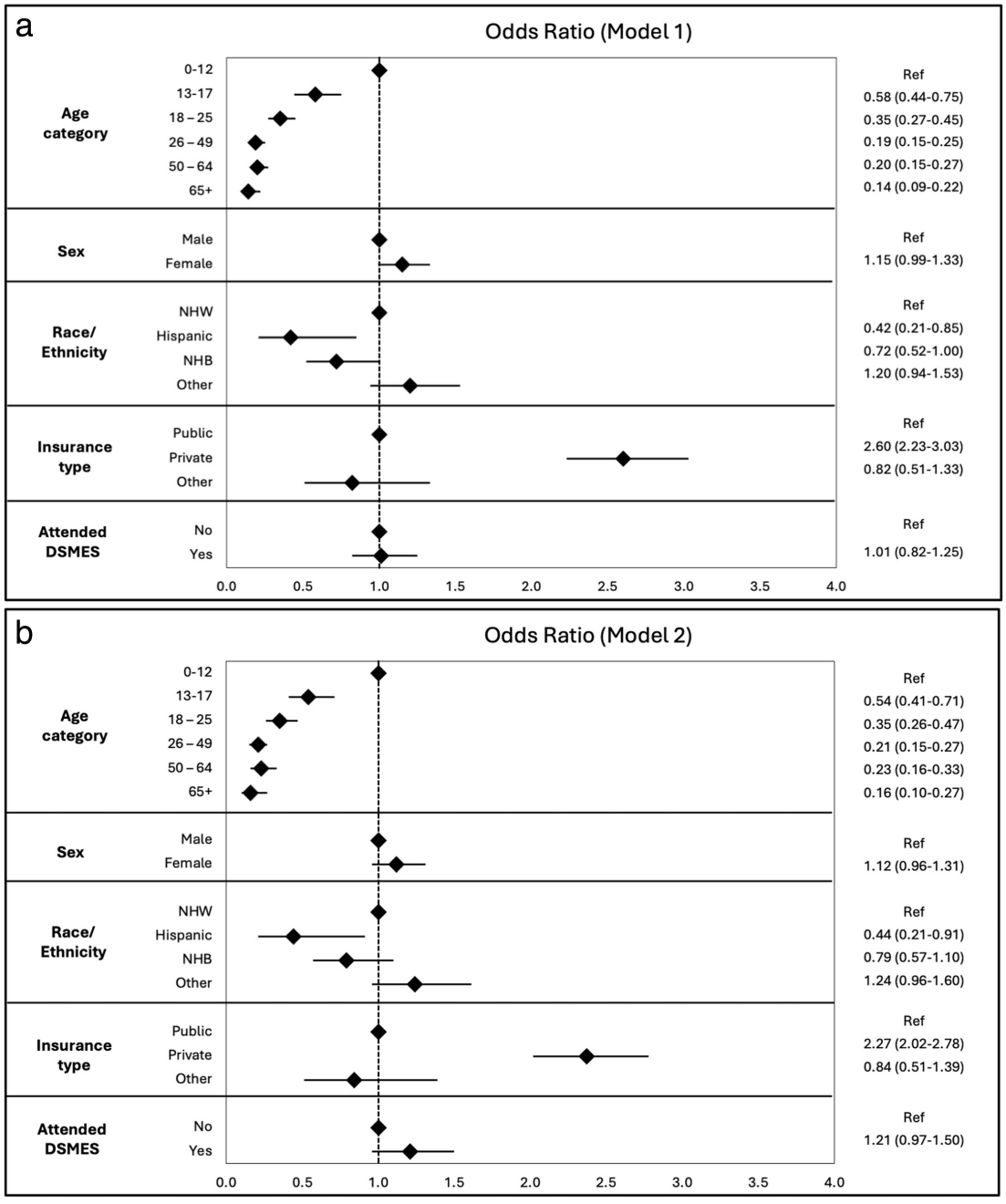

Figure 1 Logistic regression models examining the odds of CGM utilisation by demographic and clinical characteristics of individuals with type 1 diabetes. (a) Model 1 simultaneously adjusts for all demographic variables (age category, sex, race/ethnicity, insurance type and attended DSMES). (b) Model 2 additionally adjusts for clinical characteristics (body mass index and HbA1c), prior acute diabetes complications (severe diabetic ketoacidosis and hypoglycaemia) and Diabetes Complications Severity Index. CGM, continuous glucose monitoring; DSMES, diabetes self-management education and support; NHB, non-Hispanic black; NHW, non-Hispanic white.

diabetes management in patients with T1D, regardless of their demographic and clinical characteristics.[1]

While the majority of studies have focused on populations under the age of 18 years, a limited number of studies, including our own, have examined CGM use across the full spectrum of age groups.[16 24 40] In contrast to our findings, DeSalvo *et al* observed that adults were more likely to use CGM than children; this difference may be attributed to the limited sample size of adults in their study.[30] Possible explanations for this rise in CGM usage among children include the relative ease of adapting to CGM technology quickly after diagnosis, parents' ability to remotely monitor CGM data for their children and an increased likelihood that children with T1D receive care from an endocrinologist.[24 43] Older individuals may be hesitant to leave their long-standing fingerstick routines, despite clear evidence of benefits from CGM utilisation in older as well as younger populations.[44 45] Moreover, healthcare providers in diabetes management may have some hesitancy to recommend CGM usage to patients who

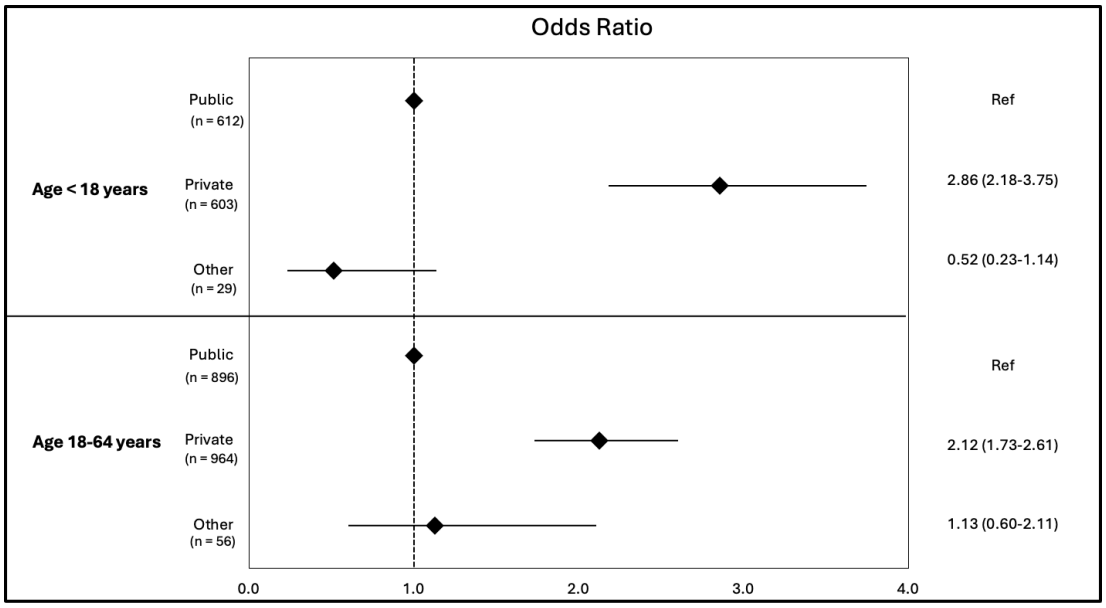

Figure 2 Logistic regression models examining the odds of CGM utilisation among individuals with type 1 diabetes by insurance-stratified age groups*. *Since 88.3% of the 65+ years age group had Medicare, they were excluded from the subgroup analyses. This model simultaneously adjusts for all demographic variables (age category, sex, race/ethnicity and attended DSMES), clinical characteristics (body mass index and HbA1c), prior acute diabetes complications (severe diabetic ketoacidosis and hypoglycaemia) and Diabetes Complications Severity Index. CGM, continuous glucose monitoring; DSMES, diabetes self-management education and support.

have demonstrated self-efficacy in managing their condition with conventional methods.[46] Providing resources and support for successful diabetes self-management in older adults with T1D is crucial as long as they are capable of self-management.

Similar to previous studies, we found a consistent pattern of lower CGM usage among NHBs and Hispanics compared with NHWs; however, in fully adjusted models, this difference was statistically significant only for Hispanic individuals.[15–17 19 21 41] Access to CGM technology remains limited in historically marginalised racial and ethnic populations, despite the presence of clear guidelines for CGM utilisation as a standard of care.[10 47] While cost has been identified as a key factor influencing CGM usage, studies indicate that disparities persist among racial/ethnic subgroups across different age groups, regardless of insurance status, household income or socioeconomic status.[16 22 30 48 49]

In our study, individuals with private insurance were 2.5 times more likely to use CGM compared with those with public insurance, aligning with prior studies.[16 21 41 42] In the United States, health insurance coverage varies, including private insurance, Medicaid, Medicare and uninsured status. Access to CGM and other diabetes-related technologies often depends on the type of insurance, with differences in coverage policies and co-payment requirements across plans. For instance, Medicaid eligibility criteria for CGM coverage differs across states, ranging from no requirement for blood glucose monitoring in some states to mandating documentation at least four times daily.[26] The most frequently identified barriers in prior studies are related to cost and coverage.[13 50] Additionally, access to an endocrinologist, which is closely related to insurance type, plays an important role in CGM utilisation, as specialist support can facilitate access to advanced diabetes management tools, including CGM.[26] However, while private insurance often covers endocrinology visits depending on the specific plan, public insurance may limit access through narrower networks or stricter referral requirements, potentially reducing CGM access.[26] Preventing complications of T1D through wider CGM adoption may result in substantial cost savings for both patients and healthcare payers.[24 27] If eligibility barriers for CGM usage are primarily cost-related, it is worth highlighting that the costs associated with managing T1D would decrease as CGM utilisation rates rise, given well-documented improvements in A1c and reductions in complications among those using CGM.

We conducted an age-stratified analysis to disentangle the contribution of age from the contribution of insurance coverage to CGM use. We found that, among those aged <18 years, individuals with private insurance were more than three times more likely to use CGM than those with public insurance. In our study, 100% of those aged <18 years with public insurance were covered by Medicaid. Kentucky expanded Medicaid under the ACA (Affordable Care Act) in 2014.[51] Notably, Kentucky Medicaid does not impose any daily insulin injection or pumping limits, blood glucose monitoring requirements or other prerequisites,[52] and yet we still observed a dramatic disparity in CGM usage based on insurance coverage within this age group. In our study, there were n=136 older adults (aged 65+ years); among this subset, 88.3% (n=120)

were covered by Medicare insurance which precluded our ability to examine the role of insurance coverage in this group. Medicare does include CGM coverage; however, because we had so few older adults in our sample who were privately insured, we were not able to assess the contribution of insurance to CGM utilisation among this subset.

Recent estimates suggest that <10% of individuals with diagnosed diabetes have participated in DSMES.[53 54] In the current study, we found that 21.10% of our T1D patients attended DSMES over a 3-year timeframe. Importantly, we also found that individuals who attended DSMES were more likely than those who did not to subsequently initiate CGM. Thus, while clinicians balance competing demands within their limited appointment times, DSMES can serve as an additional resource that provides patients with comprehensive education and the tools needed to initiate and successfully integrate CGM into diabetes management. We also found higher CGM utilisation among patients with lower BMI. One possible explanation might be related to our finding of higher CGM utilisation in the <18 years age group compared with adults. Adults with T1D have a higher prevalence of obesity compared with children with T1D.[55]

Our study has many strengths. Our sample included patients with T1D of all ages, enabling us to estimate CGM utilisation across a range of ages using the same methodology to allow for direct comparison. The study data were extracted from the electronic health record system of a large healthcare institution that serves patients with a range of insurance coverage. Approximately half of our sample was insured with public insurance. This study highlights racial/ethnic disparities in CGM use among a sample that includes individuals with public and private insurance.

Several limitations also existed. First, our observational, retrospective study is from a single centre, so the findings may not be generalisable to other settings. Second, it is not possible to make causal inferences from the observed disparities. Third, relying on diagnosis codes to identify individuals with T1D was a potential weakness. Prior studies have validated the use of ICD-9 and ICD-10 codes to identify patients with T1D, yet inherent weaknesses exist when relying on diagnosis codes to differentiate T1D patients from those with T2D.[32 33] Fourth, whether CGM was offered but declined by some patients was unclear. Fifth, despite a pattern suggestive of lower CGM use in Hispanic individuals, our sample size of Hispanic subjects was limited (n=43). Additionally, our study period overlapped with the COVID-19 pandemic, during which health-seeking behaviours among patients with diabetes were disrupted, especially in the early stages.[56] This disruption may have affected our results. Sixth, our study focused on severe DKA; however, evaluating CGM utilisation based on the presence of any DKA, rather than only severe cases, would be clinically appropriate. Finally, we are not able to ascertain years of T1D duration in our study. CGM utilisation may differ in patients with differing duration of T1D.

CONCLUSIONS

Approximately half of the individuals with T1D who were receiving care at a regional academic medical centre used CGM in this study. However, substantial variation persisted in the utilisation of CGM, most strikingly among older adults with T1D and those covered by public insurance. Future studies should explore barriers and facilitators to CGM adoption among these groups and target efforts towards ensuring equitable access to this effective technology.

Author affiliations
[1]Department of Health Management and Policy, University of Kentucky College of Public Health, Lexington, Kentucky, USA
[2]Department of Public Health, Istanbul Medipol University International School of Medicine, Istanbul, Türkiye
[3]Department of Biostatistics, University of Kentucky College of Public Health, Lexington, Kentucky, USA
[4]Department of Pharmacy Practice and Science, University of Kentucky College of Pharmacy, Lexington, Kentucky, USA
[5]Department of Epidemiology, University of Kentucky College of Public Health, Lexington, Kentucky, USA
[6]Department of Pediatrics and Barnstable Brown Diabetes Center, University of Kentucky College of Medicine, Lexington, Kentucky, USA
[7]Department of Family and Community Medicine, University of Kentucky College of Medicine, Lexington, Kentucky, USA
[8]Augusta University School of Public Health, Augusta, Georgia, USA

X Daniela Moga @epidmoga

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ORCID iDs
Omer Atac http://orcid.org/0000-0001-8984-9673
Daniela Moga http://orcid.org/0000-0002-3648-8197
Mary E Lacy http://orcid.org/0000-0002-8814-8725

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