Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

HHS Public Access

Author manuscript

Am J Med Sci. Author manuscript; available in PMC 2017 April 01.

Published in final edited form as:

Am J Med Sci. 2016 April ; 351(4): 366–373. doi:10.1016/j.amjms.2016.01.008.

Impact of Race/Ethnicity and Social Determinants of Health on Diabetes Outcomes

Rebekah J. Walker, PhD[1,2,3], **Joni Strom Williams, MD, MPH**[1,2], and **Leonard E. Egede, MD, MS**[1,2,3]

[1]Center for Health Disparities Research, Department of Medicine, Medical University of South Carolina, Charleston, SC

[2]Department of Medicine, Division of General Internal Medicine and Geriatrics, Medical University of South Carolina, Charleston, SC

[3]Health Equity and Rural Outreach Innovation Center (HEROIC), Ralph H. Johnson Veterans Affairs Medical Center, Charleston, SC

Abstract

There is strong evidence that race/ethnicity and social determinants of health significantly impact outcomes for patients with diabetes. A better understanding of the mechanisms of these relationships/associations will improve development of cost-effective, culturally tailored programs for patients with diabetes. This article reviews the current state of the literature on the impact of race/ethnicity and social determinants of health on process of care, quality of care and outcomes for diabetes, with particular emphasis on the rural South to give an overview of the state of the literature. The literature review shows that racial/ethnic differences in the clinical outcomes for diabetes, including glycemic, blood pressure, and lipid control, continue to persist. In addition, the literature review shows that the role of social determinants of health on outcomes, and the possible role these determinants play in disparities have largely been ignored. Psychosocial factors, such as self-efficacy, depression, social support, and perceived stress, show consistent associations with self-care, quality of life, and glycemic control. Neighborhood factors, such as food insecurity, social cohesion, and neighborhood aesthetics have been associated with glycemic control. Perceived discrimination has also been associated with self-care and the psychological component of quality of life. Health care professionals need to be skilled in assessing social determinants of health and taking them into consideration in clinical care. In addition, more research is needed to identify the separate and combined impact of race/ethnicity and social determinants of health on process of care, quality of care and outcomes in diabetes, especially in the South, where the burden of disease is particularly high.

Corresponding Author: Leonard E Egede, MD, MS, Center for Health Disparities Research, Medical University of South Carolina, 135 Rutledge Avenue, Room 280G, Charleston, SC 29425-0593, Phone: 843-876-1238, Fax: 843-876-1201, egedel@musc.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Disclosures: None

Conflicts of Interest: None

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Keywords

social determinants of health; diabetes; health disparities; psychosocial factors; neighborhood factors

Burden of Type 2 Diabetes

Based on estimates from the Center for Disease Control and Prevention (CDC), 29.1 million people in the United States, or 9.3% of the population, have diabetes. (1) The burden of diabetes is high, with 71% also diagnosed with high blood pressure or using prescriptions to lower their blood pressure, and 65% also diagnosed with high cholesterol or using prescriptions to lower their cholesterol. (1) Cardiovascular disease death rates are 1.7 times higher, hospitalization for heart attack is 1.8 times higher, and hospitalization for stroke is 1.5 times higher for those diagnosed with diabetes. (1) In addition, diabetes is the leading cause of blindness, kidney failure, and non-traumatic lower limb amputation in adults. (1) The economic burden is also significant, with an estimated cost of $245 billion in the United States. (1) Medical expenditures for those with diabetes are 2.3 times higher than those without diabetes, and indirect costs of disability, work loss, and premature death was estimated at $69 billion in 2012. (1)

Between 2006 and 2010, an increase occurred in the disparity between the prevalence of diagnosed diabetes among those living in the South and other regions of the United States. (2) The age-standardized prevalence of diabetes in the South increased significantly from 7.1% to 8.8%, a relative difference of 25.2% and the highest prevalence of any Census region. (2) The relative difference compared to the Northeast was 14.5% in 2006, and increased to 39.7% in 2010. (2) Based on county level diabetes prevalence estimates, a “diabetes belt” has been described to exist in the Southeast U.S. (3) This belt, covering counties from 15 states, includes large sections of the states of Alabama, Georgia, Kentucky, Louisiana, Mississippi, South Carolina, Tennessee, and West Virginia. (3) Differences in demographics and risk factors between counties in the diabetes belt and the rest of the U.S. include a higher proportion of non-Hispanic African Americans, higher prevalence of obesity and sedentary lifestyle, and a lower proportion of people with a college degree. (3) These differences suggest a need to consider variations in diabetes prevalence and outcomes by racial/ethnic, behavioral, and socioeconomic factors. As a result, it is necessary to better understand the impact of race/ethnicity and social determinants of health, or the social and economic conditions that influence health status on diabetes outcomes, in order to address the increased burden of diabetes in the Southern United States.

Racial Differences in Diabetes Outcomes

Members of racial and ethnic minority groups are disproportionally affected by diabetes compared to non-Hispanic Whites. According to the most recent estimates by the Centers for Disease Control and Prevention (CDC), among people aged 20 years of age or older in the United States, 9.0% of Asian Americans, 12.8% of Hispanics, 13.2% of non-Hispanic blacks, and 15.9% of American Indians/Alaska Natives have been diagnosed with diabetes compared to 7.6% of non-Hispanic Whites. (1) Minority populations have been shown to

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

suffer a greater burden of disease, exhibit poorer self-management abilities, and experience more diabetes-related complications compared to non-Hispanic Whites, (1,4,5) resulting in worse diabetes outcomes and higher rates of mortality. (4)

National policies such as the *Healthy People* initiatives have been implemented since the turn of the 21st century to identify, reduce, and ultimately, eliminate inequities in health care, and promote the highest level of care among all population groups across America. (6) In addition, organizations such as the American Diabetes Association have established standards of medical care in diabetes, particularly for the "*ABC's*" of diabetes, which include a glycosylated hemoglobin **A1c** (HbA1c) <7%, blood pressure (**BP**) <140/90 mmHg, and low-density lipoprotein **cholesterol** (LDL-**C**) <100 mg/dL (2.6mmol/L) (7), but these goals are often not attained by minority populations compared to non-Hispanic Whites. (7,8,9)

Despite the existence of such policies and guidelines, a divide in care across various chronic conditions such as diabetes, continues to persist between vulnerable populations and the current majority. Evidence of racial and ethnic differences observed in select clinical outcomes briefly discussed below, illustrate the aforementioned inequity in care between groups. As such, equitable and comprehensive efforts for improving care and eliminating disparate care among multiple population groups is warranted.

Glycemic Control

Glycemic control is necessary to reduce complications, especially microvascular injuries, and improve outcomes associated with diabetes care. Affected by biological, socioeconomic, and quality-of-care factors (Kirk 2006), HbA1c is the clinical measure routinely assessed to proxy glycemic control in individuals with type 2 diabetes. Unfortunately, minority groups consistently fall below the recommended guidelines for optimal results (i.e., HbA1c<7%), further widening the disparity in glycemic control observed between minority groups and non-Hispanic Whites.

In a systematic review of the literature to assess the impact of racial differences on monitoring and outcomes in diabetes, Campbell et al demonstrated significant differences in glycemic control by race/ethnicity. (10) Despite varying research designs, sample sizes, source data, and study limitations, members within minority populations (African Americans, Hispanic, and Asian Americans) were found to have significantly higher HbA1c levels compared to non-Hispanic Whites. (10) Additionally, regardless of the study population and the measured outcome (i.e., HbA1c threshold of <7% vs. <9%), differences in glycemic control by race and ethnicity were observed, and these differences were clinically significant indicated by a difference in HbA1c by a minimum of 0.5 between groups. (10) Finally, a persistent racial gap in glycemic control between African Americans and non-Hispanic Whites was continually observed in the populations assessed during the systematic review. (10) Similarly, in a meta-analysis to assess disparities in HbA1c levels between African American and non-Hispanic White adults with diabetes, Kirk et al found a difference in the HbA1c of approximately 0.65% between African Americans and non-Hispanic Whites, which indicated a higher HbA1c for African Americans across studies. (5) Kirk also conducted a meta-analysis to assess disparities in HbA1c levels between Hispanic

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

and non-Hispanic White adults with diabetes. (11) As observed between African Americans and non-Hispanic Whites, Hispanic adults had higher HbA1c levels by a difference of approximately 0.5% compared to non-Hispanic White adults. (11) The findings presented by Campbell and Kirk demonstrate differences in glycemic control by race/ethnicity and contribute to the evidence indicating disparate care between population groups.

These reviews are further supported by continued evidence in the literature demonstrating differences in glycemic control by race/ethnicity. (5,12-16) In a study describing racial/ethnic differences in HbA1c among non-Hispanic Black, Hispanic, and non-Hispanic White persons with diagnosed and undiagnosed diabetes in the United States, non-Hispanic Whites had lower mean HbA1c levels than both non-Hispanic Blacks and Hispanics. (16) In addition, non-Hispanic Whites with diabetes were less likely to have an HbA1c ≤11% compared to non-Hispanic Blacks and Hispanics. (16) In a study to examine longitudinal differences in glycemic control between 8813 non-Hispanic black and non-Hispanic White Veterans, Egede et al showed non-Hispanic black veterans to have higher HbA1c levels over time and poorer glycemic control compared to non-Hispanic White Veterans. (12) Similarly, in a study to determine racial/ethnic differences in the control of multiple diabetes outcomes in a diverse sample of adults in the Southeastern United States, the unadjusted mean HbA1c was found to be significantly higher in non-Hispanic Blacks compared to non-Hispanic Whites. (13)

Blood Pressure Control

Blood pressure control in patients with diabetes is another vital component of care management needed to reduce the risk or slow the progression of complications such as retinopathy and nephropathy. The United Kingdom Prospective Diabetes Study (UKPDS) provided strong evidence that blood pressure control greatly reduces the development of kidney disease associated with diabetes. (7,17) Despite this evidence, blood pressure control in minority populations is often suboptimal.

In their systematic review to assess disparities in diabetes outcomes, Campbell et al found evidence examining racial differences in blood pressure control among patients with type 2 diabetes. (10) As was observed in glycemic control, individuals belonging to minority populations had significantly poorer BP control, and alarmingly, African Americans consistently demonstrated the lowest rates of BP control when compared to both non-Hispanic Whites and other racial and ethnic minority groups. (10) Similarly, in an effort to understand racial differences in the associations of diabetes with uncontrolled blood pressure in patients with comorbid hypertension, Liu and Song found non-Hispanic Blacks with diabetes to have a 138% higher chance of having uncontrolled blood pressure compared to persons without diabetes. (18) Paradoxically, diabetes was associated with lower systolic and diastolic blood pressures for Mexican Americans in this sample of 6134 adults with hypertension compared to both non-Hispanic Blacks and non-Hispanic Whites, (18) which is in contrast to the vast majority of literature assessing blood pressure control in diabetes where minority populations tend to have worse control. Finally, in a systematic review to assess racial and ethnic differences in cardiovascular disease risk factors where diabetes was an independent risk factor for cardiovascular disease, Kurian et al found non-Hispanic

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Blacks more likely to have significantly higher and uncontrolled blood pressure compared to non-Hispanic Whites. (19)

In a retrospective cohort study to assess racial and ethnic differences in longitudinal BP control in Veterans with type 2 diabetes mellitus, minority veterans had an increased risk for poorer BP control when compared to non-Hispanic White Veterans. (8) Similarly, Lynch et al found the unadjusted mean BP (and independently, both systolic and diastolic pressures) to be significantly higher in non-Hispanic Blacks when assessing racial/ethnic differences in multiple diabetes outcomes among adult patients with type 2 diabetes in the Southeastern United States. (13) After adjusting for relevant confounding factors including sociodemographic characteristics, BP control continued to be worse in non-Hispanic blacks compared to non-Hispanic Whites. (13)

Lipid Control

Along with hypertension, dyslipidemia is a common comorbid condition often diagnosed in patients with diabetes. Therefore, a third vital component of diabetes management is lipid control, which along with glycemic and BP control, helps to reduce the complications associated with diabetes. The overall composite control of HbA1c, BP, and LDL-C in the sample of adults with type 2 diabetes in the Southeastern United States was significantly lower for non-Hispanic blacks as well compared to the other population groups. (13) In a study to examine simultaneous control of diabetes outcomes among 8,207 Veterans seen at primary care clinics, few patients were able to achieve simultaneous control of HbA1c, BP, and LDL-C. (20) The factors associated with poor composite control included being of African American or Hispanic race-ethnicity. (20) In a similar study, race and duration of diabetes were suggested reasons U.S. adults with diabetes have not been able to achieve ADA clinical practice recommendations for clinical outcomes such as HbA1c, high-density lipoprotein cholesterol (HDL-C), and LDL-C. (21)

When examined as an independent outcome, the studies examining lipid control by race and ethnicity are sparse; however, some studies have demonstrated disparities in lipid control by race and ethnicity. In the systematic review conducted by Campbell et al, differences in lipid control by race/ethnicity were observed, just as was noticed in both glycemic and blood pressure control. (10) African American and Hispanics were more likely to have poor lipid control compared to non-Hispanic Whites. (10) When making comparisons among racial and ethnic groups, they found Asian Americans to be less likely to have poor lipid control compared to all other minority groups. (10) In a study assessing glycemic and lipid control among patients with diabetes at six U.S. public hospitals by Chew and colleagues, minority patients were at higher risk for poor lipid (and glycemic) control. (22) Similarly, in a study to analyze medication adherence patterns to maximize control of LDL-C, being African American was significantly associated with non-adherence and ultimately poor lipid control. (23) Finally, in a study to determine racial/ethnic differences in the control of multiple diabetes outcomes in a diverse sample of adults in the Southeastern United States, Lynch et al found the unadjusted mean LDL-C to be significantly higher in non-Hispanic Blacks. (13)

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Social Determinants of Health and Diabetes

Significant effort in ongoing strategies to reduce or eliminate racial/ethnic disparities in health has been focused on improving access and quality of care. (24,25) However, an important component that is often ignored is the role of social determinants of health on outcomes, and the possible role these determinants play in disparities. (24,25) Social determinants of health have been defined by the CDC as the circumstances in which people are born, live, work, and age, as well as the healthcare system. (26) This encompasses four categories of interacting factors: 1) socioeconomic circumstances, 2) psychosocial factors, 3) neighborhood environment, and 4) political, economic and cultural drivers. (27) Research over the past decade shows the important effect of social determinants on both individual and population health. (25) A review by the World Health Organization created a guiding framework to understand this influence. (25) This framework suggests that political, economic and cultural drivers influence socioeconomic position and social status, which in turn shapes the social determinants of health, including material circumstances, behaviors/biological factors and psychosocial factors. These social determinants of health impact the health system and eventually impact health and well-being. (25) In addition to influencing health outcomes, social determinants of health have been found to influence health inequities within and between countries (28,29) suggesting they may help explain racial/ethnic differences in health outcomes.

Evidence suggests a relationship between social determinants of health and both diabetes risk and outcomes. (30,31) Much of the initial work on social determinants focused on socioeconomic factors. Research in the United Kingdom, Canada and the United States consistently shows an association between low socioeconomic status and increased risk of diabetes. (32-34) In addition, individuals in the United States with less than a high school education had a twofold higher diabetes-related mortality than those with a college degree or higher education, after adjustment. (35) Similarly, individuals without college education were more likely to have poor control of their diabetes than those with some college education. (36)

A review of the literature focusing on the impact of social determinants on health outcomes in diabetes found that many articles were only tangentially related to social determinants, and did not explicitly examine their influence on outcomes. (31) The review found that there was little evidence explaining why lower socioeconomic status is associated with poor outcomes, though one path analysis confirmed a hypothesis that financial distress, community disadvantage and educational attainment influenced A1c through depressive symptoms. (31) The review also found that a range of topics categorized into the social and community context were associated with higher A1c, including low health literacy, acculturation, depressive symptoms, belief in chance and social isolation. (31) Lower quality of life was also associated with depressive symptoms, as well as higher perceived control. (31) The majority of papers meeting inclusion criteria focused on the healthcare system, finding higher A1c was associated with difficulty obtaining care, patients using acute care facilities, no usual source of care, and lower trust in providers and the healthcare system. (31) Disparities in outcomes did not differ significantly, however, by the primary source of care, number of physician visits or type of insurance. (31) The least amount of research was

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

done in the category of neighborhood and built environment. Those who were food insecure were more likely to have poor glycemic control and lower neighborhood socioeconomic status was significantly associated with poorer physical and mental health, but more work is needed to confirm these results and understand the magnitude and direction of these relationships. (31)

A set of social determinants referred to as intermediary determinants are particularly mutable because they occur at the individual level and are amenable to individual, community and health systems interventions. (25) These have been grouped into four main categories: psychosocial, material, behavioral/biological, and the health system itself. (25) Psychosocial factors include psychological states such as depression and stress, as well as psychosocial variables such as social support and perceptions of disease. Material factors include factors such as income, housing and neighborhood quality, education level, and the physical work environment. Behavioral factors important to patients with diabetes include behaviors such as smoking, diet and physical exercise. (25) In an effort to better understand the underlying determinants of differences in diabetes prevalence and outcomes, research surrounding psychosocial, neighborhood, and behavioral factors are summarized below, with specific focus on research conducted in the Southern United States.

Psychosocial Factors and Diabetes

Psychosocial factors can be viewed as one's psychological and social surroundings, which include psychological states such as depression, as well as, influences such as social support. These factors are believed to be both cause and consequence of how an individual manages their diabetes. (37) Diabetes is a psychologically and behaviorally demanding disease; therefore, psychosocial factors can influence most aspects of its management. (38) A systematic review in 2008 showed that psychosocial factors are significantly associated with poorer diabetes outcomes, and suggested that poor social support may be more strongly associated with diabetes control than stressful events or a stress-prone personality. (39) Additionally, an analysis taking both socioeconomic and psychological components of social determinants of health into account found that while socioeconomic factors were most often associated with diabetes outcomes and diabetes knowledge, psychosocial factors were most often associated with self-care and quality of life. (40) Self-efficacy and perceived stress had the strongest and most consistent associations with self-care, and depression, serious psychological distress, and social support had the strongest and most consistent associations with quality of life. (40)

Additional work has been done to understand if these associations are the result of a direct or indirect influence on diabetes outcomes. In a study using mediation analysis and structural equation modeling, psychological distress, social support and self-efficacy were found to have a direct effect on both self-care and glycemic control. (41) In the final model, social status was not associated with either self-care or glycemic control, but lower psychological distress, lower social support and higher self-efficacy were related to lower glycemic control. (41) The recommendation to focus on diabetes distress, rather than solely on depression, was supported by this study. (42) In addition, self-care did not mediate this

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

relationship, suggesting a need to consider psychological influences beyond their influence on self-care behaviors. (41)

A path analysis of socioeconomic and psychosocial factors supported the conceptual framework linking social determinants of health to glycemic control through both direct effects and indirectly through self-care, access to care, and process of care. (43) While employment was directly associated with glycemic control, income was indirectly associated through its influence on process and access to care. (43) Similarly, while higher diabetes distress, higher fatalism, and lower self-efficacy showed a direct association with higher glycemic control, lower social support and higher perceived stress were indirectly associated through processes, access, and self-care factors. (43) These analyses are consistent with path analyses conducted in Turkey, Iran and China, suggesting clinicians should consider multi-component interventions incorporating psychological and behavioral strategies in diabetes management. (43) In addition, a systematic review of interventions found that integrated lifestyle and psychological components were more effected at improving mental health than either alone. (44)

A specific psychosocial factor consistently associated with diabetes outcomes is social support. Social support is a multifaceted experience that involves both formal and informal relationships, and can be categorized into emotional, tangible, informational, and companionship. (45) It can be either positive or negative and can include family members, friends, peers, and healthcare professionals. (45) A literature review conducted to understand its influence on diabetes self-care and glycemic control found higher levels were associated with better self-care and better outcomes. (45) Family support improved glucose monitoring, diet, and exercise, while decreasing perceived barriers to self-care; while support from health care professionals increased likelihood of meal planning and preventive services. (45) The association with better clinical outcomes remained regardless of delivery type, including peer support, couples/spouse, or nurse care managers. (45) And while negative support increases the risk of medication nonadherence, positive support was associated with decreased mortality rates. (45) The manner in which social support is perceived has been found to vary from the actual social support received, and receipt differs based on gender, race/ethnicity, culture and social environment. (45) In addition, a study found racial/ethnic differences in preferred mode of delivery, with minorities exhibiting a greater propensity for support from family and friends. (45) The variety of factors to consider in social support is an example of the need to consider in depth how best to account for psychosocial social determinants of health in intervention development.

Neighborhood Factors and Diabetes

Neighborhoods and communities play a vital role in individual health outcomes through characteristics, such as crime rates, social cohesion, and prevailing attitudes that promote health. (46) Studies have shown an association between positive health outcomes and availability and access to health care services, healthy foods, and places to exercise. (47,48) A qualitative study conducted in African Americans from a rural Georgia town noted the built environment as a major social determinant of health. (49) Many interviewees felt there were few recreational options, and those that existed required a participation fee or were

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

focused on younger children. (49) In addition, interviewees noted limited options for accessing health food options, both when considering grocery stores and restaurants. (49) Food insecurity is reported in approximately 20% of patients with diabetes, and has been linked to poor glycemic control, possibly due to difficulty following an appropriate diet or increased distress. (50,51) In an analysis considering a variety of neighborhood factors together, food insecurity and neighborhood activities had independent associations with multiple self-care behaviors. (52) Social cohesion was the only neighborhood characteristic with an independent association with glycemic control after controlling for relevant sociodemographic and clinical factors. (52) An analysis that used latent variables in structural equation modeling found that access to healthy foods was significantly associated with diabetes self-care, while neighborhood aesthetics (walking environment, recreational facilities, neighborhood activities) and neighborhood violence (safety, crime, perceived problems) were not. (53) However, when considering glycemic control, neighborhood aesthetics did have a significant negative direct effect on A1c. (54) In this analysis, access to healthy foods did not have a direct effect on A1c, suggesting it exerts its greatest influence on self-management behaviors. (54)

Overarching psychosocial constructs such as discrimination and chronic stress have also been suggested to influence health outcomes and self-management in chronic diseases. (55) An inverse association between discrimination and health has been shown in a number of diseases and over a range of outcomes. (55) Work completed in the Southern United States in patients with diabetes found that while there was no association with biologic measures, perceived discrimination was significantly associated with health behaviors and the psychological component of quality of life. (56) Associations differed by race, with perceived discrimination in African Americans significantly associated with higher blood pressure, and perceived discrimination in Whites significantly associated with lower quality of life and poor health behaviors. (56) When considering perceived discrimination based on race, level of education, gender, and language, only discrimination based on education remained statistically significant after adjustment for other types. (57)

Behavioral Factors and Diabetes

Behaviors such as eating a healthy diet, taking medications as prescribed, being physically active, and monitoring blood glucose levels are patient-level strategies vital to systematically maximizing diabetes self-management and improving health outcomes. Additional lifestyle changes such as tobacco cessation, weight management, and fruit and vegetable consumption and preventive strategies including daily foot examinations, annual eye examination and influenza shot, and vaccination with the pneumococcal vaccine, coupled with diabetes education, are also required to improve overall outcomes. (7)

Studies have shown an association between positive health outcomes and behavioral factors. (58-60) The trio of (1) adhering to prescribed medication regimens, (2) being physical active, and (3) eating a healthy diet, together with (4) self-monitoring of blood glucose are acknowledged as the major cornerstones of diabetes therapy. (61)

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Evidence suggests adherence to diabetes medications varies between 36-93% for oral agents and 63-80% for insulin. (62,63) A study of 1560 patients with type 2 diabetes to assess the influence of appointment keeping and medication adherence on HbA1c demonstrated an association between improved glycemic control (lower HbA1c) and medication adherence. (62) After 12 months of taking medications as prescribed, the HbA1c improved to 7.8%, a decline from 9.1% at baseline. (62) After adjusting for relevant sociodemographic and clinical factors, the HbA1c was found to have decreased by 0.34% with each quartile improvement in medication adherence. (62) Similarly, in a study of 540 adult patients with type 2 diabetes investigating the association between diabetes knowledge, medication adherence, and glycemic control, medication adherence coupled with diabetes knowledge and education were significant predictors of good glycemic control. (64)

The benefits of physical activity are extensive, and in diabetes management, regular physical activity is recommended to improve blood glucose levels, reduce complications, and improve overall health. (61) In a meta-analysis to assess the effects of exercise on glycemic control and body mass index in type 2 diabetes mellitus, Boule et al found significantly lower HbA1c levels when patient groups were physically active compared to control groups where exercise was not a part of the management routine. (61) Similarly, in a randomized controlled trial of an exercise program using resistance training to improve glycemic control in older adults with type 2 diabetes, individuals in the exercise program had reduced HbA1c levels and increased muscle glycogen stores compared to the individuals in the control group. (65) Individuals in the exercise group benefited even more as the prescribed medication dosages of 72% of the exercisers were eventually reduced compared to a 42% increase in the comparison group individuals who were not physically active. (65)

Several clinical trials have demonstrated an improvement in glycemic control with a low-carbohydrate diet, as carbohydrates are the driving force prompting higher glucose levels and insulin release. (66) Evidence suggests that, compared to diets higher in fat with reduced carbohydrates, diets higher in carbohydrates significantly worsen blood glucose and lipid levels, resulting in a 24% increased fasting plasma triglyceride level and a daylong increase in fasting plasma glucose level by 12% and triglyceride level by 10%, worsening overall metabolic control. (67) Further, daily consumption of diets higher in carbohydrates resulted in worsening HbA1c, persisting hyperinsulinemia, and increasing hyperlipidemia. (67)

Self-monitoring of blood glucose (SMBG) is an essential component of effective diabetes management, as it allows patients to assess their response to therapy and make directed adjustments as warranted to their self-care skills and abilities. (7) Evidence from the American Diabetes Association suggests a correlation exists between SMBG frequency and lower HbA1c levels. (7) In patients with type 2 diabetes where the prescribed SMBG regimen often varies and is patient-, goal-, and control-directed, SMBG can serve as a useful tool for patient-centered care when guiding diet therapies, making medication titrations, and improving physical activity levels. (7) In a study to evaluate the effectiveness of SMBG in improving glycemic control, Karter et al found an association between testing at least once daily with lower HbA1c in patients with type 2 diabetes who were also receiving pharmacologic treatment. (68) These findings resulted in a statistical and clinically significant reduction in HbA1c by 0.6 points. Furthermore, individuals with type 2 diabetes

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

not treated with medications (lifestyle and behavioral modification only) who tested at any frequency also benefited from SMBG and saw a reduction in HbA1c by 0.4 points compared to individuals who did not test at all. (68)

Conclusion

In conclusion, based on a scoping review of the literature, there is strong evidence that race/ethnicity and social determinants of health significantly impact outcomes for patients with diabetes. A better understanding of the mechanisms and pathways of these relationships/associations will improve development of cost-effective, culturally tailored programs for patients with diabetes that are sensitive to the needs of the populations being served. Health care professionals should be skilled in assessing social determinants of health and taking them into consideration in clinical care. A study of 34 systematic reviews on interventions to improve minority health found that effective interventions have the potential to extend beyond the traditional view of clinical care and reach into the social and cultural context. (69) Interventions such as care coordination, culturally tailored health education, and community health workers, emerged as important areas to focus future research. (69) In addition, more research is needed to identify the separate and combined impact of race/ethnicity and social determinants of health on process of care, quality of care and outcomes in diabetes, especially in the South, where the burden of disease is particularly high.

References

1. Centers for Disease Control and Prevention: National Diabetes Statistics Report, 2014. Centers for Disease Control and Prevention, U.S. Department of Health and Human Services; Atlanta: 2014.
2. Beckles GL, Chou C. Diabetes – United States, 2006 and 2010. Centers for Disease Control and Prevention Morbidity and Mortality Weekly Report. 2013; 62(Suppl 3):99–104. [PubMed: 23407125]
3. Barker LE, Kirtland KA, Gregg EW, Geiss LS, Thompson TJ. Geographic distribution of diagnosed diabetes in the U.S.: a diabetes belt. Am J Prev Med. Apr; 2011 40(4):434–439. [PubMed: 21406277]
4. Diabetes Disparities among Racial and Ethnic Minorities. Agency for Healthcare Research and Quality; 2001. AHRQ Publication No. 02-P007http://archive.ahrq.gov/research/findings/factsheets/diabetes/diabdisp/diabdisp.html [26 October 2015]
5. Kirk JK, D'Agostino RB Jr, Bell RA, Passmore LV, Bonds DE, Karter AJ, Venkat Narayan KM. Disparities in HbA1c levels between African-American and non-Hispanic white adults with diabetes: a meta-analysis. Diabetes Care. 2006; 29:2130–2136. [PubMed: 16936167]
6. U.S. Department of Health and Human Services. The Secretary's Advisory Committee on National Health Promotion and Disease Prevention Objectives for 2020. Phase I report: Recommendations for the framework and format of Healthy People 2020. Jan 6. 2010 [Internet]. Section IV: Advisory Committee findings and recommendationsAvailable from: http://www.healthypeople.gov/sites/default/files/PhaseI_0.pdf
7. American Diabetes Association. Strategies for improving care. Sec. 1 In Standards of Medical Care in Diabetes—2015. Diabetes Care. 2015; 38(Suppl. 1):S1–S94.
8. Axon RN, Gebregziabher M, Echols C, Gilbert GG, Egede LE. Racial and ethnic differences in longitudinal blood pressure control in veterans with type 2 diabetes mellitus. J Gen Med. 2011; 26(11):1278–1283.
9. Sequist TD, Adams A, Zhang F, Ross-Degnan D, Ayanian JZ. Effects of quality improvement on racial disparities in diabetes care. Arch Intern Med. 2006; 166(6):675–681. [PubMed: 16567608]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

10. Campbell JA, Walker RJ, Smalls BL, Egede LE. Glucose control in diabetes: the impact of racial differences on monitoring and outcomes. Endocrine. 2012; 42:471–482. [PubMed: 22815042]
11. Kirk JK, Passmore LV, Bell RA, Venkat Narayan KM, D'Agostino RB, Arcury TA, Quadt SA. Disparities in A1c levels between Hispanic and non-Hispanic white adults with diabetes: a meta-analysis. Diabetes Care. 2008; 31:240–246. [PubMed: 17977939]
12. Egede LE, Mueller M, Echols CL, Gebregziabher M. Longitudinal differences in glycemic control by race/ethnicity among veterans with type 2 diabetes. Med Care. 2010; 48:527–533. [PubMed: 20473215]
13. Lynch CP, Strom Williams JL, Reid J, Joseph R, Keith B, Egede LE. Racial/Ethnic differences in multiple diabetes outcomes in patients with type 2 diabetes in the southeastern United States. Ethn Dis. 2014; 24(2):189–194. [PubMed: 24804365]
14. Harris MI, Eastman RC, Cowie CC, et al. Racial and ethnic differences in glycemic control of adults with type 2 diabetes. Diabetes Care. 1999; 22:403–408. [PubMed: 10097918]
15. Saydah S, Cowie C, Eberhardt MS, et al. Race and ethnic differences in glycemic control among adults with diagnosed diabetes in the United States. Ethn Dis. 2007; 17:529–535. [PubMed: 17985509]
16. Boltri JM, Okosun IS, Davis-Smith M, Vogel RL. Hemoglobin A1c levels in diagnosed and undiagnosed black, Hispanic, and white persons with diabetes: results from NHANES 1999-2000. Ethn Dis. 2005; 15:562–567. [PubMed: 16259477]
17. UK Prospective Diabetes Study Group. Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes: UKPDS 38. BMJ. 1998; 317:703–713. [PubMed: 9732337]
18. Liu X, Song P. Is the association of diabetes with uncontrolled blood pressure stronger in Mexican Americans and blacks than in whites among diagnosed hypertensive patients? Am J Hypertension. 2013; 26(11):1328–34.
19. Kurian AK, Cardarelli KM. Racial and ethnic differences in cardiovascular disease risk factors: a systematic review. Ethn Dis. 2007; 17:143–152. [PubMed: 17274224]
20. Jackson GL, Edelman D, Weinberger M. Simultaneous control of intermediate diabetes outcomes among Veterans Affairs primary care patients. J Gen Intern Med. 2006; 21(10):1050–6. [PubMed: 16970554]
21. Resnick HE, Foster GL, Bardsley J, Ratner RE. Achievement of American Diabetes Association clinical practice recommendations among U.S. adults with diabetes, 1999-2002: the National Health and Nutrition Examination Survey. Diabetes Care. 2006; 29(3):531–7. [PubMed: 16505501]
22. Chew LD, Schillinger D, Maynard C, Lessler DS, Consortium for Quality Improvement in Safety Net Hospitals. Glycemic and lipid control among patients with diabetes at six U.S. public hospitals. J Health Care Poor Underserved. 2008; 19(4):1060–75. [PubMed: 19029737]
23. Zhu VJ, Tu W, Rosenman MB, Overhage JM. Facilitating clinical research through the health information exchange: lipid control as an example. AMIA Annu Symp Proc. 2010:947–51. [PubMed: 21347118]
24. Williams DR, Costa MV, Odunlami AO, Mohammed SA. Moving upstream: how interventions that address the social determinants of health can improve health and reduce disparities. J Public Health Manag Pract. 2008; 14(Suppl):S8–S17. [PubMed: 18843244]
25. Solar, O.; Irwin, A. A conceptual framework for action on the social determinants of health. Social Determinants of Health Discussion Paper 2 (Policy and Practice). World Health Organization; Geneva: 2010.
26. Healthy People. Secretary's Advisory Committee on Health Promotion and Disease Prevention Objectives for 2020. Healthy People 2020: An Opportunity to Address the Societal Determinants of Health in the United States. Jul 26. 2010 Available from: http://www.healthypeople.gov/2020/topicsobjectives2020/overview.aspx?topicid=39
27. Marmot, M. Fair society, healthy lives (the Marmot review). Department of Health; London: 2010.
28. Marmot M. Social determinants of health inequities. The Lancet. 2005; 365:1099–1104.
29. Stuart K, Soulsby EJ. Reducing global health inequalities. Part 1. J R *Soc Med*. 2011; 104(8):321–326. [PubMed: 21816930]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

30. Whiting, D.; Unwin, V.; Roglic, G. Diabetes: equity and social determinants. Equity, social determinants and public health programs. World Health Organization; Geneva: 2010. p. 77-94.
31. Walker RJ, Small BL, Campbell JA, Strom Williams JL, Egede LE. Impact of social determinants of health on outcomes for type 2 diabetes: a systematic review. Endocrine. 2014; 47(1):29–48. [PubMed: 24532079]
32. Agardh E, Allebeck P, Hallqvist J, Moradi T, Sidorchuk A. Type 2 diabetes incidence and socio-economic position: a systematic review and meta-analysis. Int J Epidemiol. 2011; 40(3):804e18. [PubMed: 21335614]
33. Dinca-Panaitescu S, Dinca-Panaitescu M, Bryant T, Daiski I, Pilkington B, Raphael D. Diabetes prevalence and income: Results of the Canadian Community Health Survey. Health Policy. 2011; 99(2):116–123. [PubMed: 20724018]
34. Robbins JM, Vaccarino V, Zhang H, Kasl SV. Socioeconomic status and type 2 diabetes in African American and non-Hispanic white women and men: evidence from the Third National Health and Nutrition Examination Survey. Am J Public Health. 2001; 91(1):76–83. [PubMed: 11189829]
35. Saydah S, Lochner K. Socioeconomic status and risk of diabetes-related mortality in the U.S. Public Health Report. 2010; 125(3):377–388.
36. Chatterji P, Joo H, Lahiri K. Racial/ethnic- and education-related disparities in the control of risk factors for cardiovascular disease among individuals with diabetes. Diabetes Care. 2012; 35(2): 305–312. [PubMed: 22190677]
37. Rubin RR, Peyrot M. Psychological problems and interventions in diabetes: a review of the literature. Diabetes Care. 1992; 15:1640–1657. [PubMed: 1468297]
38. Delamater AM, Jacobson AM, Anderson B, Cox D, Fisher L, Lustman P, Rubin R, Wysocki T. Psychosocial therapies in diabetes: Report of the psychosocial therapies working group. Diabetes Care. 2001; 24:1286–1292. [PubMed: 11423517]
39. Chida Y, Hamer M. An association of adverse psychosocial factors with diabetes mellitus: a meta-analytic review of longitudinal cohort studies. Diabetologia. 2008; 51:2168–2178. [PubMed: 18806995]
40. Walker RJ, Gebregziabher M, Martin-Harris B, Egede LE. Independent Effects of Socioeoconomic and Psychological Social Determinants of Health on Self-Care and Outcomes in Type 2 Diabetes. General Hospital Psychiatry. Nov-Dec;2014 36(6):662–668. [PubMed: 25103544]
41. Walker RJ, Gebregziabher M, Martin-Harris B, Egede LE. Quantifying Direct Effects of Social Determinants of Health on Glycemic Control in Adults with Type 2 Diabetes. Diabetes Technology and Therapeutics. Feb; 2015 17(2):80–87. [PubMed: 25361382]
42. Fisher L, Gonzalez JS, Polonsky WH. The confusing tale of depression and distress in patients with diabetes: a call for greater clarity and precision. Diabet Med. 2014; 31(7):764–772. [PubMed: 24606397]
43. Walker RJ, Gebregziabher M, Martin-Harris B, Egede LE. Relationship Between Social Determinants of Health and Processes and Outcomes in Adults with Type 2 Diabetes: Validation of a Conceptual Framework. BMC Endocrine Disorders. Oct 9; 2014 14(1):82–92. [PubMed: 25298071]
44. Harkness E, Macdonald W, Valderas J, et al. Identifying phsychosocial interventions that improve both physical and mental health in patients with diabetes: a systematic review and meta-analysis. Diabetes Care. 2010; 33:926–930. [PubMed: 20351228]
45. Strom JL, Egede LE. The impact of social support on outcomes in adult patients with type 2 diabetes: a systematic review. Curr Diab Rep. 2012; 12(6):769–781. [PubMed: 22949135]
46. Echeverria SE, Dietz-Roux AV, Link BG. Reliability of self-reported neighborhood characteristics. J Urban Health. 2004; 81(4):682–701. [PubMed: 15466849]
47. Larson NI, Story MT, Nelson MC. Neighborhood environments: disparities in access to healthy food in the US. Am J Prev Med. 2009; 36(1):74–81. [PubMed: 18977112]
48. Diez Roux AV, Mair C. Neighborhoods and health. Annals of the New York Academy of Sciences. 2010; 1186:125–145. [PubMed: 20201871]
49. Scott AJ, Wilson RF. Social determinants of health among African Americans in a rural community in the Deep South: an ecological exploration. Rural and Remote Health. 2011; 11:1634. [PubMed: 21299335]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

50. Seligman HK, Jacobs EA, Lopez A, Tschann J, Fernandez A. Food insecurity and glycemic control among low-income patients with type 2 diabetes. Diabetes Care. 2012; 35(2):233–238. [PubMed: 22210570]
51. Barnard LS, Wexler DJ, DeWalt D, Berkowitz SA. Material need support interventions for diabetes prevention and control: a systematic review. 2015; 15:2–8.
52. Smalls BL, Gregory CM, Zoller JS, Egede LE. Assessing the relationship beteween neighborhood factors and diabetes related health outcomes and self-care behaviors. BMC Health Services Research. 2015; 15:445–456. [PubMed: 26428459]
53. Smalls BL, Gregory CM, Zoller JS, Egede LE. Effect of neighborhood factors on diabetes self-care behaviors in adults with type 2 diabetes. Diabetes Res Clin Pract. 2014; 106(3):435–442. [PubMed: 25451904]
54. Smalls BL, Gregory CM, Zoller JS, Egede LE. Direct and indirect effects of neighborhood factors and self-care on glycemic control in adults with type 2 diabetes. Journal of Diabetes and its Complications. 2015; 29:186–191. [PubMed: 25483848]
55. Williams DR, Mohammed SA. Discrimination and racial disparities in health: evidence and needed research. J Behav Med. 2009; 32:20–47. [PubMed: 19030981]
56. Dawson AZ, Walker RJ, Campbell JA, Egede LE. Effect of Perceived Racial Discrimination on Self-Care Behaviors, Glycemic Control and Quality of Life in Adults with Type 2 Diabetes. Endocrine. Jun; 2015 49(2):422–428. [PubMed: 25414069]
57. Reynolds DB, Walker RJ, Campbell JA, Egede LE. Differential Effect of Race, Education, Gender and Language Discrimination on Glycemic Control in Adults with Type 2 Diabetes. Diabetes Tech and Therapeutics. Apr; 2015 17(4):243–247.
58. Walker RJ, Smalls BL, Bonilha HS, Campbell JA, Egede LE. Behavioral interventions to improve glycemic control in African Americans with type 2 diabetes: a systematic review. Ethn Dis. 2013; 23(4):401–408. [PubMed: 24392600]
59. Williams JLS, Walker RJ, Smalls BL, Campbell JA, Egede LE. Effective interventions to improve medication adherence in type 2 diabetes: a systematic review. Diabetes Manag (Lond). 2014; 4(1): 29–48. [PubMed: 25214893]
60. Al Mazoui NR, Kamal MM, Ghabash NM, Yacout TA, Kole PL, McElnay JC. Influence of pharmaceutical care on health outcomes in patients with type 2 diabetes mellitus. Br J Clin Pharmacol. 2009; 67(5):547–557. [PubMed: 19552750]
61. Boule NG, Haddad E, Kenny GP, Wells GA, Sigal RJ. Effects of exercise on glycemic control and body mass in type 2 diabetes: a meta-analysis of controlled clinical trials.
62. Rhee MK, Slocum W, Ziemer DC, Culler SD, Cook CB, El-Kebbi IM, et al. Patient adherence improves glycemic control. Diabetes Educ. 2005; 31(2):240–250. [PubMed: 15797853]
63. Cramer JA. A systematic review of adherence with medications for diabetes. Diabetes Care. 2004; 27:1218–1224. [PubMed: 15111553]
64. Al-Qazaz HK, Sulaiman SA, Hassali MA, Sharif AA, Sundram S, Al-Nuri R. Diabetes knowledge, medication adherence and glycemic control among patients with type 2 diabetes. Int J Clin Pharm. 2011; 33:1028–1035. [PubMed: 22083724]
65. Castaneda C, Layne JE, Munoz-Orians L, Gordon PL, Walsmith J, Foldvari M, et al. A randomized controlled trial of resistance exercise training to improve glycemic control in older adults with type 2 diabetes. Diabetes Care. 2002; 25(12):2335–2341. [PubMed: 12453982]
66. Brand-Miller J, Hayne S, Petocz P, Colagiuri S. Low-glycemic index diets in the management of diabetes: a meta-analysis of randomized controlled trials. Diabetes Care. 2003; 26:2261–2267. [PubMed: 12882846]
67. Garg A, Bantle JP, Henry RR, Coulston AM, Griver KA, Raatz SK, et al. Effects of varying carbohydrate content of diet in patients with non-insulin-dependent diabetes mellitus. JAMA. 1994; 271(18):1421–8. [PubMed: 7848401]
68. Karter AJ, Ackerson LM, Darbinian JA, D'Agostino RB, Ferrara A, Liu J, et al. Self-monitoring of blood glucose levels and glycemic control: the Northern California Kaiser Permanente Diabetes Registry. Am J Med. 2001; 111:1–9. [PubMed: 11448654]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

69. Quinones AR, Talavera GA, Castaneda SF, Saha S. Interventions that reach into communities – promising directions for reducing racial and ethnic disparities in healthcare. J Racial and Ethnic Health Disparities. 2015; 2:336–340.