

Tools to Measure Health Literacy among US African Americans and Hispanics/Latinos with Type 2 Diabetes: A Scoping Review of the Literature

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ABSTRACT

Objective: To provide an overview of the health literacy tools that have been validated in samples of African Americans and Hispanics/Latinos with type 2 diabetes, growing segments of the US population. **Methods:** Following PRISMA guidelines, three electronic databases were searched. The following inclusion criteria were used: peer-reviewed research; examined validity of a health literacy tool; and included US African American and/or Hispanic/Latino adults with type 2 diabetes.

Results: Sixteen studies were selected; none exclusively included African Americans while 3 exclusively included Hispanics/Latinos in the sample. Seventeen health literacy tools were identified. Among African Americans, 2 health literacy screeners, 2 diabetes knowledge, and 3 numeracy tools have been validated. Among Hispanics/Latinos, 1 health literacy screener, 1 diabetes knowledge, and 1 numeracy tool have been validated. However, cross-cultural adaptation principles were rarely considered in the development and validation of these tools.

Conclusion: In those with type 2 diabetes, future studies should investigate the validity of health literacy screeners among English-speaking Hispanics/Latinos and general health literacy tools among African Americans and Hispanics/Latinos. Evidence on the validity of diabetes knowledge and numeracy tools was mixed across studies.

Practice implications: Findings can inform the selection of culturally-appropriate health literacy tools in clinical and research settings.

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1. Introduction

There are persistent disparities in the prevalence of type 2 diabetes and diabetes-related complications among African Americans and Hispanics/Latinos [1,2], the largest racial and ethnic minority populations in the US [3]. Moreover, African Americans and Hispanics/Latinos are disproportionately affected by poor health literacy [4], which refers to the array of skills that are needed to obtain and understand health information to make informed decisions [5]. Research has shown that poor health literacy is associated with higher diabetes-related complications [6], health-care costs [7], and all-cause mortality rates [8]. The use of validated tools to measure health literacy in health care settings could improve patient-provider communication and, in turn, disease management and overall patient care. While in research settings, validated tools are needed to monitor trends, and to identify risk and protective factors for poor health literacy. Therefore, there has been a growing

interest regarding the assessment of health literacy among people with type 2 diabetes in both clinical and research settings [7,9].

Several tools, ranging from brief screeners to longer domain-specific instruments, are currently accessible to health care providers and researchers to measure individual-level health literacy. For example, the Health Literacy Tool Shed is a searchable database of available tools to assess an individual's health literacy [10]. However, the vast majority of available health literacy tools were validated in samples largely comprised of US non-Hispanic whites [9]. Thus, they may not perform adequately when used with racial/ethnic minorities [11]. Therefore, identifying the most appropriate tool to measure health literacy among African Americans and Hispanics/Latinos with type 2 diabetes can be a daunting task. While previous literature reviews [12,13] have focused on the assessment of health literacy among people with type 2 diabetes, these reviews have been limited by the inclusion of international studies [12] and lack of attention

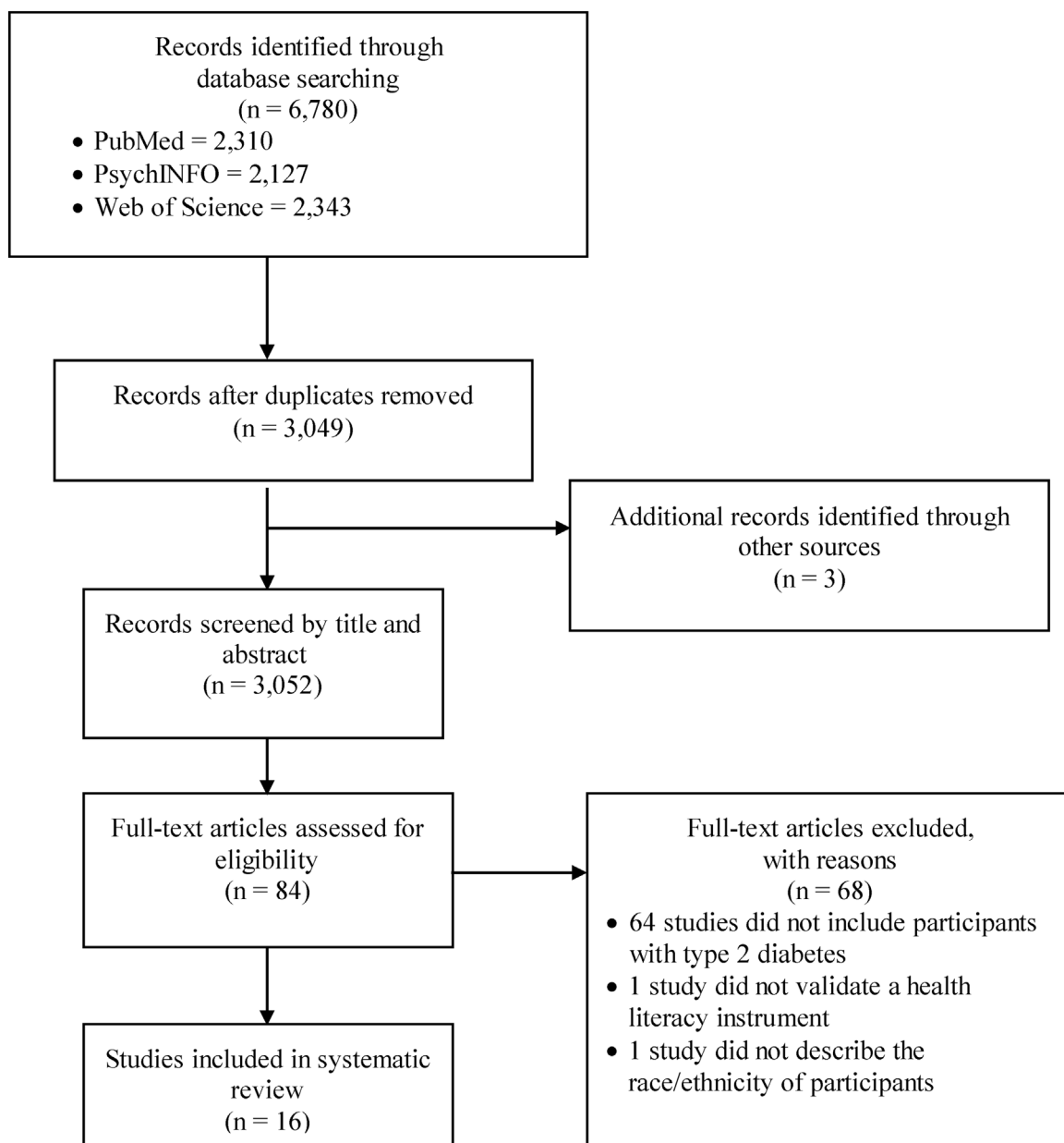


Fig. 1. PRISMA flow chart of articles excluded and included in the scoping review.

Table 1
Description of the research studies and health literacy instruments.

Author (Year)	Study		Instruments					
	Setting	Sample(s)	Title	Purpose	Language	Number of Items	Sample Item(s)	Response Options
African Americans								
Fitzgerald et al., 1998 [17]	Sample 1: Community-based, Michigan. Sample 2: General clinics, Michigan Department of Public Health	Sample 1: 312 adults with type 2 diabetes; 7% African American; Mean age 60 years; 10% education ≤ 8 years. Sample 2: 499 adults with type 2 diabetes; 17% African American; Mean age 56 years; 12% education; ≤ 8 years; Income not reported.	Brief Diabetes Knowledge Test (BDKT)	To assess patient's knowledge about diabetes and its care, including general health literacy and insulin use;	English	General diabetes literacy scale: 14-items Insulin use sub-scale: 9-items	"Which of the following is highest in carbohydrates?"	Select 1 out of 4 options
Rothman et al., 2005 [18]	Academic general medicine clinic, University of North Carolina	N = 217 adults with type 2 diabetes and poor glycemic control (A1C > 8%); 65% African American; Mean age 55 years; 17% education; $< 8^{\text{th}}$ grade; 47% annual household income $< \$10\text{K}$.	Spoken Knowledge in Low Literacy in Diabetes Scale (SKILLD)	To assess diabetes knowledge among patients with diabetes and low literacy.	English	10-items	"What are the signs and symptoms of high blood sugar?"	Open ended questions (used to avoid potential guessing) Test administrators mark each answer as correct or incorrect Complete the blanks Total number of questions correctly answered
Huizinga et al., 2008 [19]	General medicine, diabetes, and endocrinology clinics at academic and Veterans Affairs health centers	398 adults with type 1 or 2 diabetes; 34% African American; Mean age 54 years; 18% education $<$ high school; 44% annual household income $< \$20\text{K}$.	Diabetes Numeracy Test (DNT) and its short version DNT-15	To assess numeracy skills (abilities to understand and use numbers in everyday life) for diabetes management.	English	DNT: 43 items. DNT-15: 15-items.	Participant reads background information, followed by each item "How much insulin should you take for a blood sugar of 375?"	Five-point Likert scale
Jeppesen et al., 2009 [20]	Academic primary care clinic	225 adults with type 2 diabetes; 45% African American; Mean age 54 years; 14% education $\leq 11^{\text{th}}$ grade; Income not reported.	Single Item Literacy Screener (SILS)	To assess health literacy with short screening questions.	English	3-items	"How would you rate your ability to read?"	Five-point Likert scale
Kirk et al., 2011 [21]	Partner organizations from 8 counties, North Carolina	563 adults with type 2 diabetes; aged ≥ 60 years; 34% African American; 37% education $<$ high school; 70% above the poverty line.	Rapid Estimate of Adult Literacy in Medicine Short-Form (REALM-SF) Newest Vital Sign (NVS)	To assess health literacy among older adults with diabetes.	English	REALM-SF: 7-items NVS: 6-items	Not provided	REALM-SF Not provided. Scores are converted to grade reading levels NVS: Not provided.
Jeppesen et al., 2011 [22]	Family practice center in academic hospital, Ohio	384 adults with diabetes; Mean age 54 years; 46% African American; 6% completed 6 th grade as highest education; Median household income was \$25 K.	Spoken Knowledge in Low Literacy in Diabetes Scale (SKILLD)	To further validate the SKILLD measure, which is designed to assess diabetes knowledge.	English	10-items	"What are the signs and symptoms of low blood sugar?"	Open ended questions Test administrators mark each answer as correct or incorrect
Al Sayah et al., 2014 [23]	Primary care clinics at South Carolina	378 adults with type-2 diabetes 83% African American Mean age 56 years Mean years of education 12 46% annual household income $< \$10\text{K}$	3-Item Health literacy screening questions 16-Item Health Literacy Screening Questions	To assess inadequate health literacy among non-white populations and to compare 16-item screening questions with shorter versions.	English	16-items to 3-items	"How confident are you filling out medical forms by yourself?"	Five-point Likert scale

Table 1 (Continued)

Author (Year)	Study		Instruments					
	Setting	Sample(s)	Title	Purpose	Language	Number of Items	Sample Item(s)	Response Options
Quandt et al., 2014 [24]	Communities located in 8 counties, North Carolina	593 older adults with type 2 diabetes aged 60 and older; 34% African American; 52% aged 60–69 years; 37% <high school; 30% <poverty line.	Short Diabetes Knowledge Instrument (SDKI)	To assess diabetes-related literacy.	English	13-items	“Which of these tests would tell you about your average blood sugar for the past 2 – 3 months?”	Interviewer administered. Multiple choice question with 3 or 4 possible responses
Luo et al., 2018 [25]	Academic family medicine center in the southeastern US	102 patients with type 2 diabetes; 73% African American; Mean age 60 years; 44% ≤high school education; 61% annual household income <\$35 K.	Health literacy scale and subjective numeracy scale (HLS/SNS)	To assess health literacy and subjective numeracy scale with one survey.	English	22-items	HLS: “Since being diagnosed with diabetes you have collected information from various sources.” SNS: “How good are you at working with fractions?”	4-point Likert scale
Hispanics/Latinos								
Garcia et al., 2001 [26]	Participants of the Starr County Education Study, Texas (US-Mexico border area), a community-based study	502 Mexican Americans adults with high acculturation levels; Mean age 50 years; Income not reported. Sample divided into 3 groups: Group 1: 252 with type 2 diabetes; Group 2: 171 support people with diabetes; Group 3: 179 support people without diabetes.	Diabetes Knowledge Questionnaire (DKQ)	To assess general diabetes knowledge with an easy-to-use measure.	Spanish; English; or combination common to bilingual speakers at Texas-Mexico border	24-items	“A fasting blood sugar level of 210 is too high.”	Response options: Yes; No; Don't know
White III et al., 2011 [27]	Internal medicine clinic affiliated with an academic medical center and 2 urban public primary care clinics, Tennessee	144 Hispanic adults with type 2 diabetes; Mean age 48 years; 78% of Mexican heritage (foreign-born); 50% <high school; 65% annual household income <\$10 K.	Diabetes Numeracy Test (DNT-15 Latino)	To assess diabetes-specific numeracy among Spanish speaking adults with diabetes.	Spanish	15-items	Participant reads background information, followed by each item Responses require multiple step calculations	Each item is scored as correct or incorrect
Cordasco et al., 2012 [28]	Primary care and geriatrics clinics in an urban US safety-net hospital	160 older monolingual Spanish-speaking Hispanic adults with type 2 diabetes; Mean age 72 years; 94% education ≤11 years; Income not reported.	Single Item Literacy Screener (SILS)	To assess inadequate health literacy using a single screening question.	Spanish	3-items	“How confident are you filling out medical forms by yourself?”	5-point Likert scale
Garcia et al., 2015 [29]	Convenience sample recruited in a mid-sized city and its adjacent suburban and rural areas	72 Mexican American adults with type 2 diabetes; Mean age 50 years; Mean education 12 years; Income not reported.	Spoken Knowledge in Low Literacy in Diabetes (SKILLD)	To assess diabetes knowledge (conceptualized as a proxy for health literacy) among Mexican Americans with type 2 diabetes.	English and Spanish	10-items	“What are the signs and symptoms of high blood sugar?”	Open-ended questions. Interviewer codes responses as correct or incorrect based on answer key.
African Americans and Hispanics/Latinos								
Sarkar et al., 2011 [30]	Clinics, San Francisco Department of Public Health	296 English and Spanish-speaking adults with type 2 diabetes receiving primary care. 53% Hispanic; 24% African American; Mean age 55 years; 48% preferred Spanish language; 50% education < high school; 73% annual household income <\$20K.	Health Literacy Screening Questions	To assess health literacy among diverse English and Spanish speaking populations using a single screening question or a brief survey.	English and Spanish	3-items	“How confident are you filling out medical forms by yourself?”	5-point Likert scale

Author(s)	Study	Population	Intervention	Outcome	Language	Items	How often during the past month did you: "eat unplanned snacks you wished you had not eaten?"	6-point ordinal scale
Akothue et al., 2015 [31]	Primary care clinics, Tennessee	411 adults with type 2 diabetes from the Public-Private Partnership to Improve Diabetes Education Trial (focused on addressing health literacy); 17% African Americans; 24% Hispanics; Mean age 50 years; Mean education 11 years; 53% annual household income <\$10K.	Personal Diabetes Questionnaire (PDQ-11)	To assess knowledge of healthy dietary behaviors among low income patients with type 2 diabetes.	English and Spanish	11-items		
Chakkalakal et al., 2017 [32]	Partnering to Improve Diabetes Education Study, clinics of the Tennessee Department of Health	410 patients with type 2 diabetes; age 51 years; 18% African American; 19% education <12 years; 22% Hispanics; 64% education <12 years; Income not reported.	Subjective Numeracy Scale (SNS) Diabetes Numeracy Test (DNT-5); Brief Health Literacy Screen (BHLS); Short Test of Functional Health Literacy in Adults (S-TOFHLA)	To assess verbal health literacy skills among English or Spanish speakers.	English or Spanish based on participant's preferences	SNS: 8-items DNT-5: 5-items BHLS: 5-items S-TOFHLA: 36-items	SNS: "When you hear a weather forecast, do you prefer predictions using percentage or predictions using words only?" DNT-5: Mathematical questions about nutrition BHLS: "How confident are you filling medical forms by yourself?" S-TOFHLA: Participant reads 2 prose passages	SNS: 6-point response scale DNT-5: Items were scored as correct or incorrect BHLS: 5-point response scale S-TOFHLA: Multiple selection, participant is asked to select the best word to fill in the blank

to the race/ethnicity of the samples [12,13] and, thus, to the cross-cultural adaptation of these tools.

Given the aforementioned knowledge gaps, the objective of this scoping review was to describe the array of tools that have been validated to measure health literacy among US African Americans and Hispanic/Latino adults with type 2 diabetes. In this study, we summarize the focus and types of such tools, sociocultural issues considered in their development, evidence on the validity and reliability of the tools, and key conclusions regarding the use of each health literacy tool for African Americans and/or Hispanics/Latinos. Finally, we provide recommendations for future research and identify areas where culturally equivalent health literacy tools are needed to move the field forward. Study findings will help clinicians and researchers to identify health literacy tools that have been properly validated for use among African Americans and/or Hispanics/Latinos with type 2 diabetes.

2. Methods

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [14], we searched for articles published between January 1, 1990 and June 30, 2019, and indexed in three databases (i.e., PubMed, PsychINFO, and Web of Science) that cover a wide range of health, medicine, and social science publications. We used a comprehensive list of search terms that describe health literacy tools: "health literacy," AND "measurement," "measure," "validity," "survey," "questionnaire," "instrument," "screening," "tool," or "psychometric." Of note, the term "diabetes" was not used in the search because some articles may not have used it as a keyword, although participants with type 2 diabetes were included. To ensure the inclusion of relevant articles, additional articles were identified by searching Google Scholar (including the "cited by" and "related articles" features) and by searching the reference list of included articles. The following inclusion criteria was imposed for the articles: 1) peer-reviewed original research conducted in the US; 2) examined the validity of a health literacy tool; and 3) African Americans and/or Hispanics/Latinos adults (18 years and older) with type 2 diabetes were included in the sample (more specifically, to be included in this review, all participants in the study's sample had diabetes).

We performed a scoping review of the literature following the formal guidelines proposed in the Joanna Briggs Institute Reviewer's Manual [15]. The information from the selected studies was abstracted into two summary tables. First, we summarized the characteristics of each research study (i.e., study setting and sample) and health literacy tool (i.e., title, purpose, language, number of items, sample items, and response options). Second, we described the sociocultural factors (e.g., cultural values and socioeconomic status) that were considered, if any, in the tool development and validation according to recommendations for cross-cultural adaptation of measures in health disparity research [11]. Finally, we described key findings on the validity and reliability of the health literacy tools and we also summarized the key conclusions from each study regarding the use of each health literacy tool for a specific population. Studies were organized into three categories according to the race/ethnicity of the sample: African Americans (Hispanics/Latinos not included); Hispanics/Latinos (African Americans not included); and both African Americans and Hispanics/Latinos. Studies within each category are presented in chronological order of publication from oldest to most recent. A scoping review was deemed more appropriate than a systematic review, given our interest in describing and summarizing the state of health literacy assessment tools for specific populations with a sociocultural perspective [16].

Table 2

Summary of sociocultural factors, validity, reliability, and key conclusions.

Author (Year)	Sociocultural Factors	Validity	Reliability	Key Conclusions
African Americans				
Fitzgerald et al., 1998 [17]	Researchers designed instrument items for 6 th grade reading level.	In both samples, the BDKT was correlated with higher years of education and completion of the diabetes education program.	In the community sample, Cronbach's alpha = 0.70. In the health department sample, Cronbach's alpha = 0.71.	Main scale is recommended for use among adults not using insulin. Subscale can be added for those using insulin.
Rothman et al., 2005 [18]	Researchers were sensitive to cultural relevance and wording in each question. Designed for reading level below the 5 th grade. During development, questions were piloted with low-literacy patients.	SKILLD correlated with higher income, education, literacy status (based on REALM), duration of diabetes, and lower A1C. Factor analysis confirmed a single factor.	Cronbach's alpha = 0.72.	Good reliability and validity to measure diabetes knowledge in patients with type 2 diabetes and low literacy.
Huizinga et al., 2008 [19]	Clarity of items among patients was examined.	DNT and DNT-15 were each correlated with higher education, income, literacy and math skills, and diabetes knowledge.	For DNT, Kuder-Richardson coefficient = 0.95. For DBT-15, KR-20 = 0.90.	DNT is adequate for measuring diabetes numeracy skills among adults with type 2 diabetes. DNT-15 is also adequate and is faster to administer than the DNT.
Jeppesen et al., 2009 [20]	No discussion of sociocultural factors.	Total SILS score, self-rated reading ability (one of the screening questions), highest education level, sex, and race were associated with limited health literacy (S-TOFHLA).	Not reported.	Of the three screening questions, self-reported reading had the strongest association with limited health literacy. Educational attainment of high school or less and asking for help with reading materials at least sometimes are also associated with limited health literacy.
Kirk et al., 2011 [21]	No discussion of sociocultural factors. The limitations mention significant health care barriers in the study population.	23% of the participants were not able to complete at least one the health literacy tests. REALM-SF and NVS were each associated with educational attainment. Performance of each literacy assessment differed across race/ethnicity.	Not reported.	Findings suggest that the REALM-SF and the NVS are not capturing the measurement domain of the S-TOFHLA.
Jeppesen et al., 2011 [22]	No discussion of sociocultural factors.	Higher SKILLD was associated with non-black race, higher income, use of insulin, higher education. Higher REALM was associated with shorter test time and easier difficulty testing. SKILLD had moderate correlation with the oral Diabetes Knowledge Test (DKT).	Cronbach's alpha = 0.54.	Health literacy and education levels correlate well with the SKILLD. SKILLD should be further refined.
Al Sayah et al., 2014 [23]	No discussion of sociocultural factors. In the discussion, the importance of validating these measures in diverse sample of patients is suggested as a next step.	Total score (16-items) was good at discriminating between patients with inadequate health literacy versus marginal/adequate (based on the s-TOFHLA). Compared to the other 2 individual questions, the "confidence" question had the poorest performance in identifying individuals with inadequate or limited health literacy. The "difficulty understanding written information" had the better performance. Factor analysis revealed 6-items that performed better than the 6-items.	For the 16-Item measure, Cronbach's alpha = 0.87. For the 3-item measure, Cronbach's alpha = 0.56.	Overall, performance of these instruments among African Americans is not as good as previously reported for other populations.
Quandt et al., 2014 [24]	No discussion of sociocultural factors	Unidimensional model had adequate fit statistics. CFI, TLI, RMSEA, and SRMR SDKI scores were higher among non-Hispanic whites, and those with higher levels of education and income, and tended to be higher among those with lower A1C.	Cronbach's alpha = 0.75.	Findings suggests SDKI validity is demonstrated by its association with socio-demographic characteristics of the sample.
Luo et al., 2018 [25]	Questionnaire was designed for 6 th grade level. Questions were developed in Japanese and cultural validity has not been verified.	Confirmatory factor analysis identified four factors in the instrument; particularly, 3 factors in the HLS and 1 factor in the SNS. HLS/SNS was correlated with S-TOFHLA and educational attainment.	Total scale: Cronbach's alpha = 0.84. HLS: Cronbach's alpha = 0.78. SNS: Cronbach's alpha = 0.83.	Findings suggest that the total score is internally reliable and a valid measure of subjective health literacy and numeracy among adults with type 2 diabetes.
Hispanics/Latinos				
García et al., 2001 [26]	Instrument was translated to Spanish by regional native and bilingual speakers and	Examined based on differentiation between groups (participants with diabetes [group 1; experimental]	Cronbach's alpha = 0.78 for all groups. Group 1 = 0.78; group 2 = 0.84; group 3 = 0.73.	Instrument recommended for use among Mexican Americans with type 2 diabetes.

Table 2 (Continued)

Author (Year)	Sociocultural Factors	Validity	Reliability	Key Conclusions
White III et al., 2011 [27]	licensed translators. Likert scales were not used due to previously reported difficulties when used with Mexican-Americans. Content verified by an expert panel familiar with diabetes-related issues among Mexican Americans. Scale was translated into Spanish with input from bilingual members of research team and research staff of Latino heritage. Input from Latino patients was used to clarify questions.	versus support people [groups 2 and 3; control]). Higher DKQ scores among group 1 compared with control group.	Kruder-Richardson 20 = 0.78.	Showned that patients with adequate health literacy had low numeracy skills. DNT-15 Latino was not associated with self-efficacy, self-care behaviors, insulin use, or glycemic control.
Cordasco et al., 2012 [28]	Role of cultural and linguistic differences in responses among Spanish-speaking Latinos.	For the “confidence” question, any answer less than ‘extremely confident’ had a sensitivity of 0.93 (AROC curve) for detecting inadequate health literacy. For the “medical condition” and “read hospital material” questions, AROC curve <0.50. Cut-off ≤6years of education had a sensitivity of 0.88 for identifying inadequate health literacy.	Not examined.	Compared to the other 2 questions, the “confidence” question had the highest sensitivity to detect inadequate health literacy but its specificity was low. Compared to the “confidence” question, ≤6 years of education had similar sensitivity and higher specificity to detect inadequate health literacy.
Garcia et al., 2015 [29]	Measure was translated and back-translated by bilingual native Spanish speakers. Cultural relevancy was considered in measurement development.	SKILLD scores were negatively (but weakly) correlated with A1C, years of education, and acculturation.	Cronbach's alpha = 0.64.	SKILLD performed adequately in this sample, although Cronbach's alpha was low. Findings suggest SKILLD questions and key answers should be revised.
African Americans and Hispanics/Latinos Sarkar et al., 2011 [30]	Questions were translated into Spanish and back-translated into English, and pilot tested; no further details were not provided.	Each of the 3 screening questions, as well as the total score, were correlated with inadequate health literacy as measured with the S-TOFHLA. Performance of the total score was similar to the question about “confidence with forms.” Findings were similar for Spanish and English speakers.	Not examined.	A single question about “confidence with forms” or the summative scale of three questions is recommended for use among Spanish-speaking and English-speaking adults.
Akohoue et al., 2015 [31]	Measure developed for 6 th grade reading level. Measure available in English and Spanish.	Four subscales (of the PDQ-11) were identified: eating behavior problem; use of information for dietary decision making; calorie restriction; and activity and exercise. Subscales were not associated with A1C or with health literacy	Eating behavior problem subscale: Cronbach's alpha = 0.70; Use of information for dietary decision-making subscale: Cronbach's alpha = 0.81; Calorie restriction subscale: Cronbach's alpha = 0.51; and Activity and exercise subscale: Cronbach's alpha = 0.50. No correlation between PDQ-11 and health literacy (S-TOFHLA).	PDQ-11 is recommended to measure dietary behaviors in patients with type 2 diabetes. Satisfactory reliability for two (i.e., eating behavior problem; use of information for dietary decision making) of its four subscales.
Chakkalakal et al., 2017 [32]	Racial/ethnic variation was assessed in the statistical analysis. Discussion highlighted differences in performance of health literacy across racial/ethnic groups.	Among Hispanic participants, SNS and DNT-5 were correlated; BHLS and S-TOFHLA were not correlated. Among non-Hispanic black, SNS and DT-5 were correlated; BHLS and S-TOFHLA were correlated. Among Hispanic and non-Hispanic black participants, correlations between objective measures were significant but low. Correlations between subjective measures were not significant.	SNSSNS: Cronbach's alpha = 0.72 Spanish, 0.85 English. DNT-5: Cronbach's alpha = not examined. BHLS: Cronbach's alpha = 0.53 Spanish, 0.79 English. S-TOFHLA: Cronbach's alpha = not examined.	Findings support the validity of the numeracy measures. Results were less consistent for the measures of health literacy, especially among Hispanic participants, all of whom completed the measures in Spanish. Objective measures may provide a better method of assessment when working with Hispanic and Non-Hispanic black patients (than subjective measures).

The initial search returned 6,780 titles and 3,049 records remained after excluding duplicates. A total of 3 additional records were identified through other sources (i.e., Google Scholar and reference list). We screened the title and abstract of the remaining 3,052 records

based on the inclusion criteria and excluded 2,968 articles. Then, we reviewed the full text of 84 articles to assess whether the article matched our inclusion criteria. We further excluded 68 articles, which yielded a final sample of 16 articles for our review (Fig. 1).

3. Results

3.1. Study Sample and Setting

Table 1 summarizes the characteristics of the studies. Nine studies included African Americans (and did not include Hispanics/Latinos) [17–25], four studies included Hispanics/Latinos (and did not include African Americans) [26–29], and three studies included both African Americans and Hispanics/Latinos [30–32]. In five [18–20,22,25] of the nine studies that included African Americans, participants were recruited in academic clinics. African Americans represented 7% to 34% of the sample in four studies [17,19,21,24] and 45% to 83% of the sample in five studies [18,20,22,23,25]. All participants were middle-aged and older adults (three studies only had participants aged 60 and older [21,24,25]). Most studies had a small percentage of individuals with less than high school education [17,19–21,23,24]. In three studies, the annual household income was less than \$20,000 among approximately half of the sample [18,19,23]. About 70% of the sample lived above the poverty line in two studies [21,24], the annual household income was lower than \$35,000 among 61% of the sample in one study [25], and the median annual household income was \$25,000 in another study [22]. Two studies did not report the participants' income [17,20].

Hispanics/Latinos participants were recruited in academic clinics in two studies [27,28] and in community-based settings in two studies [26,29]. Hispanics/Latinos comprised 100% of the sample in the four studies in this category and participants were of Mexican American heritage with varied acculturation levels (i.e., high acculturation [26,29], foreign-born [27], to only Spanish speakers [28]). Study participants were of approximately 50 years of age in three studies [26,27,29], while in one study participants were aged 72 years on average [28]. In two studies, 94% of participants had less or equal to 11 years of education [27,28], in one study participants had 12 years of education on average [29], and one study did not report education levels [26]. Most studies did not report income levels [26,28,29] and the annual household income was less than \$10,000 in 65% of the sample in one study [27].

Of the three studies that included both African Americans and Hispanics/Latinos, one study had 53% African Americans and 24% Hispanics/Latinos (including both Spanish and English speakers) [30], one study had 18% African Americans and 22% Hispanics/Latinos [32], and one study had 17% African Americans and 24% Hispanics/Latinos [31]. Across studies, the mean age of participants was 50, 51, and 55 years. In two studies, 50% and 28% of the sample reported less than high school education [30,32], and participants had 11 years of education, on average, in one study [31]. Among the two studies reporting annual household income, 73% of participants reported <\$20,000 [30] and 53% of participants reported <\$10,000 [31].

3.2. Health Literacy Tools

Table 1 depicts the health literacy tools' characteristics (i.e., purpose, language, items, and response options). Seventeen health literacy tools were identified (including two versions of the Health Literacy Screening Questions and four versions of the Diabetes Numeracy Test [DNT]). Studies among African Americans used the following health literacy tools: screeners (i.e., Single Item Literacy Screener [SILS], and 3- and 16- item Health Literacy Screening Questions); general health literacy (i.e., Rapid Estimate of Adult Literacy in Medicine Short-Form [REALM-SF] and Newest Vital Sign [NVS]); diabetes knowledge (i.e., Brief Diabetes Knowledge Test [BDKT], Spoken Knowledge in Low Literacy in Diabetes Scale [SKILLD], and Short Diabetes Knowledge Instrument [SDKI]); and numeracy skills (i.e., DNT, DNT Short Version [DNT-15], and Health Literacy Scale and Subjective Numeracy Scale [HLS/SNS]). Studies

among Hispanics/Latinos employed the following health literacy tools: screening questions (i.e., SILS); diabetes knowledge (i.e., Diabetes Knowledge Questionnaire [DKQ] and SKILLD); and numeracy (i.e., DNT version in Spanish [DNT-15 Latino]). The following health literacy tools were used in studies conducted among African Americans and Hispanics/Latinos: screening questions (i.e., 3-item Health Literacy Screening Questions and Brief Health Literacy Screen [BHLS]); general health literacy (i.e., Short Test of Functional Health Literacy in adults [S-TOFHLA]), diabetes knowledge (i.e., Personal Diabetes Questionnaire [PDQ-11]), and numeracy (i.e., Subjective Numeracy Scale [SNS] and DNT short version [DNT-5]).

The number of items in the tools ranged from 3 to 24. Most of the tools were designed to be self-administered, in those instances, participants were asked to select the best response [17,20,21,23,25,28,30–32], to complete the blank [19], or to select yes/no [26]. Other tools were administered by an interviewer, in those cases, the interviewer asked the questions and marked the answers as correct or incorrect [18,22,33] or the participants had to answer open ended questions (some required calculations) that were marked as correct or incorrect by the interviewer [27,29]. Some of the studies reported the average time that participants needed to answer the questions, ranging from about 3 [22], less than 10 [18], to 15 minutes [17].

3.3. Sociocultural Factors

Table 2 summarizes the sociocultural factors considered in each study, findings on the validity and reliability of each tool, and authors' recommendations regarding the use of each tool (i.e., key study conclusions). Four [17–19,25] of the nine studies that included African Americans discussed, at least to some extent, the role of sociocultural factors in the development and validation of the tool(s). Sociocultural factors considered encompassed participants' education levels [17,18,25], cultural relevance and wording of questions [18], and piloting questions with patients of the target population [18,19]. In other studies [23,25], researchers discussed the need for future research examining the cultural validity of the measure. All studies conducted among Hispanics/Latinos had at least some discussion about sociocultural factors. For example, studies explained the process of translation to Spanish [26,27,29], selection of response option for tools based on previous research [26], cultural relevance of content was verified by an expert panel which was familiar with diabetes-related issues among Mexican-Americans or by Hispanic/Latino patients [26,27,29], and cultural and linguistic differences in responses across language were considered [28]. All of the 3 studies conducted among African Americans and Hispanics/Latinos discussed sociocultural factors. For instance, the process of translation was described [30], questions were piloted with target population [30], reading level of participants was considered [31], importance of availability of tools in Spanish was discussed [31], and potential presence of racial/ethnic variation was considered [32].

3.4. Validity and Reliability

All studies assessed the validity of the health literacy tools, which was mostly examined through its correlation with socio-demographic factors and/or other well-recognized health literacy tools. Among African Americans, the SILS screener was correlated with higher education and limited health literacy (based on the S-TOFHLA) [20]. In another study, the health literacy screening question about "difficulty understanding written information" had the best performance in identifying individuals with inadequate or limited health literacy compared to the other two questions [23]. Of the general health literacy tools, the REALM-SF and NVS were each negatively associated with education [21]. Of the diabetes

knowledge tools, higher BDKT was correlated with higher years of education [17]; higher SKILLD was correlated with higher income, education, health literacy (based on REALM), diabetes duration, and lower A1C [18]; higher SKILLD was associated with non-black race, higher income, use of insulin, and higher education [22]; SKILLD had moderate correlation with the DKT [22]; and SDKI scores were higher among those with higher education and income, and lower A1C [24]. Of the numeracy tools, higher DNT and DNT-15 were each correlated with higher education, income, literacy and math skills, and diabetes knowledge [19]; and HLS/SNS was correlated with S-TOFHLA and with higher educational attainment [25].

Among Hispanics/Latinos, the SILS screener was found to be less satisfactory than years of education for identifying inadequate health literacy [28]. Of the diabetes knowledge tools, higher DKQ scores were observed among the group that received diabetes education (as hypothesized); and SKILLD scores were negatively, but weakly, correlated with A1C, years of education, and acculturation [29]. Finally, of the diabetes numeracy tools, DNT-15 Latino was correlated with general health literacy (S-TOFHLA), general numeracy (WRAT-4), education level, and household income [27]. Among African Americans and Hispanics/Latinos each screener question, and the total score, were correlated with inadequate health literacy (as measured with the S-TOFHLA); performance of the total score being similar to the question about “confidence with forms” [30]; and the BHLS was correlated with S-TOFHLA among African Americans but not Hispanics/Latinos [32]. Of the diabetes knowledge tool, the four PDQ-11 subscales were not associated with A1C or with health literacy [31]. While, of the diabetes numeracy tools, the SNS and DT-5 were correlated among African Americans and Hispanics/Latinos [32]. Finally, most studies assessed internal reliability, which was examined using Cronbach's alpha for continuous variables and Kruder-Richardson test for categorical variables. Most of these studies reported adequate reliability of the health literacy tool [17–19,24–27]. In five studies, the Cronbach's alpha score was deemed to be less than adequate [22,23,29,31,32].

3.5. Key Study Conclusions

In all of the studies, the authors concluded by stating key recommendations regarding the use of health literacy measures, including whether the tool was recommended for use as well as instances where more research is needed. More specifically, among African Americans, one item of the SILS screener, (i.e., “self-reported reading”) was recommended for use [20]; however, the 3- and 16-item Health Literacy Screening Questions were not recommended and, instead, a 6-item screener was proposed as an adequate alternative [23]. Of the general health literacy tools, REALM-SF and the NVS were not recommended [21]. Among the diabetes knowledge tool, the BDKT [17] and the SDKI [24] were recommended, and the SKILLD was recommended in one study [18] but another study recommended further refinement [22]. Of the numeracy tool, the DNT [19], DNT-15 [19], and the HLS/SNS [25] were recommended.

Among Hispanics/Latinos, the SILS screening was not recommended for use, instead it was found that self-reported educational attainment may be more useful to screen for inadequate health literacy among Spanish speakers [28]. Among the diabetes knowledge tool, the DKQ was recommended for use with English and Spanish speakers [26] and, contrastingly, the SKILLD should be used with caution among English and Spanish speakers [29]. Among the numeracy tool, the DNT-15 Latino has some limitations but may be helpful to assess numeracy skills among Spanish speakers [27]. Among African Americans and Hispanics/Latinos, a single question about “confidence with forms” or the summative scale of three Health Literacy Screener Questions was

recommended for use among Spanish- and English-speakers [30]. In contrast, the BHLS may not be an adequate screener [32]. To assess general health literacy, the S-TOFHLA may not be adequate to use [32]. While, the PDQ-11 subscales were not recommended to assess diabetes knowledge [31]. Findings support the validity of the numeracy tools: SNS and DNT-5 [32].

4. Discussion and Conclusion

4.1. Discussion

The assessment of health literacy among African Americans and Hispanics/Latinos with type 2 diabetes remains a challenge. Although the use of tools that have been developed among non-minority populations is not recommended for use among racial/ethnic minorities [11], prior reviews have not considered the race/ethnicity of the samples or the cross-cultural adaptation of tools [12,13]. This scoping review is unique in that it identifies studies that have attempted to validate tools for use among African Americans and/or Hispanics/Latinos with type 2 diabetes, two understudied segments of the US population experiencing persistent health disparities [1]. Study findings highlight a variety of validated tools that could be used by clinicians and researchers to measure health literacy among African Americans and Hispanics/Latinos with type 2 diabetes.

Our key study findings are that Among African Americans with type 2 diabetes, a 1-item (i.e., “self-reported reading”) [20] and 6-item [23] tool were recommended to screen for health literacy; the BDKT [17] and SDKI [24] were recommended to assess diabetes knowledge (yet, evidence for SKILLD is conflicting across studies [18,22]); and the DNT [19], DNT-15 [19], and HLS/SNS [25] were recommended to measure numeracy skills. Among Hispanics/Latinos with type 2 diabetes, self-reported educational attainment was recommended to screen for health literacy among Spanish speakers [28]; the DKQ was recommended for use in English and Spanish speakers (while, the SKILLD should be used with caution with English and Spanish speakers) [29] to assess diabetes knowledge [26]; and the DNT-15 Latino may be somewhat helpful to assess numeracy skills among Spanish speakers [27]. Among African Americans and Hispanics/Latinos, a 1-item (i.e., “confidence with forms”) and 3-item measure were recommended for use among Spanish-speaking and English-speakers [30]; and the SNS and DNT-5 were recommended to measure numeracy [32].

Notably, the present study identified gaps in research on health literacy tools among African Americans. Mainly, no studies were conducted with samples that were only comprised of African Americans. Of the available studies among African Americans, the samples included mostly participants of higher income and education, which may not be representative of the overall African American population with low health literacy [1,2]. Furthermore, we also found that studies among Hispanics/Latinos mostly included participants of Mexican American background, which could limit the external validity of the measures to other Hispanic/Latino populations such as those of Caribbean backgrounds. However, among Hispanics/Latinos living in the US, the prevalence of diabetes varies across backgrounds from 10% in South Americans to 18% in Mexicans [34]. We also highlight the need to consider cultural and socioeconomic factors related to conducting cross-cultural research in the development and validation of health literacy tools among under-represented populations. For instance, studies among African Americans seldom discussed cultural validity and educational appropriateness of the tools. Moreover, it is important that future research collects data on the education and income of participants, as there is mixed evidence on its association with health literacy [20].

Future research among African Americans with type 2 diabetes should examine the validity of general health literacy measures and test whether the SKILLD should be recommended to assess diabetes knowledge. Moreover, to address gaps in previous research the sample of these studies should be comprised of African Americans of lower socioeconomic status. Future research among Hispanics/Latinos should examine the validity of health literacy screeners among English speakers, general health literacy measures for English and Spanish speakers, confirm whether the SKILLD should be used to assess diabetes knowledge among English and Spanish speakers, confirm whether the DNT-15 Latino should be used to examine numeracy skills among Spanish speakers, and examine the validity of numeracy measures for English speakers. Moreover, future research among African Americans and Hispanics/Latinos should examine the validity of health literacy screeners, as well as general health literacy and diabetes knowledge tools.

Our review has limitations that should be considered. Although we carefully followed the PRISMA guidelines to identify studies included in this scoping review, we may have missed some of the relevant literature during our search of articles. Furthermore, the sample population of two of the studies included in this review had a small percentage of adults with type 1 diabetes, which may have biased our findings if those participants had been living with diabetes for a longer time than those with type 2 diabetes. However, our study extends prior knowledge related to health literacy tools among the growing African American and Hispanic/Latino populations with type 2 diabetes. Strengths of this review includes that we highlighted the range of validated health literacy tools that could be used when working with each of these populations. Second, we identified gaps in the available tools to address health literacy among African Americans and Hispanics/Latinos with type 2 diabetes. Third, we noted the lack of attention to sociocultural factors in the development and validation of health literacy assessment tools in the populations currently under study.

4.2. Conclusions

To our knowledge, this is the first study to summarize the tools that are available to measure health literacy among African Americans and Hispanics/Latinos with type 2 diabetes. Taken together, our findings offer insights into the available tools that can be used to measure health literacy among African Americans and Hispanics/Latinos with type 2 diabetes. While there is a variety of tools, there is a need for additional research that validates health literacy measures for use among African Americans and Hispanics/Latinos with type 2 diabetes.

4.3. Practice Implications

Given the importance of health literacy in delivery care and communicating with patients, we reviewed the available measures and discuss which ones may be more useful to public health practitioners and clinicians. Findings from our study can be used by clinicians and researchers who are interested in assessing health literacy among African Americans and Hispanic/Latinos with type 2 diabetes. Identifying health literacy tools that have been validated among the largest racial/ethnic minority populations in the US, which also have the highest burden of diabetes and poor health literacy, may provide additional insights to advance health literacy research. The assessment of health literacy may assist in the development of culturally-relevant interventions and best patient-provider communication practices for improving diabetes-related outcomes.

Declaration of Competing Interest

The authors declare that there is no conflict of interest

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