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Impact of Social Determinants of Health on Outcomes for Type 2 Diabetes: A Systematic Review

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Abstract

Objective: Social determinants of health include the social and economic conditions that influence health status. Research into the impact of social determinants on individuals with type 2 diabetes has largely focused on the prevention of risk of developing diabetes. No review exists summarizing the impact of social determinants health outcomes in patients with type 2 diabetes. This systematic review examined whether social determinants of health have an impact on health outcomes in type 2 diabetes.

Design: Medline was searched for articles that: (a) were published in English, (b) targeted adults, ages 18+ years, (c) had a study population was diagnosed with type 2 diabetes, (d) the study was done in the United States, and (e) the study measured at least one of the outcome measures- glycemic control (HbA1c), cholesterol (LDL), blood pressure, quality of life or cost.

Results: Using a reproducible strategy, 2,110 articles were identified, and 61 were reviewed based on inclusion criteria. Twelve were categorized as Economic Stability and Education, 17 were categorized as Social and Community Context, 28 were categorized as Health and Health Care, and 3 were categorized as Neighborhood and Built Environment.

Conclusions: Based on the studies reviewed, social determinants have impact on glycemic control, LDL, and blood pressure to varying degrees. The impact on cost and quality of life were not often measured, but when quality of life was investigated, it did show significance. More research is needed to better characterize the direct impact of social determinants of health on health outcomes in diabetes.

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INTRODUCTION

Social determinants of health include the social and economic conditions that influence health status. (1) As such, social determinants can be defined as the circumstances in which people are born, live, work and age, as well as the systems set up to address illness. (2) This includes the economic and social gradient influenced by a broad set of conditions such as availability of resources to meet daily needs, access to educational, economic and job opportunities, access to health care services, availability of community-based resources and opportunities, transportation options, social support, and socioeconomic conditions. (2) A number of national and global organizations have developed frameworks to understand social determinants of health. Each framework organizes the key components into categories, establishing broad areas across multiple domains into one framework. Healthy People 2020 is an example of this framework, which was used to establish evidence based resources, tools and examples of addressing social determinants at the state and local level. (2)

The relationship between social determinants of health and health outcomes has been established, but is not well understood. (3-5) Frameworks to conceptualize these influences generally indicate a bi-directional relationship between the individual and the socioeconomic and political context of their environment, with many mediating factors in between. (6-8) Studies have found associations between increased incidence, prevalence, and burden of disease with increasing levels of poverty and hunger, and lower levels of income, education and socioeconomic status. (3, 9-12) In addition, studies have found differences in incidence, prevalence and burden of disease by age, gender, race, and home circumstances. (3,9-12)

Increasingly, type 2 diabetes is being recognized as a condition upon which social determinants of health have a great impact. (13) Diabetes impacts more than 25.8 million people in the United States and 366 million people worldwide. (14-15) While studies show the effectiveness of lifestyle-based diabetes interventions on improving individual outcomes, changes in diabetes outcomes at the population level have not followed. Insufficient attention to the essential role of social determinants of health has been suggested to explain this dichotomy. (5,13, 16-21) Research into the impact of social determinants on individuals with type 2 diabetes has largely focused on the prevention of or risk of developing diabetes. International and domestic research suggests that social determinants such as income, education, housing, and access to nutritious food influence the development of type 2 diabetes. (13,21-27) However, less evidence exists regarding the impact of social determinants of health on the progression of type 2 diabetes.

As no review exists summarizing the impact of social determinants on outcomes in patients with type 2 diabetes, this systematic review was conducted to answer whether social determinants of health have an impact on health outcomes in type 2 diabetes. To examine this, we focused on populations with type 2 diabetes and disease progression, rather than patients at risk of diabetes, and we examined multiple clinical and non-clinical outcomes including glycemic control, lipids, blood pressure, cost, and quality of life. The purpose of the review was to examine the impact of a broad range of social determinants, rather than limit the review to a specific subset. Given the current literature and the diverse topics, the

Healthy People 2020 framework was used to select variables for analysis and categorize current knowledge on the impact of social determinants of health on outcomes for patients with type 2 diabetes.

METHODS

Information sources, eligibility criteria and search

A reproducible strategy was used to identify studies investigating the impact of social determinants of health on outcomes in patients with type 2 diabetes. Studies were identified by searching Medline on May 29, 2013 for articles published in English between 2000 through 2013. A full description of the search terms and search process is shown in Table 1. This search was based on the comprehensive search conducted by Bamba et al., investigating social determinants of health and health inequities (28). Some search terms were not used given the goals of this review to focus only on social determinants and not health inequities.

The following inclusion criteria were used to determine eligible study characteristics: (a) published in English, (b) targeted adults, ages 18+ years, (c) study population was diagnosed with type 2 diabetes, (d) the study was done in the United States, and (e) the study measured at least one of the outcome measures-glycemic control (HbA1c), cholesterol (LDL), blood pressure, quality of life or cost. The aforementioned clinical outcomes (HbA1c, LDL and blood pressure) were chosen as required outcome measures because they are associated with successful self-care behaviors and lower rates of disease progression (13,14). Quality of life and cost were chosen as additional outcome measures because of the increasing demand for understanding the impact of diabetes to patients beyond classic clinical measures (14). Quality of life is a well-accepted measure of general health status and can provide insight into the impact of complications and independent functioning. After adjusting for age and gender, average medical expenditures for patients with diabetes were shown to be 2.3 times higher than patients without diabetes (13). Therefore, in addition to quality of life, cost can be an important consideration for the impact of social determinants of health on patients with type 2 diabetes.

Study selection and data collection

The process used to identify eligible citations is shown in Figure 1. Titles were reviewed to ensure the study targeted a population with type 2 diabetes. Articles were eliminated if they did not meet the study criteria, for instance describing Type 1 diabetes, gestational diabetes, risk of developing diabetes, or diabetes prevention studies. Abstracts were then read and reviewed by four independent reviewers (RW, BS, JC, JW) using a standardized check-list for inclusion criteria to ensure all articles included of at least one outcome measure of interest. Finally, the abstracts and full articles were reviewed to determine which studies were conducted in the United States and to ensure the articles were focused on social determinants of health. We used the Healthy People definition of social determinants of health to determine if articles were focused on social determinants. Each article was placed in one of five categories (see Figure 2) that described social determinants of health as related to economic stability, education, social and community context, health and health care, and,

lastly, neighborhood and build environment (2). Reviewers discussed any disagreement on inclusion or exclusion of articles and the senior topic expert (LE) weighed in as a fifth independent reviewer to help make the final decision regarding eligibility in the case of disagreement.

Data collected from the eligible articles is shown in Tables 2-5, where each table is specific to a social determinants category. Due to only one article being categorized as education, the economic stability and education categories were combined in the tables and discussion. Data were extracted for each article on the study design, study objective, number of participants, sample population, study setting, and the impact of the study on health outcomes (Tables 2-5). The outcomes of interest measured, and statistical significance, if applicable, were noted in Table 6 for all categories. A narrative review was performed as the heterogeneous interventions and diverse study designs precluded conducting a meta-analysis. Though risk of bias exists, articles were not excluded due to the limited evidence available in the literature. The risk of bias across studies is discussed in the limitations, and the discussion gives more weight to studies using RCT design.

RESULTS

Study selection

Figure 1 shows the results of the search. After duplicates were removed, the search resulted in 2,110 citations. After conducting a title review for type 2 diabetes populations producing 876 articles, an abstract review was done to ensure an outcome of interest was measured, resulting in 205 eligible studies conducted in the United States. Sixty-one eligible studies were identified based on the predetermined eligibility criteria and categorized into one of five Healthy People categories. (29-89) Twelve were categorized as Economic Stability and Education, 17 were categorized as Social and Community Context, 28 were categorized as Health and Health Care, and 3 were categorized as Neighborhood and Built Environment.

Study characteristics and outcomes of studies

Tables 2-5 provide a summary of the 61 studies that met eligibility criteria. Study designs included cross-sectional, retrospective cohort, randomized-controlled trials, path analysis, mixed methods, prospective cohort, and quasi-experimental. Sample sizes ranged from 30 to 148,846. Sample population and setting both varied substantially, as did impact on outcome.

Table 6 provides a summary of the outcomes measured and whether they were statistically significant. Across all 61 articles, 54 measured HbA1c, 18 measured LDL, 17 measured blood pressure, 6 measured cost and 5 measured quality of life. Of these, 37 showed a significant association in HbA1c, 12 showed significance in LDL, 7 showed significance in blood pressure, 2 showed significance in cost, and 4 showed significance in quality of life. Within those categorized as Economic Stability and Education, 10 measured HbA1c, 5 of which were significant; 3 measured LDL, all of which were significant; 3 measured blood pressure, 2 of which were significant; 4 measured cost, 2 of which were significant; and no studies measured quality of life. Within those categorized as Social and Family Context, 14 measured HbA1c, 7 of which were significant; 5 measured LDL, 1 of which were

significant; 4 measured blood pressure, 1 of which were significant; 1 measured cost, which was not significant; and 4 studies measured quality of life, 3 of which were significant. Within those categorized as Health and Health Care, all 28 measured HbA1c, 23 of which were significant; 10 measured LDL, 8 of which were significant; 10 measured blood pressure, 4 of which were significant; 1 measured cost, which was not significant; and no studies measured quality of life. Within those categorized as Neighborhood and Built Environment, 2 measured HbA1c, both of which were significant; no studies measured LDL, blood pressure, or cost; and 1 measured quality of life, which was significant.

DISCUSSION

This systematic review is the first to synthesize the literature regarding the impact of social determinants of health on health outcomes in type 2 diabetes. Using a reproducible strategy 2,110 articles were identified, and 61 were reviewed based on inclusion criteria. When categorizing by the Healthy People framework, studies tended to cluster into the Economic Stability, Social and Community Context, and Health and Health Care groups. Few studies investigated Education or Neighborhood and Built Environment. For the most part, studies were cross-sectional or cohort design, limiting the conclusions that can be made regarding causation. However, based on the studies reviewed, there is impact on glycemic control, LDL, and blood pressure to varying degrees. This suggests that social determinants of health have an influence on the progression of type 2 diabetes. The impact on cost and quality of life were not often measured, but when quality of life was investigated, it did show significance.

Summary of evidence by category

While care was taken to categorize and summarize studies included in the review, many articles were only tangentially related to social determinants of health. For example, many of the articles categorized as Economic Stability and Education were conducted in indigent populations, but the impact of their socioeconomic status was not taken into account. Kollannoor-Samuel et al. found that those with lower socioeconomic status were more likely to have higher HbA1c, and a path analysis conducted by Kogan et al. confirmed their hypothesis that financial distress, community disadvantage and educational attainment demonstrated significant indirect effects on HbA1c through depressive symptoms. (60-61) Considering the substantial evidence that exists linking increased diabetes incidence and prevalence to low socioeconomic status, more research is needed to determine the impact of Economic Stability and Education on diabetes outcomes.

Articles categorized as Social and Community Context considered topics such as depressive symptoms, health literacy, acculturation, race/ethnicity, gender, support resources, locus of control, and perceived control. Higher HbA1c was associated with low health literacy (70), acculturation (86), race (69), depressive symptoms (36), belief in chance (50), and social isolation (56). However, these associations were not found across the board, with no significant relationships found in other studies investigating acculturation (68), social support resources (42), and depressive symptoms (43). Higher quality of life was associated with lower depressive symptoms (40,89) and higher perceived control (51). Given the range

of topics investigated and the varying degrees of association, Social and Community Context is an important influence to include when designing studies that take social determinants of health into consideration.

In the Health and Health Care category, many articles focused on the efficacy or effectiveness of a program, but often did not investigate the impact of health and health care access on the outcome. An impact on glycemic control was common, with 23 of the 28 showing statistically significant impact on HbA1c. Difficulty obtaining care, patients using acute care facilities and no usual source of care were associated with higher HbA1c. (74) Harris et al. found that with few exceptions, outcomes disparities between different racial groups did not differ significantly due to primary source of care, number of physician visits or type of health insurance. (49) Other aspects of health care, such as trust were investigated, finding that patients with high trust were less likely to have poor glycemic control than those with lower trust. (41)

Few studies investigated the impact of Neighborhood and Built Environment on diabetes outcomes. Seligman et al. found that those who were food insecure were more likely to have poor glycemic control in a sample of federally qualified health centers in the San Francisco Bay and Chicago areas. (81) Additionally, lower neighborhood SES was significantly associated with poorer physical and mental health. (44) Though, many authors have suggested the neighborhood context plays a role in diabetes outcomes, this topic needs more evidence to fully understand its' impact.

The Healthy People organizing framework was useful for categorizing articles related to social determinants of health and understanding what themes emerged in each broad area. It was challenging, however, to create mutually exclusive designations, especially if articles spanned multiple topics. As a result, it is possible that a different categorization scheme would help explain the evidence related to social determinants of health. Since the Healthy People framework was designed to create objectives for improving health and benchmarks for monitoring progress (2), this was a useful framework to inform how social determinants may need to be addressed at the national scale. Expanding research that consciously incorporates social determinants of health may, therefore, assist in both building an evidence base in the literature and informing national policy and legislation. (13)

Summary of evidence by outcome

Glycemic control was the most commonly measured outcome, with 54 of the 61 articles measuring HbA1c and over half finding statistical significance. As glycemic control has been associated with lower rates of disease progression and fewer complications (14), this association is an important finding of the review. LDL and blood pressure were measured in roughly 1/3 of the articles, with 12 of the 18 showing statistical significance in LDL, and 7 of the 17 showing statistical significance in blood pressure. Most of the studies measuring these two outcomes were categorized in Health and Health Care. This suggests that social determinants related to health care access and technology can influence outcomes beyond glycemic control, and more investigation into other domains may be informative.

Cost and quality of life were rarely measured, with only 6 of the 61 measuring cost, and 5 of the 61 measuring quality of life. Five of the six studies measuring cost, and both of the 2 studies that found statistical significance in cost outcomes, were located in the category Economic Stability and Education. Conversely, the studies measuring quality of life were located in the Social and Community Context and Neighborhood and Built Environment categories, 4 of the 5 finding statistical significance. Considering the extensive search used and the lack of studies measuring these outcomes, more research is needed regarding the impact of social determinants of health on cost and quality of life. Additionally, these outcomes should be measured in studies across the domains, in order to inform how social determinants of health impact a wide range of health and functioning.

Limitations

There are four limitations to this study worth addressing. First, the search was limited to articles published in English between 2000 and 2013. Second, since studies with positive results are more likely to be published, the studies in this review may reflect publication bias. Third, the small number of RCTs and heterogeneous methodology prevented a meta-analysis from being performed. Finally, the majority of articles were observational designs, precluding the ability to comment on causation. Conclusions from this review are therefore qualitative and meant to guide future research rather than serve as conclusive answers.

CONCLUSION

Based on this review, social determinants may influence diabetes outcomes through an impact on glycemic control, though more investigation into other domains would be informative. More research is needed regarding the impact of social determinants of health on outcomes in type 2 diabetes. Specifically, more research should be focused on investigating the direct impact of social determinants of health on outcomes. Researchers should be careful to clearly define the health determinant of interest and ensure that the measure is deliberately being examined in studies. The impact of neighborhood environments must be explored further, as they are likely contributors to diabetes and diabetes-related outcomes. Also, the social determinants of health literature must be strengthened, allowing for evidence useful in developing national policies for diabetes research and clinical care.

Further, social determinants of health is a poorly defined term that is used to describe an array of social, cultural, economic, demographic, psychosocial, and healthcare related issues that may hinder an individual from achieving optimal health outcomes. In some research areas studies are not labeled as being focused on social determinants of health but they may shed light on the subject area. In order to synthesize information on this topic area and draw meaningful conclusions, researchers must decide on terminology and/or fundamental categories of social determinants of health. In fact, this may be a vital piece in developing effective and efficient interventions in the future.

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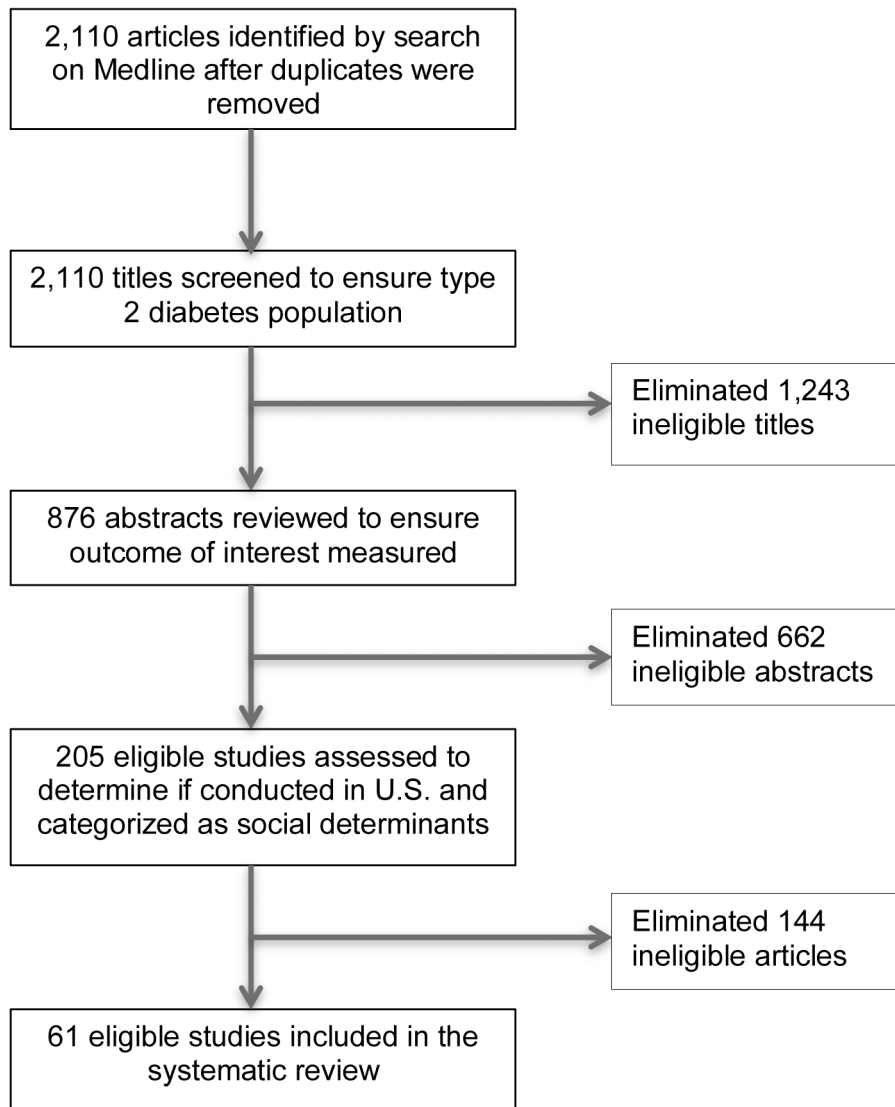


Figure 1:
Process for eligible article selection



Figure 2: Healthy People 2020 organizing framework displaying five key areas of social determinants of health.

Table 1.

Structure of Search and Search Terms

Search #	Search Terms	Number of Articles Found
1	diabetes mellitus, type 2 ^F OR insulin resistance ^F OR insulin resistance OR MODY OR NIDDM OR noninsulin dependent OR non insulin dependent OR non-insulin-dependent OR type 2 diabetes OR type II diabetes	149,259
2	access healthcare OR avail* healthcare OR access care OR avail* care	85,443
3	social depriv* OR social disadvantage	1,471
4	education achieve* OR education status	280
5	financial difficult* OR financial problem* OR income difference OR indigent	3,486
6	insurance health OR insurance status	36,629
7	jobless OR job insecurity OR low income OR marginalized OR occupational status	20,436
8	poverty OR psychosocial depriv* OR rural health OR SES	73,744
9	social disparity OR social environment OR social exclu* OR social factor* OR social gradient* OR social position OR social variation	45,104
10	socioeconomic status OR socioeconomic circum* OR socioeconomic factor* OR socioeconomic gradient* OR socioeconomic health* difference* OR socioeconomic position OR socioeconomic status socioeconomic variable	40,382
11	standard living OR underinsure* health OR underprivilege* OR unemployed OR unemployment OR unisur* health	14,432
12	vulnerable population* OR vulnerable group* OR vulnerable communit* OR vulnerable people OR vulnerable person*	10,157
13	#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12	294,295
14	#13 AND #1	2,549
15	#13 AND #1 Filters: English, 2000 to 2013	2110

^F indicates MeSH term

Table 2:

Summary of articles focused on Economic Stability and Education

Author/Year	Study Design	Objective	Number of Participants	Sample population	Setting	Impact on Outcome
Durden, 2009 (39)	Retrospective, cross-sectional cohort	Evaluate the economic burden of privately insured patients with T2DM at two time points (2000 and 2005)	21,592 in 2000 and 127,254 in 2005 (both with matched controls)	Two cohorts: patients with T2DM with medical and prescription claims from the MarketScan Commercial Claims and Encounters database for (1) 2000 and (2) 2005. Controls met the same criteria except a diagnosis of T2DM and requirements for anti-DM treatment regimen for 2000 & 2005.	Database of claims derived from health plans with fee-for-service, fully capitated, or partially capitated payment arrangements from 1/1/99 to 12/31/00 and from 1/1/04 to 12/31/05	Adjusted health care costs of patients with T2DM were higher in both years studied (146% higher in 2000, \$12,423 vs. \$5058; $p<0.001$) and 136% higher in 2005, \$12,733 vs. \$5406; $p<0.001$). (Cost figures for 2000 were inflated to 12/2005 dollars using the medical care component of the Consumer Price Index).
Lind, 2006 (63)	Retrospective, cross-sectional cohort	Investigate whether insurance coverage for complementary and alternative medicine (CAM) providers is associated with increased health care use and expenditures	20,722 adults with diabetes (Enrollees with allowed claims=497,597; CAM users with DM=3,605)	Adult patients (18-64yrs) with T2DM who had both continuous enrollment in a single plan (directly regulated by the Every Category of Provider Law) and complete claims information in 2002 (Medicare, Medicaid, state-supplemental programs, self-insured plans all excluded) Controls: randomly chosen age and gender matched adults without T2DM (5 matches for each DM patient)	Claims data from two large insurers in Washington State for 2002	CAM users had more outpatient visits (on average, 28 vs. 16) and had higher average annual expenditures (\$8,736 vs. \$7,356). CAM was not statistically associated with expenditures after adjusting.
Rodbard, 2010 (75)	Cross-sectional, prospective longitudinal (Study to Help Improve Early Evaluation and Management of Risk Factors Leading to Diabetes (SHIELD) Study)	Assess whether patients with T2DM have a greater economic burden (prescription medications and out-of-pocket expenses) compared to patients without T2DM	12,237 (patients with T2DM=3,551 and patients without T2DM=8,686)	Adult patients with T2DM	National survey of adult patients with T2DM or risk factors for DM in over 200,000 households in the US	Patients with T2DM had a significantly higher total (mean) number of prescription medications vs. patients without T2DM (6.2 vs. 4.1, $p<0.001$); therefore, patients with T2DM had 2% more prescription meds ($\beta=2.09$). Patients with T2DM had significantly higher mean out-of-pocket healthcare expenses annually (>200%) vs. those without T2DM (\$1158 vs. \$925, $p<0.001$); expenses annually.
Schechtman, 2002 (80)	Cross-sectional	Examined relationship between adherence to drug therapy and DM metabolic control	810	Low socioeconomic adults with T2DM receiving oral diabetes medication from clinic pharmacy	University of Virginia Health Systems primary care clinic	Adherence to medication in T2DM patients was strongly associated with metabolic control in indigent populations.
Lairson, 2008 (62)	Intervention	Evaluate the effect of a disease management program on adherence with recommended testes, health outcomes and	870	Adult patients with T2DM	Kelsey-Seibold Clinic Houston, Texas	The intervention increased compliance with testing for A1c and decreased A1c value and the percent of patients with A1c ≥ 9.5 . Point estimates showed small reduction in health care cost, with cost

Author/Year	Study Design	Objective	Number of Participants	Sample population	Setting	Impact on Outcome
Grant, 2005 (47)	Cross sectional	health care expenditures for patients with T2DM To assess differences in demographics, self-care behaviors, and diabetes-related risk factor control by frequency of Internet use	909	Individuals with type 2 diabetes attending primary care clinics	Hospital-based internal medicine clinic practice in Boston, MA	of office visits showing the only significance (.10). Those who were internet users were not statistically significant nor more likely to have an HbA1c >7% [OR 1.0 95% CI 0.7-1.4] and blood pressure <130/80mmHg [1.3 95% CI 0.9-2.0] but there was a internet users were statistically more likely to have an LDL <100mg/dl [OR 0.7 95% CI 0.5-0.99]
Salvo, 2012 (79)	Retrospective cohort study comparing pharmacist-managed insulin to standard care Duration: 24 months	To assess the impact of pharmacist-managed insulin titration program compared to standard medical care on glycemic control and preventive care measures in an indigent population with diabetes	126	Low income patients with type 1 or type 2 diabetes using insulin therapy	St. Louis County Department of Health	At the end of the study the intervention group showed a significant difference in HbA1c compared to standard of care (-1.3% vs. -0.18%, p=0.001)
Camacho, 2002 (34)	Cross sectional	Describe and find correlates of health-related quality of life	249	Underserved, low-income patients in North Carolina with type 1 or type 2 diabetes	Public and private, non-profit, health organizations	There was an inverse relationship between glycemic control and energy and mobility ($\beta=-4.58$, $p<0.05$); LDL control predicted better mental health ($\beta=4.54$, $p<0.01$); blood pressure was inversely associated with sexual function ($\beta=-5.89$, $p<0.01$)
Hills-Briggs, 2005 (52)	Randomized controlled trial Duration: 24 months	Examine medication adherence, association of medication adherence with HbA1c, and the association of medication adherence with sociodemographic and psychosocial variables	181	African Americans with type 2 diabetes who reside in an impoverished sociodemographic environment	Johns Hopkins-affiliated primary care clinics	Individuals in this impoverished environment tended to have higher HbA1c due to behaviors of carelessness in taking medications and stopping medications because of feeling better. No p-value reported.
Kollanoor-Samuel, 2011 (61)	Randomized controlled, longitudinal study	Identify demographic, socioeconomic, acculturation, lifestyle, sleeping patterns, and biomedical determinants of fasting plasma glucose and glycosylated hemoglobin	211	Latino adults with type 2 diabetes who were recruited from a metabolic syndrome clinic at Hartford Hospital	Home interview	Those who had a lower income were more likely (OR 10.4, 95% CI 1.54-69.30) to have higher HbA1c
Kogan, 2009 (60)	Cross sectional path analysis	Test the hypothesis that financial distress, community disadvantage and educational attainment contribute to poor glycemic control indirectly via depressive symptoms among rural African Americans	192	African Americans with type 2 diabetes	Rural counties in central Georgia	Structural equation modeling analyses confirmed hypothesis that financial distress, community disadvantage and educational attainment demonstrate significant indirect effects on HbA1c via depressive symptoms
Hill-Briggs, 2011 (53)	Randomized controlled trial Compare intensive	Determine feasibility, acceptability and effect of problem-based diabetes self-	52	Adult (25+) African Americans with type 2 diabetes	Urban African Americans in Baltimore, MD	Intensive problem-solving based program led to improvements in HbA1c (-0.72%) above that of condensed

Author/Year	Study Design	Objective	Number of Participants	Sample population	Setting	Impact on Outcome
Khan, 2011 (57)	and condensed program format Randomized controlled trial Computer multimedia education program vs educational brochure (control)	management training in low socioeconomic, low literacy population Evaluate the impact of a waiting room-administered, low-literacy, computer multimedia diabetes education program on patient self-management and provider intensification therapy	129	Uninsured adults with type 2 diabetes	County clinic in Chicago, IL	format (p=0.02). Showed clinically significant changes for those with suboptimal baseline measures in HbA1c, blood pressure, and LDL. There was a decrease in HbA1c when comparing the intervention and control groups (-1.5% vs -0.8%, p=0.06)

Table 3:

Summary of articles focused on Social and Community Context

Author/Year	Study Design	Objective	Number of Participants	Sample population	Setting	Impact on Outcome
Knight, 2008 (59)	Cross-sectional	Using screening by student pharmacists to identify depression, undiagnosed and under treated in patients with T2DM and to understand influence on DM control	45	Adults with primarily T2DM seen urban primary care clinic	5 Cincinnati Health Department Clinics	No significant differences were found on mean A1c or fasting blood glucose between depressed and non-depressed individuals.
Egede, 2010 (40)	Cross sectional	Assess differences in metabolic control and health-related quality of life among depressed and non-depressed adults in indigent population with type 2 diabetes	201	Low income adults with type 2 diabetes	Academic medical center in Southeastern United States	Depressed compared to non-depressed patients had a lower SF-12 PCS (36.1 vs. 39.0, p 0.001) and MCS (41.6 vs. 46.8, p 0.001); there was no significant difference in LDL and HbA1c between these two groups
Moxayad, 2006 (68)	Cross-sectional	Evaluate effect of family cohesiveness, acculturation, socioeconomic position, and CVD risk factors on DM severity	275 (n=193 for patients deemed to have severe DM)	Mexican Americans with T2DM	Two medical clinics in north Fort Worth, TX for 2 years	HbA1c used to define disease severity (≥ 7 =severe; <7 =non-severe). Acculturation and family cohesiveness were not statistically associated with disease severity. Factors associated with disease severity: receiving food stamps (adjusted OR 3.8, 95% CI 1.5-9.6), having spent childhood in Mexico (adjusted OR 1.2, 95% CI 1.1-1.4), and smoking status (adjusted OR 3.2, 95% CI 1.1-10.0).
Venkatesh, 2013 (86)	Mixed methods	Examine impact of acculturation on glycemic control	30	1 st generation Asian Indian (AI) adults with T2DM	Participants recruited from community (AI organizations, stores, restaurants, and listers) in a mid-western state (MI)	Statistical difference in mean HbA1c (6.4±0.3 intervention, vs. 7.9±0.7 control; p<.01). Interactions among acculturation and annual household income, BMI, and DM duration significantly predicted higher HbA1c levels (R ² change=.368; F change=4.2; p=.02).
Osborne, 2010 (70)	Cross-sectional	To examine the relationship between health literacy, determinants of DM self-care and glycemic control	130	Adults with T2DM seen in local primary care clinic	University Internal Medicine Clinic of the Medical University of South Carolina	Glycemic control and DM self-care was indirectly effected by health literacy ($r = -0.01$), ($r = -0.07$)
Okusun, 2002 (69)	Secondary data analysis using the Third National Health and Nutrition Examination Survey (NHANES III)	To compare racial/ethnic differences in diabetes awareness, treatment and glycemic control between NHW, NHB, and HW Americans	6334	Individuals who were NHW, NHB, or HW, 40 years old and had data available for weight, height, waist circumference, had health insurance, and HbA1c values	N/A	NHB and HW men were 0.73 [CI 0.45-1.17] and 0.45 [95% 0.29-0.71] less likely than NHW to have poor glycemic control than NHW men; NHB and HW women were 0.39 [95% CI 0.26-0.61] and 0.43 [0.26-0.70] less likely than NHW to have poor glycemic control than NHW women
Toobert, 2007 (85)	Randomized controlled trial-intervention	To examine the long-term effects of interactions between lifestyle behaviors,	270	Postmenopausal women with type 2 diabetes	N/A	Quality of life was not statistically significant between the intervention and usual care groups ($F=3.45$, p<.01); the direct and indirect cost of the

Author/Year	Study Design	Objective	Number of Participants	Sample population	Setting	Impact on Outcome
	Mediterranean Lifestyle Program Duration: 24 months	psychosocial factors and social environment				intervention group was \$409,165 compared to \$309,302 for the usual care group
Kirk, 2011 (58)	Chart review and cross-sectional survey	Examine the relationship between patient variables and glycemic control (HbA1c <7%) in a cohort of family medicine patients with type 2 diabetes	669	Individuals were selected if their chart had an International Classification of Diseases, Ninth Revision, Clinical Modification codes for diabetes	University-based family medicine teaching site	Of the study population, 43.2% had an HbA1c > 7%, 36.3% had an LDL < 100 mg/dL, 44.7% had a systolic blood pressure <130mmHg, and 69.1% had a diastolic blood pressure < 80mmHg
Fortmann, 2011 (42)	Cross-sectional path analysis	Investigate value of support resources in disease management	208	Latinos with type 2 diabetes	Low-income serving community clinics in San Diego	Path analyses revealed that greater support resources were linked to better self-management (p<0.001) and less depression (p<0.01). Once these factors were statistically controlled the pathway from support resources to HbA1c was markedly reduced (p=0.57)
Gary, 2000 (43)	Cross-sectional	Determine prevalence of depressive symptoms and relationship between depressive symptoms and metabolic control	183	African American adults aged 35-75	Two primary care clinics in Baltimore, MD	Depressive symptoms are marginally associated with suboptimal levels of HbA1c (p=0.104), blood pressure (p=0.073), and LDL (p=0.176), and significantly associated with suboptimal levels of total cholesterol and triglycerides (p<0.05).
Bird, 2007 (31)	Cross-sectional	Assess gender differences in quality of care	4,054	Enrollees in commercial and Medicare health plans	National sample	Gender differences found in variety of quality of care measures. Statistically significant differences in intermediate outcomes for diabetes includes lipid control for Medicare enrollees (p<0.01) and commercial enrollees (p<0.01), and blood pressure control for commercial enrollees (p<0.05). Relative risk for women relative to men for LDL was 0.84.
Chiu, 2010 (36)	Longitudinal cohort	Longitudinal association between depressive symptoms and glycemic control and extent to which it is explained by health behaviors	998	Adults with diabetes	National sample from Health and Retirement Study	Adults with higher levels of depressive symptoms at baseline showed higher HbA1c levels at 5 year follow-up. Health behaviors account for 13% of link.
Culica, 2007 (37)	Quasi-experimental	Evaluate cost and impact of educational model delivered to predominantly Spanish speaking Mexican American population with type 2 diabetes	162	Adults diagnosed with diabetes and no advanced complications	Clinic in Dallas, TX	Change in HbA1c at 6 mo was not significant, but change from baseline at 12 mo was significant (p<0.01). Blood pressure did not change at 6 or 12 mo.
Hayes, 2000 (50)	Prospective cohort within trial to assess provider adherence to diabetes management protocol	Examine applicability and relationship of locus of control to glycemic control in low-literacy, economically deprived population	312	African Americans with type 2 diabetes referred to diabetes unit of public hospital	Urban public hospital in Georgia	No significant association between locus of control and baseline HbA1c. Significant relationship between belief in chance and glycemic control at 6-mo follow up (p<0.05) and change in HbA1c (p<0.05). Patients with stronger believe in change had higher HbA1c levels and less change in HbA1c.

Author/Year	Study Design	Objective	Number of Participants	Sample population	Setting	Impact on Outcome
Hernandez-Tejada, 2012 (51)	Cross-sectional	Examine relationship between perceived control of diabetes and quality of life	188	Adults with type 2 diabetes having been seen in clinic	Low-income clinic in Southeast US	Positive association between perceived control and quality of life ($p<0.05$) when controlling for sociodemographics and comorbidity.
Kaceroovsky-Bielesz, 2009 (56)	Cross-sectional	Examine sex-specific differences and influences of social and psychological factors on glucometabolic control.	257	Adults ages 40-80 diagnosed with diabetes and seen at diabetes outpatient clinic at least twice in 6-mo	Metropolitan diabetes outpatient clinic	Mean HbA1c did not differ between genders. Variables predicting high HbA1c differed by gender. For women: pain ($p=0.003$), social isolation ($p=0.008$), internal control ($p=0.039$), external control ($p=0.019$), and depressive coping ($p=0.031$). For men: emotional support ($p=0.007$), satisfaction with support ($p=0.054$), and instrumental support ($p=0.066$)
Wexler, 2006 (89)	Cross-sectional	Assess impact of medical comorbidities, depression, and treatment intensity on quality of life	909	Adults diagnosed with diabetes with continuous care	Two outpatient primary care clinics and hospital based primary care practice in Massachusetts	Emotion, pain and impaired vision were predominant drivers of overall health utility. Patients with depression had the lowest quality of life ($p<0.0001$) and differed by comorbidity. After adjustment the utility penalty diminished to some degree. Presence of depression was strongest correlate in multivariate model, decreasing utility by 0.37.

Table 4:

Summary of articles focused on Health and Health Care

Author/Year	Study Design	Objective	Number of Participants	Sample population	Setting	Impact on Outcome
Bains, 2011 (29)	Cross-sectional	Assess association among health literacy, diabetes knowledge, self-care, and glycemic control	125	Low-income, predominantly minority adults diagnosed with T2DM	Internal Medicine clinic in southeastern US (SC)	Health literacy was not associated with glycemic control; however, diabetes knowledge ($\beta=0.12$; 95% CI 0.01, .23) and perceived health status ($\beta=1.14$, 95% CI 0.13, 2.16) were significantly associated with glycemic control.
Banister, 2004 (30)	Quasi-experimental (diabetes self-management program, DSMT)	Assess clinical outcomes (HbA1c, BMI, and prescribed medication regimen) and cost-effectiveness of a DSMT	70	Adult patients with T2DM living at or below the US federal poverty level	Community clinic-based DSMT in the south (TX)	Statistical improvement in mean HbA1c ($9.7 \pm 2.4\%$ to $8.2 \pm 2.0\%$, $p < .001$) ($n=70$). Cost of the program was \$280 pp/yr; \$185 for each point reduction in HbA1c ($n=127$).
Bradley, 2009 (32)	Retrospective, observational	Describe changes in clinical risk factors (HbA1c, LDL, HDL, TG, SBP, DBP) while using naturopathic complementary and alternative medicine	37	Adult patients with T2DM who received naturopathic care for at least 6 months over a 5-year period	Abstracted medical charts from patients seen at a natural health center in Seattle, WA	Significant mean changes in HbA1c (-0.65% , $p=0.046$), SBP (-7 mmHg, $p=0.02$), DBP (-5 mmHg, $p=0.003$), and TG (-45 mg/dL, $p=0.037$). No significant mean changes in LDL or HDL. Clinically significant risk factor improvements in HbA1c (42%), SBP (51%), DBP (54%), LDL (28%), HDL (25%), and TG (38%).
Cavanaugh, 2009 (35)	Two RCTs	Assess the impact of literacy and numeracy on diabetes care using an enhanced multidisciplinary program vs. usual delivery of the same program (baseline vs. 3 months vs. 6 months)	198	Adult patients with T1DM or T2DM with most recent HbA1c 7%	Two academic medical centers (Vanderbilt University Medical Center in TN and the University of NC Chapel Hill) from April 2006 to June 2008	Both groups had significant improvements in HbA1c at 3 months (intervention: -1.50 , 95% CI -1.80 , -1.02 ; control: -0.80 , 95% CI -1.10 , -0.30 ; $p=0.005$). After adjustments, intervention group had greater improvement in HbA1c vs. control group ($p=0.03$). There were no statistical differences in HbA1c between groups at 6 months ($p=1.0$).
Fernandez, 2012 (41)	Cross-sectional	Assess the association between aspects of cultural competence (doctor communication-positive behaviors, trust, and doctor communication-health promotion) and diabetes clinical outcomes (HbA1c, LDL, SBP)	600	Ethnically diverse, low-income patients with T2DM	Data from the Immigration, Culture, and Health Care (IHC) Study conducted within 9 free-standing or hospital-based safety net clinics in San Francisco and Chicago in 2008-2009	Patients with high trust were less likely to have poor glycemic control than those with low trust (41.2% vs. 53%, $p=0.005$); this persisted after adjusting for sociodemographic and clinical factors (OR 0.59, CI 0.41, 0.84). Patients reporting high health promotion communication with their physician were more likely to have poor glycemic control (54.3% vs. 44%, $p=0.03$); this remained true after adjustments (OR 1.49, 95% CI 1.02-2.19). Patients reporting high doctor communication about positive behaviors were more likely to have poor SBP control (39.7% vs. 29.1%, $p=0.007$); this did not persist after adjusting. No domains of cultural competence were associated with LDL in unadjusted or adjusted analyses.

Author/Year	Study Design	Objective	Number of Participants	Sample population	Setting	Impact on Outcome
Jakicic, 2013 (50)	RCT	Examine the impact of an intensive lifestyle intervention (ILI) vs. diabetes support and education (DSE) on the four-year change in fitness and physical activity (PA) and the effect of change in fitness and PA on glycemic control	3,942	Overweight/obese adults with T2DM with available fitness data at 4 years	Several large, randomized, multicenter trials	Fitness change at 4 years was inversely related to change in HbA1c after adjustments overall (p<0.0001) and for both DSE (p<0.0001) and ILI (p<0.001). Change in PA was not associated with change in HbA1c.
Littenberg, 2006 (64)	Cross-sectional	Describe the use of medication adherence aids and evaluate their impact on clinical outcomes (HbA1c, HTN, hypercholesterolemia)	289	Random selection of adults with T2DM	The Vermont Diabetes Information System (125 primary care providers from 69 practices across VT, NH, and upstate NY)	Patients who placed adherence aid in special place had better glycemic (-0.36%, p=.04) and blood pressure (-5.9, p=.05) control after adjusting. Associating adherence with a daily event improved glycemic control (-0.56, p=.01) vs. those without aids. The use of adherence aids was not associated with cholesterol control.
Miller, 2003 (66)	Prospective RCT	Determine whether rapid-turaround HbA1c availability improves intensification of DM therapy and reduces HbA1c levels in T2DM (baseline vs. 1 follow-up visit vs. 2 follow-up visits)	597	Adult patients with T2DM of at least 6 months	Neighborhood primary care clinic affiliated with an academic health system (Atlanta, GA)	No significant changes in HbA1c at the first follow-up visit between groups (p=0.56); however, for those whose therapy was intensified and whose HbA1c was 7%, glycemic control improved in both groups (rapid, p<0.001; routine, p=0.02). In patients with 2 follow-up visits, HbA1c improved significantly in the rapid group (8.4 to 8.1%, p=0.04), but not in the routine group (8.1 to 8.0, p=0.31).
Otero-Sabogal, 2010 (71)	Pilot Study	Assess changes in self-management among patients with T2DM when using community health workers in clinical team	114	Predominantly low-income Latino adult patients with T2DM (from ethnically diverse neighborhood)	"Safety-net" clinics in San Francisco, CA serving low income (underinsured and underserved) Spanish-speaking patients	For (20) patients with poor glycemic control (.9%) at baseline, the HbA1c improved significantly (p<0.001) at follow-up. LDL decreased significantly from baseline to follow-up for (88) patients (p<0.005). No significant changes in SBP or DBP.
Polonsky, 2011 (72)	Cluster-randomized, multicenter trial	Evaluate the impact of a structured patient/physician self-monitoring program (STG) on glycemic control and treatment modification recommendations (TMR) over 12 months (vs. active control group, ACG)	483	Ethnically diverse sample of adults with T2DM	34 primary care practice sites across the southeastern US	Significant reduction in HbA1c in STG vs. ACG with at least one TMR (-1.2% vs. -0.8%, p<0.03). Patients with baseline HbA1c 8.5% who received a TMR at 1-month visit had greater reduction in HbA1c (-1.8% vs. -1.3%, p=0.002). No significant association between total number of visits with TMR and glycemic control over time.
Rothman, 2003 (76)	Quasi-experimental	Evaluate a pharmacist-led, primary care-based diabetes disease management program	159	Patients with uncontrolled T2DM	Academic general internal medicine practice at Vanderbilt University Medical Center from September 1999 to May 2000	The mean reduction in HbA1c was 1.9% (95% CI 1.5, 2.3) after 6 months. Baseline HbA1c and new onset diabetes were associated with significant improvements in HbA1c.
Ruggiero, 2010 (78)	Randomized pilot study	Evaluate the impact of an intervention using coaching by certified medical assistants (MAC) to provide DM education and self-care support vs.	100	Low-income minority patients with T2DM	Primary care clinic at a federally qualified health center in Chicago	No significant differences between groups on HbA1c (ANCOVA, F [2, 88]=0.888, ns); however, HbA1c decreased from baseline to follow-up for the MAC patients and increased

Author/Year	Study Design	Objective	Number of Participants	Sample population	Setting	Impact on Outcome
		treatment as usual (TAU) and compared to matched no contact controls (NCC)				over time for patients in the TAU group and the NCCs.
Smith, 2008 (82)	Observational	Understand clinical differences and associated risk factors in patients diagnosed with T2DM early vs. later in life	1385	Medically indigent patients with T2DM in a large urban setting	Outpatient clinic in the Chicago metropolitan area between October 2000 and December 2003	Early onset patients had higher HbA1c (p 0.001), were more likely to smoke (p 0.01) and be depressed (p 0.01), and had more emergency department visits (p 0.001).
Wendel, 2006 (87)	Prospective, cross-sectional (observational) study	Examine the association between race/ethnicity and control of CVD risk factors	338	Insulin-treated veterans with T2DM	Consortium of 3 Veteran Affairs Medical Centers in the southwest	Mean HbA1c differed significantly by race/ethnicity (NHW 7.86 vs. H 8.16 vs. AA 8.84, p=0.05). Adjusted HbA1c significantly higher in AA (+0.93%, p=0.002) vs. NHW. Higher depression scores (p=0.049), greater work hours per week (p=0.002), greater number of household dependents (p=0.023), being employed (p=0.004), and age (p=0.0001) were significantly associated with higher baseline HbA1c. Statistically significant differences in insulin doses for patients with HbA1c 8% (p<0.01)
Bray, 2013 (33)	Quasi experimental	To determine the effectiveness of a redesigned primary care model on glycemic control, blood pressure and lipid levels	727	Rural African American adults with T2DM	8 Rural fee for service primary care practices	Intervention patients showed reduction in A1c at intermediate follow-up (p<.05) as well as long term follow-up (p<.005). Intervention patients also showed greater reduction blood pressure levels (p<.01)
de Rekeneire, 2003 (38)	Cross-sectional	To evaluate racial differences and factors associated with poor glycemic control in older adults with T2DM	468	Older adults age 70-79 with T2DM enrolled in the Health, Aging and Body Composition Study	The Health ABC Study	Control was poor in all diabetic patients and blacks had worse glycemic control than whites (p<0.01)
Gold, 2008 (46)	Quasi experimental	Evaluate the efficacy of a multidisciplinary diabetes self-management program with a focus on improving diabetes control by synchronizing regularly scheduled provider visits with a multidisciplinary diabetes education program.	44	Predominately Hispanic patients with T2DM with average A1c 9.5	Olive View-UCLA Medical Center	Synchronous management approach significantly improved A1c level for Hispanic patients with long standing poorly controlled T2DM (p<.001)
Grant, 2003 (48)	Cross-sectional	To determine medication adherence and predictors of suboptimal adherence in a community cohort of patients with diabetes. To test the hypothesis that adherence decreases as medicines prescribed increases.	128	Adults with T2DM from single community health center	Massachusetts General Hospital Revere HealthCare Center	High medication adherence rates were reported regardless of number of prescriptions. Patients with suboptimal adherence were found to be adherent to all medication except one. Side effects and lack of confidence were predictors of suboptimal adherence.
Johnson, 2010 (55)	Retrospective observational	To evaluate the clinical outcomes of uninsured or underinsured patients with T2DM who received care from pharmacists in local medical homes	484	Adults with T2DM	The University of Southern California School of Pharmacy-local safety net clinic	Patients receiving care from pharmacists showed a reduction in A1c by 1.38%, p<0.001), compared to usual care. Integrating "safety net" medical homes with clinical pharmacy services showed improvement in clinical outcomes in patients with T2DM.

Author/Year	Study Design	Objective	Number of Participants	Sample population	Setting	Impact on Outcome
McPherson, 2008 (65)	Cross-sectional	To determine the relationship between patient's knowledge about their diabetes medications and their blood glucose control	44	Predominantly African American adults with T2DM	University of Maryland Medical System	A1c and knowledge scores were inversely related ($p<.001$).
Rhee, 2005 (74)	Observational Cross-sectional	To examine whether differences in health care access affected A1c levels in patients with T2DM.	605	Adults with T2DM, predominantly African American	Outpatient diabetes program affiliated with a large public health system with hospital and community primary care sites.	Patients with difficulty obtaining care had higher A1c levels ($p=0.001$) as well patients who used acute care facilities ($p<0.001$) or who no usual source of care ($p<0.001$).
Spencer, 2011 (83)	RCT	To test the effectiveness of a culturally tailored, behavioral theory based community health worker intervention for improving glycemic control	164	African American and Latino adults with T2DM	Federally qualified community health center in southwest Detroit and major local health system from eastside Detroit	Intervention patients showed a significant drop in A1c level compared to control group ($p<0.01$). Also showed significant improvements in self-report diabetes understanding compared to control group.
Strum, 2005 (84)	Retrospective analysis	To evaluate the effects of a clinical based medication assistance program (MAP) on the health outcomes and medication use of patients with T2DM	52	Adults with T2DM enrolled in MAP	University of Arkansas for Medical Sciences pharmacy managed MAP and outpatient pharmacy database	Mean A1c and LDL levels decreased significantly after enrollment in the program ($p<0.001$ for both)
Welch, 2011 (88)	RCT	Evaluate the clinical usefulness of the CDMP care model	67	Adults age 30-85 with T2DM	Urban community healthcare center in Springfield, Massachusetts	Intervention patients had significant improvements in A1c from baseline to 12months compared to control ($p=.01$). Treatment satisfaction and DM distress also improved significantly for intervention patients.
Miller, 2012 (67)	Randomized controlled trial with parallel interventions compared to Smart Choices Mindfulness Based Eating Awareness Training Duration: 3 months	To evaluate the impact of a diabetes self-management education intervention compared to the Mindfulness-Based Eating Awareness Training	120	Individuals between the ages of 35-65 years with type 2 diabetes for at least 1 year, body mass index ≥ 27 , HbA1c $\geq 7\%$, and not insulin dependent	N/A	Reduction in HbA1c in the Smart Choices ($-0.67\pm0.24\%$) and Mindfulness Based Eating Awareness Training ($-0.83\pm0.24\%$) groups
Quandt, 2005 (73)	Cross-sectional	To describe the level of glycemic control by ethnic control by ethnicity and gender and to consider whether health and healthcare characteristics account for ethnic differences in glycemic control.	693	Adults 65 years old with type 2 diabetes in rural North Carolina	Home interviews	In older adults, having an HbA1c $\geq 7\%$ was associated with ethnicity ($p=0.019$), living arrangements ($p=0.041$), use of medications for diabetes ($p<0.0001$), and having had a diabetes-related healthcare visit in the previous year ($p=0.0006$); this population is at an increase risk for diabetes complications
Harris, 2001(49)	Cross-sectional	Evaluate health care access and utilization and health status and outcomes according to race and	1,480	Adults studied in NHANES III that reported being	National US sample	With few exceptions outcomes in each racial and ethnic group were not significantly associated with having a primary source of

Author/Year	Study Design	Objective	Number of Participants	Sample population	Setting	Impact on Outcome
Ruelas, 2009 (77)	Randomized, prospective, observational study	Evaluate which factors are associated with reaching program goals in a disease-management program for underserved Latino area	162	diagnosed with diabetes, excluding pregnant women and those defined at at<30 at diagnosis Adults with type 2 diabetes	Health center serving low-income Latino patients in east Los Angeles	ambulatory care, number of physician visits per year, any type of health insurance or having private health insurance. HbA1c decreased by 1%, with medication adherence being strongest predictor (p=0.01). Knowledge scores increased for those reaching target, but measures of self-efficacy and empowerment did not.

Table 5:

Summary of articles focused on Neighborhood and Build Environment

Author/Year	Study Design	Objective	Number of Participants	Sample population	Setting	Impact on Outcome
Geraghty, 2010 (45)	Geographic information systems (GIS) software	To use GIS to expand understanding of disparities in health outcomes in within a community	7288	Individuals who had been diagnosed with type 2 diabetes and had been seen by a family physician or internist from April 2008–April 2009 at the University of California Davis Health System who had addresses on file	N/A	Women had higher HbA1c levels, being Black was predictive of having a higher HbA1c, patients who were seen in a primary care network were more likely to have lower HbA1c than those seen at a medical center; Patients were less likely to have a controlled LDL level if they had a higher HbA1c (OR 1.07 95% CI 1.04-1.11)
Seligman, 2011 (81)	Cross-sectional and chart review	To determine whether food insecurity is associated with poor glycemic control and whether this association is mediated by difficulty following a healthy diet, diabetes self-efficacy, or emotional distress related to diabetes	711	Patients with type 2 diabetes in the San Francisco Bay area or Chicago	Federally qualified health centers or affiliated with a public safety net health system	Those who were food insecure were more likely (OR 1.48, 95% CI 1.07-20.4) to have poor glycemic control (A1c 8.5%)
Gary-Webb, 2011 (44)	Cross-sectional	Evaluate relationship between neighborhood-level SES and health status and depression	1010	Participants from Look AHEAD trial of long-term weight loss among adults with type 2 diabetes	Clinical sites in Baltimore, Philadelphia, Pittsburgh and New York	Lower neighborhood SES was significantly associated with poorer health status (-1.90 physical health, -2.92 mental health, -2.77 composite score)

Table 6:

Outcome Measures of Studies Meeting Inclusion Criteria

Study Author, Year	HbA1C	LDL	Blood Pressure	Cost	Quality of Life	Statistical Significance in HbA1c	Statistical Significance in LDL	Statistical Significance in Blood Pressure	Statistical Significance in Cost	Statistical Significance in Quality of Life
<i>Economic Stability and Education</i>										
Durden, 2009 (39)				x					x	
Lind, 2006 (63)				x						
Rodbard, 2010 (75)				x					x	
Schectman, 2002 (80)	x					x				
Lairson, 2008 (62)	x			x						
Grant, 2005 (47)	x	x	x				x			
Salvo, 2012 (79)	x					x				
Camacho, 2002 (34)	x	x	x			x		x		
Hills-Briggs, 2005 (52)	x									
Kollannoor-Samuel, 2011 (61)	x									
Kogan, 2009 (60)	x					x				
Hill-Briggs, 2011 (53)	x	x	x			x		x		
Khan, 2011 (57)	x									
<i>Social and Family Context</i>										
Knight, 2008 (59)	x	x								
Egede, 2010 (40)	x	x			x					x
Moayad, 2006 (68)	x					x				
Venkatesh, 2013 (86)	x					x				
Osborn, 2010 (70)	x					x				
Oksuon, 2002 (69)	x									
Toobert, 2007 (85)					x					
Kirk, 2011 (58)	x	x	x							
Fortmann, 2011 (42)	x									

Study Author, Year	HbA1C	LDL	Blood Pressure	Cost	Quality of Life	Statistical Significance in HbA1c	Statistical Significance in LDL	Statistical Significance in Blood Pressure	Statistical Significance in Cost	Statistical Significance in Quality of Life
Gary, 2000 (43)	x	x	x							
Bird, 2007 (31)	x	x	x				x	x		
Chiu, 2010 (36)	x					x				
Culica, 2007 (37)	x		x	x		x				
Hayes, 2000 (50)	x					x				
Hernandez-Tejada, 2012 (51)					x					x
Kacerovsky-Bielez, 2009 (56)	x					x				
Wexler, 2006 (89)					x					x
Health and Health Care										
Bains, 2011 (29)	x					x				
Banister, 2004 (30)	x			x		x				
Bradley, 2009 (32)	x	x	x			x	x	x		
Cavanaugh, 2009 (35)	x					x				
Fernandez, 2012 (41)	x					x				
Jakicic, 2013 (50)	x					x				
Littenberg, 2006 (64)	x	x	x			x		x		
Miller, 2003 (66)	x					x				
Otero-Sabogal, 2010 (71)	x	x	x			x	x			
Polonsky, 2011 (72)	x					x				
Rothman, 2003 (76)	x					x				
Ruggiero, 2010 (78)	x									
Smith, 2008 (82)	x									
Wendel, 2006 (87)	x					x				
Bray, 2013 (33)	x	x	x			x				x
de Rekeneire, 2003 (38)	x					x				x
Gold, 2008 (46)	x									
Grant, 2003 (48)	x	x	x			x	x	x		x

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Study Author, Year	HbA1C	LDL	Blood Pressure	Cost	Quality of Life	Statistical Significance in HbA1c	Statistical Significance in LDL	Statistical Significance in Blood Pressure	Statistical Significance in Cost	Statistical Significance in Quality of Life
Johnson, 2010 (55)	x	x	x			x	x	x		
McPherson, 2008 (65)	x					x				
Rhee, 2005 (74)	x					x				
Spencer, 2011 (83)	x	x	x			x	x			
Strum, 2005 (84)	x	x	x			x	x			
Welch, 2011 (88)	x	x	x			x				
Miller, 2012 (67)	x									
Quandt, 2005 (73)	x					x				
Harris, 2011 (49)	x	x	x							
Ruelas, 2009 (77)	x					x				
<i>Neighborhood and Build Environment</i>										
Geraghty, 2010 (45)	x					x				
Seligman, 2012 (81)	x					x				
Gary-Webb, 2011 (44)					x					x