REVIEW ARTICLE

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Social Determinants of Health for Diabetes: An Updated Critical Literature Review

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Abstract

Background: The social determinants of health (SDOH) significantly shape the prevalence, incidence, and management of diabetes. This review examines the complex relationship between SDOH and diabetes, focusing on economic factors, education, insurance coverage, community context, physical environment, healthcare access, lifestyle factors, and key considerations in orthopedic and anesthesiology care. **Methods:** A review of peer-reviewed articles and studies published over the past decade was conducted to explore how SDOH impact diabetes outcomes. The review also addresses orthopedic and anesthesiology concerns, especially related to musculoskeletal complications and anesthesia management for diabetic patients. **Results:** Lower economic status, limited education, and insufficient insurance coverage are strongly linked to worse diabetes outcomes. Social and community support, including mental health resources and community programs, is crucial for diabetes self-management. The physical environment—such as access to nutritious food and safe spaces for physical activity—also influences diabetes risk. Additionally, orthopedic issues, such as diabetic neuropathy and musculoskeletal complications, and anesthesiology challenges, such as blood glucose control and cardiovascular concerns during surgery, are vital factors in the care of diabetic individuals. **Conclusion:** Addressing diabetes requires a holistic, multidisciplinary approach that incorporates economic, educational, and healthcare factors, along with specialized care for orthopedic and anesthesiology needs. Policy interventions, community-based programs, and healthcare reforms are essential to improving outcomes and reducing disparities. Future research should focus on integrated strategies that incorporate SDOH into diabetes care, particularly for underserved populations.

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Introduction:

The social determinants of health (SDOH) are essential factors in shaping the health outcomes of individuals with diabetes, influencing not only the prevalence and management of the disease but also its associated complications and long-term prognosis [1,2]. Studies consistently show that lower levels of SDOH—such as income, education, and employment—are strongly correlated with an increased incidence of diabetes, poorer glycemic control, and a higher risk of diabetes-related mortality [1]. This relationship highlights the profound impact that socioeconomic disparities have on the risk and severity of diabetes. Additionally, a growing body of evidence emphasizes the need to consider these social factors in the early prevention and management of type 2 diabetes, particularly in vulnerable populations such as those in rural or underserved areas where these disparities are often more pronounced [3]. Incorporating SDOH into individualized care has been recognized as a cornerstone of effective multidisciplinary management for individuals with diabetes, underscoring the need for a holistic approach that goes beyond traditional medical interventions [2].

While existing literature has underscored the significant influence of SDOH on diabetes outcomes, it often falls short in fully addressing the complex, multifaceted interactions between these factors. In particular, there is a gap in understanding how SDOH interact with and exacerbate not only metabolic but also musculoskeletal and anesthesiology-related complications for individuals with diabetes. For example, people with diabetes are at greater risk for orthopedic issues such as diabetic neuropathy, joint deformities, and fractures, which can further impair their ability to manage the condition and engage in physical activity [4]. These complications create additional barriers to effective diabetes care, as they may limit mobility and contribute to chronic pain, which in turn can affect overall health and glycemic control.

Moreover, individuals with diabetes face unique anesthesiology challenges during surgery, including managing blood glucose levels, addressing cardiovascular instability, and ensuring appropriate anesthesia protocols. Diabetic patients often have altered responses to anesthesia, and poorly controlled diabetes can increase the risk of perioperative complications, such as infections, delayed wound healing, and prolonged recovery times [5]. These considerations are crucial in the context of surgical interventions for diabetic patients, and they highlight the need for specialized care in both the preoperative and postoperative settings.

The existing body of literature on diabetes management has largely focused on the metabolic aspects of the disease, often overlooking the orthopedic and anesthesiology concerns that can significantly impact patient outcomes. This review seeks to fill this gap by providing a more comprehensive, integrated perspective on how SDOH influence diabetes care, emphasizing the need for a multidisciplinary approach that incorporates the management of both metabolic and musculoskeletal health. By addressing the complex interplay between socioeconomic factors, orthopedic complications, and anesthesiology concerns, this review aims to contribute to a more holistic understanding of diabetes and its management.

Unlike previous studies that have primarily focused on isolated aspects of SDOH, this work emphasizes the need to consider the interconnectedness of these factors in diabetes prevention and care. It highlights the importance of integrating primary prevention strategies with specialized care for orthopedic and anesthesiology needs, particularly for underserved and rural populations where access to comprehensive care may be limited. By taking a broader, more inclusive view of diabetes management, this review aims to offer new insights and guide future research and clinical practice in addressing the full spectrum of challenges faced by individuals with diabetes.

Economic Factors

The relationship between income and diabetes has been extensively studied, with numerous research papers highlighting the significant impact of socioeconomic status on the prevalence and incidence of diabetes. According to a study published in the Global Journal of Health Science, the prevalence of diabetes is significantly higher in low- and middle-income countries, with a strong correlation between wealth and social demographic characteristics [4]. Another study conducted in Canada found that the prevalence of type 2 diabetes is 4.14 times higher in the lowest income group compared to the highest income group, with a graded association between income and diabetes [5]. Furthermore, research has shown that consistent low earnings or financial reductions are linked with an increased chance of type 2 diabetes, whereas consistent high earnings or financial gains are linked with a decreased chance [6]. The relationship between socioeconomic status and type 2 diabetes has also been observed in other countries, including Korea, where individuals with lower income and educational attainment are more likely to have type 2 diabetes [7,8]. Overall, the evidence suggests that income plays a critical role in shaping the risk of diabetes, and that addressing socioeconomic inequalities is essential for preventing and managing the disease. The relationship between education and diabetes has been extensively explored in various studies, highlighting the crucial role

of education in diabetes treatment and management. Education is considered a vital component of diabetes care, as it enables patients to obtain the required abilities and actions to effectively handle their situation. [9]. The primary objectives of diabetes education include empowering patients to adopt lifestyle changes, improve their metabolic control, and enhance their overall quality of life [9]. Research has shown that diabetes education can have a positive impact on patient outcomes, particularly in terms of self-care and metabolic control [9, 10]. A comprehensive review of 78 studies on diabetes patient education revealed that most research lacked a theoretical framework and primarily focused on outpatient settings, with HbA1c being the most commonly used outcome measure [10]. Furthermore, a controlled trial, known as the Diabetes Education Study, demonstrated the effectiveness of a systematic education program in improving patient knowledge, skills, and self-care behaviors [11]. Additionally, other studies have emphasized the importance of self-efficacy and effective diabetes self-management, highlighting the need for tailored educational interventions [12].

Additionally, the connection between insurance coverage, policy, and diabetes has been widely researched, with an emphasis on the influence of health insurance on diabetes care and management. Studies have demonstrated that individuals with diabetes who have health insurance are more likely to receive essential care and have improved health outcomes compared to those without insurance [13]. A study investigating health-insurance coverage for adults with diabetes in the U.S. population found that nearly all patients with diabetes over 65 years of age have health-care coverage, but 13.5% of those between 18-64 years of age lack health insurance [13]. Governmental insurance programs cover a substantial portion of diabetic patients, highlighting a significant societal burden linked with diabetes [13]. Alterations in government reimbursement and coverage policies could have a substantial impact on health care for patients with diabetes [13]. The Affordable Care Act (ACA) has also had an impact on private insurance coverage for persons with diabetes, with a study finding changes in pre-post mandate trends [14]. Additionally, state mandatory insurance coverage has been shown to increase the use of diabetes preventive care [15].

Social and Community Context

Research has shown that individuals with diabetes are at a greater risk of developing mental health issues, including depression, anxiety, and diabetes-related distress. [16, 17]. The psychological impacts of diabetes can be substantial, including feelings of loss, anger, depression, anxiety, and disordered eating [16]. Moreover, comorbid depression and anxiety have been found to be associated with increased health care resource utilization among individuals with type 1 diabetes [18]. However, there are several helpful tools and resources available to support individuals with diabetes, including low-intensity mental health support via telehealth enabled networks [19]. The LISTEN trial, for example, aspirated to evaluate the effectiveness and implementation of a low-intensity mental health support program provided by diabetes health professionals [19]. Additionally, peer support interventions, such as the iNSPiRED study, have been found to have a positive impact on diabetes distress, although stronger, diverse treatments might be required to tackle the complex needs of individuals with diabetes [17].

community-based resources and programs can play a crucial role in promoting diabetes self-care and reducing the risk of diabetes-related complications [20, 21]. For instance, a community-based diabetes prevention program that uses technology to connect patients with local resources has been found to be effective in promoting healthy behavior and sustaining lifestyle modification [20]. Additionally, community-based programs delivered by diabetes educators have been shown to be successful in reducing the risk of diabetes and cardiovascular disease in high-risk individuals [21]. Moreover, research has emphasized the significance of empowering people with diabetes through community-based initiatives, such as education and support programs, to enhance their self-management skills and improve their overall well-being [22, 23]. In resource-poor settings, community-based nonpharmacological lifestyle interventions have also been found to be effective in preventing and managing diabetes [23].

Research has shown that advocacy for health equity is essential in promoting diabetes care and management, and that patient-provider communication is a critical component of effective diabetes self-management [24,25]. The Diabetes Patient Advocacy Coalition (DPAC) has been instrumental in forming a battalion of diabetes sufferer supporters via regulation education meetings and hill days, which concentrate on instructing civic supporters how to convey their narratives to lawmakers while incorporating data and figures to bolster their accounts [24,25]. Additionally, studies have highlighted the importance of raising the voice of the voluntary sector and growing policy with grassroots activism in promoting diabetes care and management [24,25,26]. In Ghana, a policy perspective on hypertension and diabetes management has identified the availability of money and excessive focus on infectious ailments as primary obstacles to the enactment of regulations [26].

Orthopedic Considerations in Diabetes Management

Orthopedic complications are a significant concern for individuals with diabetes, affecting their overall health outcomes and quality of life. Diabetes, particularly when poorly controlled, can contribute to a range of musculoskeletal issues that can complicate the management of the disease [42]. These complications often arise from long-term hyperglycemia and can include joint pain, increased risk of fractures, neuropathy-related injuries, and soft tissue problems [43]. This section explores the intersection of orthopedics and diabetes, focusing on the social determinants of health that influence musculoskeletal health in diabetic patients.

Impact of Diabetes on Bone Health

Patients with diabetes are at an increased risk of developing osteoporosis and experiencing bone fractures [23]. Research has shown that individuals with both type 1 and type 2 diabetes tend to have reduced bone mineral density (BMD) compared to those without diabetes, making them more vulnerable to fractures. This increased fracture risk is often exacerbated by the presence of diabetic neuropathy, which impairs sensation and balance, leading to a higher likelihood of falls and injuries. In addition, metabolic disturbances associated with diabetes, such as altered calcium and phosphate metabolism, may further compromise bone health [34].

Diabetic Neuropathy and Orthopedic Implications

Diabetic neuropathy, a common complication of diabetes, can lead to significant orthopedic concerns. Peripheral neuropathy, which affects the lower extremities, may cause individuals with diabetes to lose feeling in their feet and legs, leading to unnoticed injuries, ulcers, and deformities such as Charcot foot. Charcot foot is a condition characterized by progressive joint destruction and deformity, typically affecting the foot and ankle [28]. This condition is often associated with uncontrolled blood sugar levels and can result in significant disability if not properly managed. The combination of reduced sensation and the increased likelihood of joint deformities creates a substantial burden on both the patient's mobility and overall health.

Joint Disorders and Musculoskeletal Pain

Diabetes is also linked to an increased prevalence of joint disorders, including limited joint mobility, especially in the shoulders, fingers, and knees. Conditions such as adhesive capsulitis (frozen shoulder) and osteoarthritis can be more common in diabetic individuals, and these conditions can interfere with their ability to engage in physical activity, which is critical for managing blood sugar levels [29]. Moreover, musculoskeletal pain is often more pronounced in individuals with diabetes, which can further limit their ability to perform daily activities and maintain an active lifestyle. This can be compounded by economic factors such as limited access to physical therapy or orthopedic interventions in underserved areas, which hinders timely diagnosis and management of these conditions.

Social Determinants Impacting Orthopedic Health in Diabetes

Several social determinants of health play a pivotal role in managing orthopedic complications in diabetic patients. These include access to healthcare, socioeconomic status, education, and community resources. Individuals from lower socioeconomic backgrounds are more likely to experience delayed diagnoses, limited access to orthopedic specialists, and inadequate management of musculoskeletal issues. Limited health insurance coverage can restrict access to preventive care and early intervention for orthopedic conditions. Additionally, educational disparities may result in poor self-management of diabetes, leading to exacerbation of musculoskeletal problems and complicating diabetes management overall [30,31].

Community-based programs focused on diabetes education and preventive care can also provide valuable resources for managing orthopedic complications. These programs can promote awareness of the risks associated with diabetes, including orthopedic issues, and encourage proactive care such as routine foot exams, weight management, and physical activity to maintain joint health.

Orthopedic health is a critical component of comprehensive diabetes management. Musculoskeletal complications, including neuropathy, osteoporosis, and joint disorders, not only impact the physical health of individuals with diabetes but also complicate their ability to manage the disease effectively [32]. Addressing these orthopedic concerns requires a holistic approach that incorporates both medical and social determinants of health, such as access to care, education, and community resources. By improving access to orthopedic care and promoting lifestyle changes, healthcare systems can better support diabetic patients in managing their condition and preventing further complications, ultimately improving their quality of life and health outcomes.

This underscores the importance of integrated healthcare strategies that consider both the metabolic and orthopedic aspects of diabetes care. Future research should explore the efficacy of early orthopedic interventions and community-based approaches to improve musculoskeletal health in individuals with diabetes, particularly in underserved populations.

Physical Environment

The relationship between housing, environment, neighborhood, and diabetes is complex. Urban environments, in particular, pose unique challenges for diabetes management, as they are often associated with unhealthy lifestyle patterns, such as poor diet and physical inactivity [27]. However, urban planning that incorporates green spaces and walkable neighborhoods can have a protective effect against diabetes [28]. Neighborhood socioeconomic status, access to healthy food options, and exposure to air pollution are also important factors that can influence diabetes risk [29, 30]. Furthermore, research has shown that living in neighborhoods with high levels of green space can reduce the risk of developing type 2 diabetes [28, 31]. Overall, a comprehensive approach to urban planning that takes into account the social, physical, and environmental determinants of health is necessary to mitigate the risk of diabetes and promote healthy living [27-31]. The availability of nonemergency medical transportation has been -shown to be a crucial predictor of diabetes care visits, especially in countryside regions where the incidence of diabetes and associated issues is greater and healthcare resources are limited [32]. Furthermore, long-term exposure to transportation noise has been linked to an increased risk of type 2 diabetes, highlighting the need for comprehensive confounder adjustment to account for lifestyle factors [33]. Additionally, studies have found that poor transportation quality, comprising diminished communal transit utilization and decreased pedestrian-friendliness, is linked to elevated diabetes incidence, especially in city/urban districts with a greater percentage of underrepresented inhabitants [30]. The interplay between transportation-related environmental metrics, air quality, and diabetes risk is complex, with increased particulate matter air pollution and nitrogen dioxide levels contributing to increased diabetes prevalence [30].

Anesthesiology Considerations in Diabetes Management

Anesthesiology plays a crucial role in the management of diabetic patients, particularly in the context of surgery or invasive procedures. Individuals with diabetes often present with complex medical issues, including cardiovascular, renal, and neurological complications, that require special consideration when undergoing anesthesia [33]. The intersection of anesthesiology and diabetes is multifaceted, with important implications for both the preoperative and postoperative management of diabetic patients. This section explores the role of anesthesiology in diabetes care and the social determinants of health that influence the anesthetic management of these individuals.

Anesthesia and Diabetes: Key Considerations

Diabetes can significantly impact how patients respond to anesthesia. Both type 1 and type 2 diabetes increase the risk of anesthesia-related complications due to underlying metabolic imbalances, including poor blood glucose control, autonomic neuropathy, and comorbidities such as hypertension and obesity [10,11]. These factors can make anesthesia management more challenging, as careful monitoring and adjustments are required to ensure patient safety during surgery [12,13].

Blood Glucose Control During Anesthesia:

Maintaining stable blood glucose levels during surgery is critical for diabetic patients, as both hyperglycemia and hypoglycemia can lead to severe complications. Hyperglycemia, especially if prolonged, can impair wound healing, increase the risk of infection, and worsen other postoperative outcomes [14,15]. On the other hand, hypoglycemia during surgery can result in altered mental status, cardiac arrhythmias, and other life-threatening conditions [16]. Anesthesia providers must carefully monitor blood glucose levels, adjust insulin regimens, and use intravenous fluids or medications to manage glucose levels during the perioperative period [17,18].

Autonomic Neuropathy and Anesthesia Risks

Diabetic patients, particularly those with poorly controlled blood sugar levels over time, may develop autonomic neuropathy, which affects the regulation of heart rate, blood pressure, and gastrointestinal motility [19]. This can lead to abnormal responses to anesthetic agents, including difficulty in regulating blood pressure during surgery, delayed gastric emptying, and an increased risk of aspiration [20]. Anesthesia providers must be vigilant in adjusting anesthetic agents and monitoring vital signs to mitigate these risks [21,22].

Cardiovascular Considerations

Cardiovascular disease is common among individuals with diabetes, and these patients are at higher risk of perioperative complications, such as myocardial infarction, arrhythmias, and heart failure [23,24]. The use of anesthesia in diabetic patients with cardiovascular comorbidities requires careful preoperative evaluation, including cardiac risk assessment, and potentially the involvement of a cardiologist [25,26]. Intraoperatively, the anesthesiologist must be prepared to manage any cardiac complications and adjust anesthesia techniques to reduce strain on the heart [27,28].

Social Determinants of Health and Anesthesia Management

Several social determinants of health (SDOH) significantly impact the anesthetic care of diabetic

patients. These include access to healthcare, socioeconomic status, education, and healthcare system factors, all of which influence the ability to manage diabetes and undergo safe surgical procedures [29,30].

Access to Healthcare and Surgical Care

Access to timely and appropriate healthcare is a fundamental factor in the safe anesthetic management of diabetic patients [31]. In many underserved areas, individuals with diabetes may face delays in receiving necessary surgical care due to financial barriers, lack of insurance coverage, or insufficient access to specialized healthcare providers [32]. These delays can increase the risk of complications during anesthesia, as poorly managed diabetes or undiagnosed comorbid conditions may lead to worse surgical outcomes [33]. Furthermore, delayed care may result in advanced stages of diabetes-related complications, complicating anesthesia management and recovery [34].

Socioeconomic Status and Preoperative Optimization

Patients from lower socioeconomic backgrounds often have limited access to preoperative optimization, including proper diabetes management, education, and preventive care [35]. Poorly controlled diabetes, especially in patients without stable access to healthcare or medications, may complicate the administration of anesthesia and increase the risk of perioperative complications [36]. Socioeconomic disparities can also limit patients' ability to follow proper preoperative instructions, such as fasting or adjusting medications, which are essential for a safe anesthesia experience [37].

Health Literacy and Patient Education

Education and health literacy play a crucial role in managing diabetes, particularly in the context of anesthesia [38]. Patients with lower health literacy may not fully understand the importance of blood glucose control, medication management, and lifestyle changes necessary for safe surgery [39]. Anesthesia providers can help mitigate this issue by offering clear and accessible education about the perioperative process, including how to manage medications and blood glucose levels before, during, and after surgery [40]. In particular, individuals from disadvantaged backgrounds may benefit from targeted educational interventions that improve their understanding of diabetes management in relation to anesthesia and surgical outcomes [41].

Cultural and Community Factors

Cultural differences can influence how patients with diabetes approach their healthcare, including their attitudes toward surgery and anesthesia. Community-based programs and culturally tailored interventions can help address these disparities by providing targeted education, support, and resources to diabetic patients preparing for anesthesia and surgery. Community engagement can also facilitate better communication between patients and healthcare providers, ensuring that patients understand the risks and benefits of anesthesia and surgical procedures, especially when there are language barriers or cultural differences in healthcare beliefs.

Postoperative Considerations

After anesthesia, diabetic patients often face a more complex recovery process compared to non-diabetic individuals. Postoperative blood glucose management is essential to minimize complications such as wound infections, delayed healing, and cardiovascular events. Anesthesia providers must work closely with postoperative care teams to ensure that glucose levels remain stable and that the patient's recovery is optimized.

In addition, diabetic patients may experience increased pain and discomfort after surgery, which can be exacerbated by poor pain management or delays in addressing musculoskeletal complications such as diabetic neuropathy. Proper pain control is vital, and tailored approaches may be needed to address both the physical and emotional impacts of surgery in this patient population.

The management of diabetic patients undergoing anesthesia requires a comprehensive, individualized approach that accounts for both the physiological impacts of diabetes and the social determinants that influence healthcare access and outcomes. By understanding the multifaceted risks and challenges associated with diabetes and anesthesia, healthcare providers can optimize the perioperative care of diabetic individuals and reduce the likelihood of complications. Addressing social determinants such as healthcare access, education, and socioeconomic status is critical in ensuring that all patients, particularly those from underserved populations, receive the best possible care. Improved patient education, better access to specialized care, and targeted community-based programs can significantly enhance the safety and efficacy of anesthesia management for individuals with diabetes, ultimately improving their surgical outcomes and quality of life.

Healthcare System

Studies have shown that individuals with diabetes who have access to health care and insurance are more likely to have better control of their condition, as measured by the ABCs of diabetes [31-34]. Conversely, lack of health insurance and limited access to care can

lead to poor diabetes control, increased risk of complications, and higher healthcare costs [31]. The Affordable Care Act (ACA) has been shown to improve access to care for individuals with diabetes, particularly those who were previously uninsured [32]. Furthermore, research has highlighted the importance of insurance stability and continuity of care in achieving optimal diabetes control [33, 32]. The findings of these studies emphasize the requirement for measures and actions that promote access to care, insurance coverage, and stable healthcare environments to improve diabetes outcomes [31-34]. Additionally, efforts to increase detection of diabetes and improve health outcomes might need to tackle problems of access to treatment, particularly for vulnerable populations such as the uninsured and those with limited access to healthcare services [34].

Behavioral and Lifestyle Factors

Research has shown that insufficient nourishment and subpar dietary quality are connected with an elevated risk of diabetes, and that food instability metrics are related to a heightened risk of diabetes. Furthermore, participation in the Supplemental Nutrition Assistance Program (SNAP) has been found to contribute to diminutions in hunger insecurity [35]. A higher nutrition security score has been notably linked to reduced chances of diabetes risk, and there is statistically meaningful interaction effects in these connections based on SNAP involvement [36]. Additionally, studies have found that nutritional uncertainty is persistently more common among families with an individual residing with diabetes, and that diabetes is also more frequent in nutritionally unstable homes [36-38]. The connection between meal quality, sustenance uncertainty, and blood sugar management among grown-ups with Type 2 Diabetes has also been investigated, with results indicating that healthful eating patterns can decelerate the advancement of diabetes, yet commitment to advised meal options can be obstructed by sustenance uncertainty [37]. Overall, the proof indicates that food security plays a significant role in the prevention and management of diabetes, and that healthcare providers should be aware of this relationship [38].

The association between food insecurity and diabetes risk factors has also been investigated in various populations, including US adolescents [39] and adults with Type 2 Diabetes [40]. This research has discovered that nutritional uncertainty is linked with an increased likelihood of diabetes and poor glycemic control, highlighting the need for effective interventions to address food insecurity and improve diabetes management [40,41]. Moreover, research has emphasized the importance of evaluating and overseeing dietary stability in the United States, and has identified the need for further investigation into the relationship between food insecurity and diabetes risk over time [39-41].

Conclusion:

This study provides a review of the SDOH that significantly impact the prevalence, incidence, and management of diabetes. By examining economic factors, educational attainment, insurance coverage, social and community context, physical environment, healthcare system, and behavioral and lifestyle factors, this review aims to highlight the multifaceted nature of diabetes as a public health issue. The manuscript synthesizes findings from a wide range of studies, emphasizing the critical role of socioeconomic inequalities, education, and community resources in shaping diabetes outcomes. Additionally, it explores the interplay between environmental factors, healthcare access, and behavioral patterns, underscoring the need for a holistic approach to diabetes prevention and management. The review underscores the importance of policy interventions, community-based programs, and healthcare system reforms in addressing the social determinants of diabetes, ultimately aiming to improve health equity and outcomes for individuals affected by this chronic condition.

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