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Health literacy, illness perception, depression, and self-management among African Americans with type 2 diabetes

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) causes significant morbidity and mortality. Compared with non-Hispanic Whites, African Americans are more likely to suffer and die from T2DM.

Purpose: This study examines the associations between health literacy, illness perception, depression, working memory, executive function, and self-management among African Americans (18–65 years) with T2DM.

Methodology: A descriptive cross-sectional design was used. Data were collected through Research Electronic Data Capture and transferred to the Statistical Package for the Social Sciences software version 26 for statistical analysis. Fifty-three participants met study eligibility criteria.

Results: Health literacy was associated with depression ($r = -0.433$, $p = .003$), more concerns about illness ($r = -0.357$, $p = .02$), and better medication adherence ($r = 0.487$, $p = .001$). Higher levels of depression were inversely associated with medication adherence ($r = -0.449$, $p = .002$; $r = 0.449$, $p = .003$). Higher concern about illness was associated with lower medication adherence ($r = -0.414$, $p = .005$).

Conclusions: Lower health literacy coupled with illness perception and depression is associated with lower self-management behaviors among African Americans which can lead to complications of T2DM. More studies are needed to examine the association of cognitive factors with self-management activities among African Americans with T2DM.

Implications: Limited health literacy is associated with lower medication adherence among African Americans with T2DM. Illness perception is a significant factor that influences self-management of T2DM among African Americans. Using screening tools that assess health literacy and illness perception may address underlying concerns regarding adherence to T2DM treatment regimens in African Americans.

Keywords: African Americans; cognitive function; depression; illness perception; self-management; type 2 diabetes.

Background

Diabetes mellitus is one of the most common diseases globally and causes significant mortality and morbidity. The World Health Organization has reported that over 422 million people are diagnosed with type 2 diabetes mellitus (T2DM), and in 2040, the number of people affected by diabetes will increase to 640 million people worldwide (World Health Organization, 2021). Type 2 diabetes mellitus is a chronic disease that affects all racial groups and is the seventh leading cause of death in the United States (American Diabetes Association, 2021). It is estimated that

in the United States alone, diabetes affects 34.2 million people with 26.8 million diagnosed and an estimated 7.3 million who remain undiagnosed. In the United States, African Americans represent 13.4% of the population, yet this group is disproportionately affected by diabetes (13.2%) compared with non-Hispanic Whites (7.4%) (American Diabetes Association, 2021). African Americans are twice as likely to be diagnosed with diabetes, and they have two to four times the rates of T2DM-associated kidney failure, blindness, lower-limb amputations, and amputation-related mortalities when compared with non-Hispanic Whites (American Diabetes Association, 2018; Bhattacharya, 2012; Bogner & Vries, 2010). Complications are mostly related to poor diabetes self-management (Ajuwon & Love, 2020; American Diabetes Association, 2018; Bhattacharya, 2012; Bogner & Vries, 2010). African Americans, as compared with non-Hispanic Whites, are estimated to be 2.2 times more likely to die

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from diabetes because of poor self-management of diabetes (Lynch et al., 2019; Pena-Purcell et al., 2015). Other long-term complications of poorly controlled T2DM include retinopathy, nephropathy, peripheral nerve damage, cardiovascular disease, and amputation (American Diabetes Association, 2018; Chlebowy et al., 2018). Intensive self-management of T2DM requires lifestyle behaviors involving meticulous blood glucose monitoring, healthy eating, physical activity, and medication adherence (Gomes et al., 2020). These lifestyle behaviors are important to obtain optimal glycemic control and prevent diabetes-related complications (Gomes et al., 2020).

Self-management of diabetes is challenging, and health disparities exist in the outcomes of diabetes among African Americans compared with other racial groups. African Americans are the least healthy racial group in the United States (Noonan et al., 2016). They are often poorer, have less education, are more likely to live in a distressed neighborhood and household, and are less able to access quality health care (Cunningham et al., 2018; Noonan et al., 2016). African Americans have almost twice the rate of unemployment (6.1%) compared with non-Hispanic Whites (3.5%) (Bureau of Labor Statistics, 2020). These factors can affect health and contribute to health disparities while increasing relative risk of health disparities for this population (Noonan et al., 2016).

Health literacy is an essential component of self-management, and limited health literacy is observed in people with T2DM, with an estimate ranging from 22% to as high as 38% (Ferguson et al., 2015). Individuals with T2DM and limited health literacy have challenges reading medication labels accurately, may take medications incorrectly, and have difficulty understanding printed instructions for follow-up of their T2DM (Abdullah et al., 2019). Limited health literacy is associated with worse glycemic control, higher rates of diabetic retinopathy, less comprehension of medication instructions, dosing, timing and warnings, poorer disease knowledge, significant hypoglycemic events, and worse depressive symptoms (Al Sayah et al., 2015). Limited health literacy is a significant problem among African Americans with T2DM, and nearly one quarter (24%) of African Americans have low health literacy, compared with 9% of non-Hispanic Whites (Han et al., 2019). African Americans with limited health literacy may also have difficulty communicating effectively with their health care provider, frequently do not understand treatment recommendations (Abdullah et al., 2019), and may have difficulty taking their antidiabetic medications properly (Han et al., 2019).

Another factor that might be associated with poor self-management among African Americans is how individuals view T2DM, referred to here as illness perception. Illness representation of diabetes for African Americans might be constructed based on their experiences with family members, their own personal experiences and sociocultural background, and perceived knowledge about health care providers. African American cultural beliefs have been found to undesirably influence diabetes management (Shiyanbola, Ward, et al., 2018). African Americans who have diabetes are more likely to have negative beliefs and attitudes about diabetes that affect possible control of the disease. Thus, hopelessness and fear of discussing diabetes and its complications may be a particular problem with this population (Shiyanbola, Ward, et al., 2018). Other comorbid conditions such as depression and concern about ongoing vascular injury because of T2DM may also affect cognitive processes in these individuals, further limiting their ability to manage their T2DM (Tomlin & Sinclair, 2016). Depression is associated with a 60% risk for developing T2DM, with the overall prevalence of depression with T2DM being 25% in African Americans (Ajuwon & Love, 2020; Mezuk et al., 2008; Rovner et al., 2014). Depression is associated with risk for poor self-management among African Americans with T2DM (Ajuwon & Love, 2020; Chireh et al., 2019).

Cognitive processes such as working memory (WM) and executive function (EF) have the potential to influence self-management of T2DM. Working memory is the cognitive process describing how one maintains and holds information as can be reflected in mental math activities, for example, calculating the dose of insulin based on needs. Executive function is the ability to focus attention, plan, inhibit distractions, and shift attention as needed (Insel et al., 2006; Tomlin & Sinclair, 2016). Cognitive processes such as WM and EF have the potential to influence self-management of T2DM (Gatlin & Insel, 2015; Insel et al., 2006; Tomlin & Sinclair, 2016).

The purpose of this study was to examine the associations between health literacy, illness perception, depression, WM, EF, and self-management among African Americans (18–65 years) with T2DM. The theoretical framework that guided this study was the Common-Sense Model of Self-Regulation. The model has three central tenets: (1) The person is an active problem-solver seeking information. Understanding the meaning of the symptom and physical condition and the relevance of these meanings to both media and interpersonal messages about their health risks; (2) illness representation guides coping and consideration of action outcomes; and (3) representations depend on individuals, wherein they may or may not be accompanied with medical facts (Diefenbach & Leventhal, 1996; Leventhal et al., 2003). Gaps continue to exist in our understanding of the self-management of T2DM among the African American population. Currently, heterogeneity in methodological analyses and participants involved in previous studies make reaching cogent conclusions difficult. There is a gap in evidence in understanding glycemic control in the African American population with T2DM and the role of EF and WM in self-

management of T2DM in the African American population.

Methodology

Study design

A descriptive cross-sectional design was used to examine the association between health literacy, illness perception, depression, WM, and EF among African Americans aged 18–65 years with T2DM. The study was conducted between September 24, 2020, and January 12, 2021.

Participants and data collection

Sample size estimation was based on the data from a recently published study (Milo & Connelly, 2019) "predictors of glycemic management among patients with T2DM (N = 100)". The effect size (ES) in this study was .13, considered to be moderate ES using the Cohen (1988) criteria with an alpha = .05 and power = .80. The projected sample size needed with this ES (G*Power 3.1, Jochen Grommisch, Aichach, Germany) was N = 78. Calculation was completed with the assumption of 20% variance (R^2 = 0.192) based on variables in a study that predicted HbA1c levels (gender, level of education, years of T2DM, perceived self-efficacy), self-management activities (exercise, blood glucose testing, diet, foot care, medication adherence, self-care recommendations, and smoking), and diabetes knowledge (Milo & Connelly, 2019). The consequent sample size was N = 53 and was consistent with the rule of thumb of 10 participants per variable for multiple regression (Gorsuch, 2015).

An Institutional Review Board (IRB) approved this study. Data collection were performed virtually first through recruiting persons of African American heritage with T2DM using Facebook, a social media site. Research Electronic Data Capture (REDCap) was used for data collection. Research Electronic Data Capture is a web-based application used to capture clinical research and create database for projects (Patridge & Bardyn, 2018). The Kramer et al. (2014) recommendations for strategies to validate data collected using the internet included: (1) limiting web-based access to those who respond affirmatively to the following questions: "I am an African American between the age of 18 and 65 years" and "I am currently living with T2DM" and (2) potential responses that demonstrate "insider knowledge". The first question reflecting insider knowledge asked potential participants to report the symptoms of T2DM that they currently had. The second question asked how they are currently taking care of their diabetes; (3) participants were also asked to report how and where they found out about the study (Kramer et al., 2014). Financial compensation of $25 Walmart gift card was provided after the participants completed the survey. Delayed compensation is considered to reduce the perceived benefits of participation for fraudulent purposes (Kramer et al., 2014); (4) additional technical/software strategies were to limit enrollment to a URL web link embedded in the Facebook post.

Respondents answered basic demographic and "insider" knowledge screening questions and then were directed to complete the following questionnaires: Brief Health Literacy Screening Tool (BRIEF), the Brief Illness Perception Questionnaire (BIPQ), Patient Health Questionnaire-9 (PHQ-9), WM Questionnaire (WMQ), and Simplified Medication Adherence Questionnaire (SMAQ). The questionnaires took less than 35 minutes to complete. Although there were 92 REDCap entries, only 53 entries met the study criteria. Eligibility for the study included African Americans who were aged 18–65 years and self-reported a diagnosis of T2DM. Participants must have been able to read and write in English. Participants with type 1 diabetes mellitus were excluded from the study. Participants who met eligibility and completed the surveys were given an electronic Walmart gift card through the provided email address. Participation was totally voluntary, and participant identities were anonymized. All data were kept confidential.

Measures

Demographic information including age, gender, years since diagnosis of T2DM, sense of financial well-being, obtaining health care (health care obstacles), height, and weight were obtained. Psychometric properties assessing health literacy, illness representation, depression, WM and EF (storage, attention, executive domains), and medication adherence were measured.

Brief Health Literacy Screening Tool

The BRIEF assesses participants' self-reported health literacy. Four questions are scored from 4 to 20, which took less than 2 minutes to administer. The BRIEF consists of the following questions (Haun et al., 2009): (1) "How often do you have someone help you read hospital materials?" (2) "How confident are you filling out medical forms by yourself?" (3) "How often do you have problems learning about your medical condition because of difficulty understanding written information?" (4) "How often do you have a problem understanding what is told to you about your medical condition?" The first, third, and fourth questions response options are scored using a five-point Likert scale: 1 = not at all, 2 = a little bit, 3 = somewhat, 4 = quite a bit, and 5 = extremely (Haun et al., 2009). The first three questions were evaluated by Chew et al. (2004). The fourth question was added to assess difficulties with auditory health information which increased the tools' validity (Haun et al., 2009). The BRIEF has been used in clinical practice among Black patients and other ethnic minorities (Haun et al., 2009).

Brief Illness Perception Questionnaire

The BIPQ is a nine-item criterion rated on a scale from 0 (minimum) to 10 (maximum) (Basu & Poole, 2016). The

first five items of the questionnaire assessed cognitive perceptions such as effect on life (item 1), duration of illness (item 2), control over illness (item 3), beliefs about effectiveness of treatment (item 4), and experience of symptoms (item 5) (Basu & Poole, 2016). Items 6 and 8 assess emotional aspects including concern about illness and multifaceted questions about their mood, and item 7 assesses the degree of understanding of the illness (Basu & Poole, 2016; Broadbent et al., 2015). The questionnaire also included a final item, which is an open-ended question, asking the respondent to rank the three most important factors causing their illness (Basu & Poole, 2016; Broadbent et al., 2015). The BIPQ is widely used and has a good psychometric property and is purported to be a reliable and valid instrument with reliable values ranging between 0.80 and 0.85 (Broadbent et al., 2015; Karatas et al., 2017). The instrument was tested in patients with asthma, renal, and diabetes (Broadbent et al., 2006).

Patient Health Questionnaire-9
The PHQ-9 is a nine-item criterion self-administered questionnaire with a four-point Likert scale, with possible scores ranging from 0 to 27. It is a screening tool that also assesses symptom severity of depression for the past 2 weeks and has a Cronbach α of 0.89 (Kroenke et al., 2001). The PHQ-9 instrument has been previously used in the African Americans with T2DM (Cooke & O'Lawrence, 2017).

The Working Memory Questionnaire
Working memory and EF were assessed using the WMQ. The WMQ is a self-administered questionnaire developed by Vallat-Azouvi et al. (2012). It contains 30 items that address three dimensions of WM, including short-term storage, attention, and executive control (Vallat-Azouvi et al., 2012). The WMQ was found to have good internal consistency when evaluated in healthy participants and among patients with brain injury (Vallat-Azouvi et al., 2012). The WMQ was found to have good sensitivity to discriminate patients from matched controls in the short-term storage, attention, and executive control domains (Vallat-Azouvi et al., 2012). The questionnaire was found to have a good internal consistency when evaluated in healthy participants and patients with brain injury (Cronbach α, 0.89 and 0.94, respectively) (Vallat-Azouvi et al., 2012).

Simplified Medication Adherence Questionnaire
The SMAQ is a six-item questionnaire to evaluate different aspects of medication compliance in patients (Dagli-Hernandez et al., 2016; Ortega Suarez et al., 2011). Assessed areas consist of forgetfulness, routine, adverse effects, and quantification of omissions (Ortega Suarez et al., 2011). The SMAQ has a Cronbach α = 0.75; it also has a good interobserver agreement (88.2%), sensitivity of 91% and specificity ratio of 7.94 in

identifying nonadherent patients (Stirratt et al., 2015), and has been used in patients with diabetes (Al Matari et al., 2019).

Data analysis
Data collected were transferred from REDcap to the Statistical Package for the Social Sciences software version 26 for statistical analysis (SPSS Inc, IBM, Chicago, IL). The data entered were reviewed for accuracy, comparing entries with the instrument reports and scoring sheets. Demographic variables were analyzed with descriptive statistics, and inferential statistics was used to analyze the correlation between variables.

Results
Demographic variables and frequencies for gender, financial well-being, and health care obstacles are reported in **Tables 1 and 2**. The mean age was 49.35 years (SD = 10.33). The mean years diagnosed with T2DM was 7.38 (SD = 6.33). The mean height in inches was 64.2 (SD = 3.0). The mean weight (in pounds) was 168.4 (SD = 44.95), showing a minimum of 92 pounds and heaviest of 310 pounds. There were 23 men (43.4%) and 30 women (56.6%) in this study. Most participants (35.4%) reported "income does not meet expenses" (35.4%) whereas fewest participants (12.5%) reported "income exceeds expenses". Cost of health care (30.2%) was the second highest obstacle for obtaining health care for participants who reported "none of the above" (**Tables 1 and 2**). It is noteworthy that there was a large amount of missing data on the cognitive measures indicating people did not complete the measures (**Table 3**). The large amount of missing data made use of data on the cognitive measures difficult to interpret. Difficulty in obtaining these data through online survey was a challenge in this study.

Health literacy was inversely correlated with illness perception ($r = -0.357$, $p = .02$), indicating higher health literacy was associated with lower scores in illness perception. Health literacy was positively correlated with

Table 1. Demographics		
Characteristics	**Mean**	**SD**
Age		
26–65	49.35	10.3
Years diagnosed with type 2 diabetes		
1–30	7.38	6.3
Height in inches		
58–70	64.20	2.9
Weight in pounds		
92–310	168.4	44.96

Table 2. Frequency

	Frequency	Percent
Gender		
Men	23	43.4
Women	30	56.6
Financial well-being		
Income does not meet expenses	17	35.4
Income barely meets expenses	15	31.3
Income meets expenses	10	20.8
Income exceeds expenses	6	12.5
Health care obstacles		
Cost	16	30.2
Trust	1	1.9
Availability	2	3.8
None of the above	34	64.2

medication adherence ($r = 0.487$, $p = .001$). This finding indicates that higher health literacy is associated with medication adherence (**Table 4**).

Illness perception was inversely correlated with medication adherence (SMAQ) ($r = -0.414$, $p = .005$), indicating that participants who self-reported concerns about illness had lower medication adherence (**Table 4**).

Depression was positively correlated with illness perception measure ($r = 0.449$, $p = .003$), indicating that the higher the depression level, there were more concerns about their illness. Depression was inversely correlated with health literacy ($r = -0.433$, $p = .003$), indicating that the higher the depression, the lower the health literacy. Depression was also inversely correlated with medication adherence ($r = -0.449$, $p = .002$) indicating that the higher the depression level, the lower the adherence to medication (**Table 4**).

Discussion

Limited health literacy is believed to affect the outcome of the self-management of T2DM in different ways including decreased utilization of health care services, suboptimal patient–provider communication, and

Table 3. Missing Data From Working Memory Questionnaire (Storage and Executive Domains)

Survey	Missing Data
Storage domain	28
Executive domain	30

limited understanding of treatment recommendations (Han et al., 2019). In this study, health literacy was inversely related to depression and illness perception; these findings converge with recent studies that individuals who self-reported limited health literacy may have depressive tendencies (Hsu et al., 2020), and concerns about medication adherence might be an issue for individuals with low health literacy because of lower comprehension of health information (Shiyanbola, Unni, et al., 2018). By contrast, individuals who self-reported adequate health literacy had better medication adherence. Self-management of diabetes relies heavily on printed and verbal instructions and requires high health literacy skills. These are considered essential tools to help individuals make appropriate health decisions (Gomes et al., 2020). African Americans with T2DM and limited health literacy often cannot read medication labels accurately, may not take medication correctly, may not understand consent forms, and generally may have difficulty understanding print instructions for follow-up care and reading health instructions (Abdullah et al., 2019).

Illness representation among African Americans might be constructed based on an individual's experiences with family members, their own personal experiences and sociocultural background, and perceived knowledge about health care providers. African Americans' cultural beliefs have been found to negatively influence diabetes management (Shiyanbola, Ward, et al., 2018). African Americans who have diabetes are more likely to have negative beliefs and attitudes about diabetes and possible control of the disease. Thus, hopelessness and fear of discussing diabetes and its complications may be a problem in this population (Shiyanbola, Ward, et al., 2018). Improved understanding of self-management among

Table 4. Correlation

	PHQ-9	BIPQ	BRIEF
PHQ-9			
BIPQ	.449[a]		
	.003		
BRIEF	−.433[a]	−.357[b]	
	.003	.019	
SMAQ	−.449[a]	−.414[a]	.487[a]
	.002	.005	.001

Note: BIPQ = the Brief Illness Perception Questionnaire; BRIEF = Brief Health Literacy Screening Tool; PHQ-9 = Patient Health Questionnaire-9; SMAQ = Simplified Medication Adherence Questionnaire.
[a]*Correlation is significant at the .01 level (two-tailed).*
[b]*Correlation is significant at the .05 level (two-tailed).*

African Americans with T2DM is essential to inform potential interventions to improve T2DM outcomes.

Finding an inverse association between depression and medication adherence, suggesting that participants who had higher levels of depression had poorer self-management behavior, is consistent with previous studies (Ajuwon & Love, 2020; Chlebowy et al., 2018). Depression is a common comorbidity in individuals with diabetes (Ajuwon & Love, 2020; Gonzalez Heredia et al., 2021), and having depression complicates the management of T2DM, adversely affecting self-management behaviors and consequently leading to poor health outcomes (Al Sayah et al., 2015). In addition, according to a recent study, individuals with depression often have poor adherence to medication and health care recommendations eventually leading to poor glycemic control and complications of T2DM (Gonzalez Heredia et al., 2021). In addition, depression frequently goes undiagnosed and untreated in individuals with T2DM leading to unhealthy behaviors such as poor diet, sedentary lifestyle, and smoking, which are known to increase the risk and sequelae of obesity and diabetes (Hunter et al., 2018).

Furthermore, this study found a significant inverse relationship between depression and illness perception. Participants in this study perceived diabetes as a chronic disease with significant adverse effects on daily life and reported more depressive symptoms. These findings converge with other studies on the impact of illness perception and depression (Li et al., 2020; Nowicka-Sauer et al., 2018). In the common-sense model, illness perception consists of five components (cause of illness, identity, consequences of illness, timeline, and control or cure). Together, these components form an illness schema that determines how individuals respond to their illness, which also predicts their health behaviors, such as adhering to the treatment regimen (Broadbent et al., 2004, 2006; Leventhal et al., 2003). Illness perception is a significant factor that influences self-management practices, psychological distress, and other health outcomes among persons living with T2DM (Kugbey et al., 2017). The association between illness perception and the health outcomes could be due to the fact that engagement in self-care practices involves complex decision-making which depends on the patients' representation of their illness regarding whether it is controllable or curable, timeline of the illness, and consequences (Kugbey et al., 2017). Individuals who have difficulties performing complex diabetes regimens have increased risk of complications from T2DM. In addition, illness perception was inversely associated with medication adherence. Participants in this study who self-reported concerns about their illness had poor medication adherence. Evidence shows that illness perception predicts medication adherence (Alyami et al., 2019).

Implications

It is crucial to note that health disparities still exist in the outcomes of diabetes among African Americans compared with other racial groups. Self-management of T2DM is challenging because of its requirement for meticulous routine practice. According to the American Diabetes Association, 2017, following diabetes clinical practice guidelines and individualizing this to each patient are key for optimal outcome. Treatment decisions should be timely and rely on evidence-based guidelines; it should also support team-based care and community involvement such as the diabetes clinic for ongoing diabetes education (American Diabetes Association, 2017). Health providers/nurse practitioners should screen African Americans with T2DM for health literacy and illness perception of diabetes. Limited health literacy is a significant problem with T2DM, and nearly one quarter (24%) of African Americans have low health literacy (Han et al., 2019). In addition, African American with limited health literacy may also have difficulty communicating effectively with their health care provider and frequently do not understand treatment recommendation (Abdullah et al., 2019). African Americans who have diabetes are more likely to have negative attitudes about diabetes and possible control of the disease. Thus, hopelessness and fear of discussing diabetes and its complications may be a problem with this population (Shiyanbola, Ward, et al., 2018). Evidence-based tools such as BRIEF and BIPQ have been validated and used in both primary health care and community setting in assessing health literacy and illness perceptions in individuals with T2DM, both tools take less than 10 minutes to administer and easily accessible on the internet. It is also imperative to note that the scores on the PHQ-9 instrument alone do not reflect diagnosis of depression. The PHQ-9 is a tool for screening for depression but is not a diagnostic tool. The DSM-V criteria are used for an accurate diagnosis of major depression.

Limitations

Certain limitations of this study should be noted. The sample was self-selected using a convenience sample of those interested in participating in a T2DM self-management study. This study included one recruitment method, connecting through social media, which likely limited the population to which the findings can be generalized to those who use social media. Furthermore, the sample was not randomly selected. Owing to the study's cross-sectional design, causality between variables could not be determined, and the result should be interpreted with caution. The Facebook post was used for recruitment participants, so it may be possible that people who did not meet inclusion criteria participated in this study. Participation without meeting inclusion criteria could affect validity of the findings. Owing to the COVID-19 pandemic, the

study design did not allow for the collection of blood samples for HbA1c analysis as originally planned. Using HbA1c data as an indicator of self-management may have allowed for a better understanding of self-management among African American with T2DM rather than the self-report measure used. In addition, there was relatively large proportion of WMQ (storage domain, executive domain) missing data (**Table 3**). It is unknown why, when otherwise willing to participate, people chose not to complete the cognitive measures. It could be that the items were long and or difficult to complete.

Data collection during the COVID-19 pandemic
The COVID-19 pandemic and associated lockdowns forced this study to shift from the traditional in-person data collection approach to collecting data remotely. All measures that required face-to-face administration were changed to online recruitment and use of self-report measures to accommodate the remote recruitment and data collection procedures as outlined in the University of Arizona IRB. Remote data collection during the COVID-19 pandemic was not without its challenges. The low response rate observed in this study was particularly challenging but is a well-understood problem with online surveys. According to Saleh and Bista (2017), the response rate with an online survey is about 11% compared with another data collection method. Although this study was well-advertised on Facebook, the response rate remained low through December 2020. January 2021 brought more participants logging into the study. The study received 92 participant entries; only 53 participants met eligibility criteria.

Conclusions
This study provides evidence that limited health literacy, illness perception, and depression impact self-management of T2DM in African Americans. African Americans with higher levels of depression may have a greater risk of not adhering to the T2DM self-management regimen. The health literacy measure showed association with depression, illness perception, and medication adherence. African Americans who self-reported having difficulties caused by either depression or illness perception coupled with limited health literacy may have lower self-management behaviors and suffer complications from their T2DM. There is a gap in evidence in understanding glycemic control in the African American population with T2DM and the role of EF and WM in self-management of T2DM in the African American population. Future studies may include causes of perceptions about self-management among African American with T2DM and creating interventions to improve self-management of T2DM specific for the African American population. More needs to be done to support persons self-managing

diabetes to prevent or mitigate the deleterious outcomes of T2DM in this population.

Authors' contributions: *A. M. Ajuwon and K. Insel contributed to the manuscript.*

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