Health Literacy Educational Interventions for Adults With Diabetes: Effects on Glycaemic Control, Self-Management, and Patient-Reported Outcomes

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Abstract

Background: Diabetes mellitus is a leading global public health challenge that requires continuous self-management and informed decision-making by patients to achieve optimal outcomes. Despite major advances in pharmacological therapies and clinical guidelines, glycemic control and prevention of diabetes-related complications remain suboptimal in many populations. Health literacy has emerged as a critical determinant of diabetes outcomes, influencing patients' ability to understand health information, adhere to treatment regimens, engage in self-care behaviors, and effectively interact with healthcare systems. Adults with diabetes frequently face complex educational demands, including interpreting blood glucose readings, medication instructions, nutrition labels, and lifestyle recommendations. Limited health literacy is highly prevalent among people with diabetes, particularly among older adults, individuals with low socioeconomic status, and populations in low- and middle-income countries, contributing to poor glycemic control, increased complications, higher healthcare utilization, and widening health inequities.

Aim: This review aims to synthesize the existing evidence on health literacy–focused educational interventions for adults with diabetes and to evaluate their effects on glycemic control, diabetes self-management behaviors, and patient-reported outcomes. The review adopts a public health and community medicine perspective, emphasizing population-level implications, health system relevance, and equity considerations.

Evidence from observational studies, randomized controlled trials, systematic reviews, and consensus reports demonstrates that health literacy–tailored educational interventions—particularly those integrated within diabetes self-management education and support programs—are associated with meaningful improvements in glycemic control, commonly reflected by reductions in HbA1c. These interventions also enhance self-management behaviors, including medication adherence, self-monitoring of blood glucose, healthy dietary practices, physical activity, and preventive foot care. Beyond clinical indicators, health literacy–oriented education has been shown to improve patient-reported outcomes such as diabetes knowledge, self-efficacy, empowerment, quality of life, and reduced diabetes-related distress. Importantly, interventions that use simplified language, culturally appropriate materials, interactive teaching strategies, and teach-back techniques appear more effective, especially among vulnerable populations.

Conclusion: Health literacy educational interventions represent a cost-effective and scalable strategy to improve diabetes outcomes at both individual and population levels. Integrating health literacy principles into diabetes education, primary care, and community-based programs can strengthen self-management, reduce preventable complications, and promote health equity. Future research should prioritize standardized intervention frameworks, long-term sustainability, and implementation in resource-limited settings to maximize public health impact.

Keywords: *Health Literacy, Educational Interventions, Diabetes*

Introduction

Diabetes mellitus is one of the most significant and rapidly expanding public health challenges worldwide, characterized by rising prevalence, high morbidity and mortality, and substantial economic burden on healthcare systems. According to global estimates, hundreds of millions of adults are currently living with diabetes, with projections indicating a continued increase, particularly in low- and middle-income countries. Despite advances in diagnostic methods and therapeutic options, diabetes remains a leading cause of cardiovascular disease, renal failure, blindness, and lower-limb amputation, underscoring the urgent need for effective population-level strategies to improve outcomes and reduce complications [1].

Effective diabetes management depends heavily on patients' ability to engage in complex, lifelong self-management behaviors outside formal healthcare settings. Adults with diabetes are required to make daily decisions regarding medication adherence, blood glucose monitoring, dietary intake, physical activity, and early recognition of acute and chronic complications. Evidence indicates that nearly 95% of diabetes care is performed by patients themselves, highlighting the central role of patient engagement and understanding in achieving glycemic control and preventing disease progression [2].

Health literacy has emerged as a critical determinant influencing individuals' capacity to manage chronic diseases such as diabetes. It encompasses not only basic reading and writing skills, but also cognitive and social abilities that enable individuals to access, understand, appraise, and apply health information for informed decision-making. From a public health perspective, health literacy is increasingly recognized as a key factor shaping health behaviors, healthcare utilization, and outcomes across populations, particularly in chronic disease management [3].

A growing body of evidence demonstrates that limited health literacy is highly prevalent among adults with diabetes and is associated with adverse clinical and behavioral outcomes. Patients with inadequate health literacy often experience difficulties understanding medication instructions, interpreting blood glucose values, following dietary recommendations, and navigating healthcare systems. These challenges contribute to poorer glycemic control, reduced adherence to treatment, higher rates of hospitalization, increased healthcare costs, and overall worse health outcomes compared with individuals who have adequate health literacy [4].

In response to these challenges, health literacy–focused educational interventions have been increasingly implemented as part of diabetes care and prevention strategies. Such interventions aim to tailor educational content and delivery methods to patients' literacy levels, numeracy skills, and cultural contexts, using simplified language, visual aids, interactive teaching approaches, and verification of understanding through techniques such as teach-back. These approaches are particularly relevant in community and primary care settings, where they have the potential to improve self-management behaviors and reduce health inequities [5].

Despite the expanding implementation of health literacy–oriented education, existing evidence remains heterogeneous with respect to intervention design, outcome measures, and study settings. While some studies emphasize improvements in glycemic control, others focus on self-care behaviors or patient-reported outcomes such as self-efficacy and quality of life. Moreover, much of the available evidence originates from high-income countries, with limited synthesis addressing applicability in low-resource settings where diabetes burden and health literacy challenges are substantial [6].

Therefore, this review aims to synthesize and critically appraise the evidence on health literacy educational interventions for adults with diabetes, with a specific focus on their effects on glycemic control, diabetes self-management behaviors, and patient-reported outcomes. By adopting a public health and community medicine perspective, this review seeks to inform policy, practice, and future research on integrating health literacy principles into diabetes education programs to improve population health outcomes and promote health equity [7].

Conceptual Framework of Health Literacy in Diabetes Care

Health literacy is a multidimensional concept that has evolved substantially over the past two decades, moving beyond a narrow focus on reading ability toward a broader understanding of how individuals interact with health information and healthcare systems. In the context of public health and community medicine, health literacy is defined as the knowledge, motivation, and competencies required to access, understand, appraise, and apply health information in order to make informed decisions related to healthcare, disease prevention, and health promotion across the life course. This comprehensive framing emphasizes that health literacy is shaped not only by individual skills but also by the demands placed on individuals by health systems and societal structures [8].

One of the most widely accepted conceptual models of health literacy categorizes it into three progressive levels: functional, interactive, and critical health literacy. Functional health literacy refers to basic skills in reading, writing, and numeracy that are necessary to understand health-related information such as prescription labels or appointment instructions. Interactive health literacy encompasses more advanced cognitive and social skills that enable individuals to actively participate in healthcare encounters, communicate effectively with providers, and apply information to changing circumstances. Critical health literacy represents the highest level, involving the ability to critically analyze information and exert greater control over life events and health-related decisions, including engagement in collective and community action [9].

In diabetes care, these dimensions of health literacy are particularly relevant due to the complexity of disease management and the high cognitive burden placed on patients. Functional health literacy is required for understanding medication regimens, insulin dosing instructions, and written educational materials. Interactive health literacy supports effective communication with healthcare providers, shared decision-making, and problem-solving when glycemic control fluctuates. Critical health literacy enables individuals to evaluate conflicting health information, recognize misinformation, and make informed lifestyle and treatment choices within their social and economic contexts. Deficits at any of these levels can compromise self-management and contribute to poor clinical outcomes [10].

Numeracy, often considered a core component of health literacy, plays a central role in diabetes management and warrants specific attention within conceptual frameworks. Adults with diabetes are routinely required to interpret numerical data, including blood glucose readings, carbohydrate counting, insulin titration, and risk probabilities related to complications. Research indicates that limited health numeracy is independently associated with poorer glycemic control, increased risk of hypoglycemia, and lower adherence to treatment plans, even among individuals with adequate general literacy. This highlights the need for educational interventions that explicitly address numeracy skills alongside traditional literacy components [11].

From a public health perspective, health literacy should be understood as an interaction between individual capacities and the complexity of health systems. The concept of “health-literate organizations” has emerged to emphasize the responsibility of healthcare institutions to present information in accessible ways, reduce unnecessary complexity, and support patients in navigating services. In diabetes care, this includes simplifying care pathways, standardizing educational messages, using clear communication strategies, and integrating health literacy principles into routine clinical practice and community-based programs [12].

Importantly, health literacy is closely intertwined with social determinants of health, including education, income, culture, language, and access to healthcare. Populations disproportionately affected by diabetes—such as older adults, ethnic minorities, migrants, and individuals with low socioeconomic status—are also more likely to experience limited health literacy. This intersection contributes to persistent health inequities and reinforces the need for health literacy interventions that are culturally appropriate, context-sensitive, and embedded within broader strategies addressing social and structural determinants [13].

Within diabetes education, conceptual frameworks increasingly advocate for integrating health literacy into diabetes self-management education and support rather than treating it as a standalone component. Such frameworks emphasize patient-centered communication, skills-based learning, reinforcement over time, and alignment with community resources. By grounding educational interventions in robust health literacy models, programs are more likely to produce sustainable improvements in self-management behaviors and clinical outcomes, particularly at the population level [14].

Health Literacy and Diabetes: Mechanistic Pathways Linking Literacy to Outcomes

Health literacy influences diabetes outcomes through multiple interrelated behavioral, cognitive, and system-level mechanisms that shape how individuals manage their condition on a daily basis. From a public health standpoint, these pathways help explain why limited health literacy is consistently associated with poorer glycemic control, higher complication rates, and increased healthcare utilization. Understanding these mechanisms is essential for designing effective educational interventions that address not only knowledge deficits but also broader communication and structural barriers within healthcare delivery [15].

One key pathway linking health literacy to diabetes outcomes is medication adherence. Adults with diabetes are often prescribed complex treatment regimens involving oral hypoglycemic agents, insulin, or combination therapies, each with specific dosing schedules and administration techniques. Individuals with limited health literacy may struggle to understand prescription labels, differentiate between medications, or recognize the importance of adherence, leading to missed doses or inappropriate use. Studies have demonstrated that low health literacy is independently associated with poorer adherence to diabetes medications, which in turn contributes to suboptimal glycemic control and increased risk of complications [16].

Self-monitoring of blood glucose represents another critical mechanism through which health literacy affects diabetes management. Effective monitoring requires patients to understand how and when to measure glucose levels, accurately interpret numerical readings, and take appropriate corrective actions based on results. Limited literacy and numeracy skills can impair patients' ability to recognize patterns, respond to hyperglycemia or hypoglycemia, and adjust behaviors accordingly. Evidence suggests that patients with lower health literacy are less likely to engage in regular self-monitoring and are more prone to misinterpretation of glucose values, undermining the benefits of this essential self-care practice [17].

Dietary management and physical activity are central components of diabetes self-management and are strongly influenced by health literacy. Patients must interpret nutritional information, understand portion sizes, and apply dietary recommendations within their cultural and socioeconomic contexts. Limited health literacy can hinder comprehension of nutrition labels, carbohydrate counting, and the rationale behind dietary restrictions, resulting in poor adherence to recommended eating patterns. Similarly, inadequate understanding of physical activity guidelines may reduce engagement in regular exercise, further contributing to poor glycemic control and increased cardiometabolic risk [18].

Health literacy also plays a significant role in patients' ability to recognize and respond to symptoms of acute and chronic diabetes-related complications. Individuals with limited literacy may have difficulty identifying early warning signs of hypoglycemia, hyperglycemia, or infection, delaying appropriate self-care or healthcare seeking. This can lead to preventable emergency department visits, hospitalizations, and progression of complications such as neuropathy, retinopathy, and nephropathy. Research has shown that lower health literacy is associated with higher rates of diabetes-related complications and increased use of acute care services [19].

Communication between patients and healthcare providers constitutes another important pathway through which health literacy influences outcomes. Limited health literacy can reduce patients' confidence in asking questions, expressing concerns, or participating in shared decision-making. As a result, misunderstandings regarding treatment plans may persist, and opportunities for individualized care may be missed. Conversely, effective provider communication that accounts for patients' literacy levels has been shown to improve understanding, satisfaction, and adherence, highlighting the bidirectional nature of this pathway [20].

At the health system level, the complexity of healthcare environments can amplify the negative effects of limited health literacy. Navigating appointments, referrals, insurance processes, and follow-up care requires substantial organizational and cognitive skills. Adults with diabetes and limited health literacy may face difficulties accessing preventive services, attending regular follow-up visits, or utilizing community resources. These system-level barriers contribute to fragmented care and exacerbate existing disparities, particularly among socioeconomically disadvantaged populations [21].

Collectively, these mechanistic pathways underscore that health literacy is not merely a patient attribute but a dynamic interaction between individual capacities and healthcare system demands. Interventions that address multiple pathways simultaneously—such as combining simplified education, numeracy support, enhanced provider communication, and system-level modifications—are more likely to produce sustained improvements in diabetes outcomes. From a community medicine perspective, targeting these mechanisms offers a strategic approach to reducing the population burden of diabetes and advancing health equity [22].

Burden and Prevalence of Low Health Literacy Among Adults With Diabetes

Limited health literacy is highly prevalent among adults living with diabetes and represents a substantial but often underrecognized public health burden. Population-based studies conducted across different regions consistently demonstrate that a significant proportion of individuals with diabetes have difficulty understanding and applying health-related information necessary for effective self-management. Estimates suggest that between one-third and one-half of adults with diabetes exhibit limited or inadequate health literacy, with prevalence varying according to assessment tools, population characteristics, and healthcare settings. From a community medicine perspective, this widespread burden underscores the need for population-level strategies that address health literacy as a foundational determinant of diabetes outcomes [23].

Global patterns indicate marked disparities in the distribution of low health literacy among people with diabetes. Higher prevalence has been documented in low- and middle-income countries, where educational opportunities, access to health information, and health system resources are often constrained. In these settings, diabetes prevalence is rising rapidly, frequently outpacing the capacity of healthcare systems to deliver comprehensive education and long-term follow-up. As a result, low health literacy exacerbates challenges related to delayed diagnosis, poor treatment adherence, and late presentation of complications, further amplifying the public health impact of diabetes in resource-limited contexts [24].

Within countries, low health literacy among adults with diabetes is strongly patterned by sociodemographic factors. Older age, lower educational attainment, low income, unemployment, and limited access to healthcare services have all been consistently associated with poorer health literacy. In addition, individuals living in rural areas or underserved urban communities may face compounded barriers due to reduced availability of diabetes education programs and limited continuity of care. These patterns highlight how health literacy operates at the intersection of individual capacity and broader social determinants of health [25].

Ethnic and linguistic minority populations are disproportionately affected by limited health literacy in diabetes care. Language barriers, cultural differences in health beliefs, and limited availability of culturally appropriate educational materials contribute to misunderstandings and reduced engagement with healthcare services. Migrants and refugees with diabetes may encounter additional challenges related to health system navigation and trust in healthcare providers. Evidence suggests that these populations experience poorer glycemic control and higher complication rates, partly mediated by lower health literacy and inadequate communication within healthcare encounters [26].

Low health literacy among adults with diabetes is also closely associated with adverse clinical outcomes at the population level. Studies have demonstrated that individuals with limited health literacy are more likely to have poor glycemic control, as reflected by higher HbA1c levels, and are less likely to achieve recommended targets for blood pressure and lipid control. Furthermore, limited health literacy has been linked to increased rates of diabetes-related hospitalizations, emergency department visits, and

preventable complications, contributing to substantial healthcare costs and inefficiencies [27].

From a health systems perspective, the high prevalence of low health literacy among people with diabetes places additional strain on already burdened services. Patients with limited understanding of their condition often require more frequent consultations, longer visits, and repeated explanations, while still experiencing poorer outcomes. This mismatch between patient needs and system design underscores the importance of integrating health literacy considerations into service planning, provider training, and quality improvement initiatives as part of comprehensive diabetes care [28].

Importantly, the burden of low health literacy among adults with diabetes is not static and may evolve over time in response to demographic shifts, educational policies, and changes in healthcare delivery. The aging of populations worldwide, increasing multimorbidity, and growing reliance on digital health technologies may further widen health literacy gaps if not proactively addressed. Recognizing and monitoring the prevalence of low health literacy is therefore essential for informing public health surveillance, targeting interventions, and evaluating progress toward more equitable diabetes outcomes [29].

Health Literacy Educational Interventions in Diabetes: Types, Settings, and Delivery Approaches

Health literacy educational interventions in diabetes have been developed in response to the recognition that traditional education models often fail to meet the needs of patients with limited literacy and numeracy skills. These interventions are designed to reduce the cognitive demands placed on patients while enhancing understanding, engagement, and practical skills for self-management. From a public health and community medicine perspective, such interventions are most effective when they are embedded within routine care and adapted to the sociocultural context of the target population, rather than delivered as isolated or one-time educational activities [30].

Individual-level educational interventions remain one of the most commonly implemented approaches in diabetes care. These interventions typically involve one-on-one counseling sessions delivered by physicians, nurses, diabetes educators, or community health workers, with content tailored to the patient's literacy level. Strategies frequently include the use of plain language, visual aids, simplified written materials, and confirmation of understanding through teach-back techniques. Evidence suggests that individualized health literacy–sensitive education can improve patients' comprehension of treatment plans and enhance adherence, particularly among adults with poorly controlled diabetes [31].

Group-based diabetes self-management education and support programs have also been widely adopted as platforms for integrating health literacy principles. In these settings, educators can use interactive teaching methods, peer learning, role-playing, and problem-solving exercises to reinforce key messages. Group formats offer additional benefits by fostering social support and shared learning, which may be particularly valuable for individuals with limited confidence or prior educational experiences. Studies indicate that group-based interventions tailored for low health literacy populations can lead to improvements in self-care behaviors and glycemic outcomes comparable to, or greater than, standard education programs [32].

Community-based interventions represent an important extension of health literacy education beyond clinical settings. These programs are often delivered in community centers, religious institutions, workplaces, or through home visits, and may be facilitated by trained community health workers or peer educators. Community-based approaches are especially relevant in underserved populations, as they address barriers related to access, trust, and cultural relevance. By situating education within familiar environments and leveraging local social networks, these interventions have demonstrated success in improving diabetes knowledge, self-efficacy, and engagement in preventive behaviors [33].

Digital and technology-assisted educational interventions have gained increasing attention in recent years, particularly in response to expanding access to mobile phones and internet-based platforms. Health literacy–oriented digital interventions include simplified mobile applications, text messaging programs, video-based education, and interactive web platforms designed to support diabetes self-management. While digital tools offer scalability and convenience, evidence suggests that their effectiveness depends on careful design that accounts for literacy, numeracy, and digital skills. Poorly

designed digital interventions may inadvertently widen disparities, whereas literacy-sensitive digital tools can enhance understanding and self-management when appropriately implemented [34].

Across intervention types, several core components have been identified as critical for success in populations with limited health literacy. These include the use of plain language, culturally and linguistically appropriate materials, visual and pictorial aids, repetition and reinforcement over time, and active verification of understanding. Interventions that focus on skill-building—such as demonstrating glucose monitoring techniques or practicing medication dosing—tend to be more effective than those relying solely on information provision. These components align with public health principles emphasizing empowerment, participation, and sustainability [35].

The settings in which health literacy educational interventions are delivered also influence their reach and impact. Primary care and outpatient clinics serve as key entry points for integrating literacy-sensitive education into routine diabetes management. However, coordination across healthcare levels and linkage with community resources are essential to ensure continuity and reinforcement of messages. From a health systems perspective, integrating health literacy education into standard care pathways can enhance efficiency, reduce duplication, and support long-term behavior change [36].

Overall, the diversity of health literacy educational interventions reflects the complexity of diabetes management and the heterogeneity of affected populations. Evidence suggests that no single approach is universally effective; rather, interventions must be tailored to local needs, resources, and population characteristics. For public health practitioners and policymakers, understanding the range of available intervention models is critical for designing comprehensive strategies that address health literacy as a core component of diabetes prevention and control [37].

Effects of Health Literacy Educational Interventions on Glycemic Control (HbA1c)

Glycemic control, commonly assessed using glycated hemoglobin (HbA1c), is a central clinical outcome in diabetes management and a key indicator of long-term risk for microvascular and macrovascular complications. From a public health perspective, even modest reductions in HbA1c at the population level are associated with substantial reductions in diabetes-related morbidity, mortality, and healthcare costs. Health literacy educational interventions have therefore been increasingly evaluated for their potential to improve glycemic control by enhancing patients' understanding, skills, and engagement in self-management behaviors [38].

Early observational and interventional studies established a strong association between limited health literacy and poorer glycemic control among adults with diabetes. Individuals with inadequate health literacy consistently demonstrate higher HbA1c levels compared with those with adequate literacy, independent of age, education, and socioeconomic status. These findings provided a compelling rationale for developing educational interventions specifically designed to address health literacy barriers, with the goal of improving glycemic outcomes through clearer communication and skill-based education [39].

Randomized controlled trials evaluating health literacy–focused educational interventions have reported clinically meaningful improvements in HbA1c, particularly among patients with poorly controlled diabetes at baseline. Interventions that incorporate simplified educational materials, interactive teaching, and verification of understanding have demonstrated reductions in HbA1c ranging from 0.3% to over 1.0% compared with usual care. Such reductions are considered clinically significant and comparable to the effects of adding a second-line pharmacological agent, underscoring the potential value of educational strategies as adjuncts to medical therapy [40].

The magnitude and sustainability of HbA1c improvement appear to be influenced by the intensity and duration of health literacy interventions. Short-term interventions may produce initial improvements in glycemic control, but sustained benefits are more consistently observed when education is reinforced over time through follow-up sessions, ongoing support, or integration into routine care. Programs embedded within diabetes self-management education and support frameworks, rather than one-time educational encounters, have shown greater potential for maintaining HbA1c reductions over extended follow-up periods [41].

Health literacy–oriented interventions have demonstrated particular effectiveness among vulnerable populations, including individuals with low baseline literacy, low income, and limited formal education. In these groups, standard diabetes education often fails to achieve meaningful improvements in glycemic control due to misalignment with patients' learning needs. Literacy-sensitive interventions help narrow this gap by reducing misunderstandings, enhancing confidence, and supporting practical problem-solving, thereby contributing to reductions in disparities in HbA1c outcomes [42].

Several studies suggest that the effect of health literacy interventions on glycemic control is mediated through improvements in intermediate outcomes such as medication adherence, self-monitoring of blood glucose, and dietary behaviors. By strengthening patients' ability to correctly implement daily self-care tasks, literacy-focused education creates a pathway through which knowledge and skills translate into improved metabolic control. This mechanistic link reinforces the importance of designing interventions that prioritize actionable skills rather than information alone [43].

Despite generally positive findings, variability exists across studies with respect to the magnitude of HbA1c improvement, reflecting differences in intervention design, population characteristics, and outcome measurement. Some trials report modest or non-significant changes, particularly in settings where baseline glycemic control is already relatively good or where intervention exposure is limited. These mixed results highlight the need for standardized intervention frameworks and careful targeting of populations most likely to benefit from health literacy–focused education [44].

From a public health and health systems perspective, the evidence that health literacy educational interventions can improve HbA1c supports their inclusion as a core component of comprehensive diabetes care. When implemented at scale, such interventions have the potential to reduce the population burden of poor glycemic control, prevent complications, and improve the efficiency of healthcare delivery. Integrating health literacy principles into routine diabetes education and primary care practice represents a pragmatic and equitable approach to improving glycemic outcomes across diverse populations [45].

Effects of Health Literacy Educational Interventions on Diabetes Self-Management Behaviors

Effective diabetes care relies heavily on patients' ability to perform daily self-management behaviors, including healthy eating, regular physical activity, medication adherence, self-monitoring of blood glucose, problem solving, and risk reduction. These behaviors are cognitively and practically demanding and require patients to understand, interpret, and act on complex health information. Health literacy educational interventions directly target these competencies and are therefore positioned as key enablers of effective diabetes self-management [46].

A substantial body of evidence demonstrates a strong association between health literacy and diabetes self-management behaviors. Adults with limited health literacy consistently report poorer adherence to recommended self-care activities, including medication use, dietary modification, and glucose monitoring. Conversely, higher health literacy levels are associated with greater diabetes knowledge, stronger self-efficacy, and more consistent engagement in self-management practices. These findings underscore the importance of literacy-sensitive educational strategies as a foundation for behavior change in diabetes care [47].

Interventional studies indicate that health literacy educational programs can significantly improve multiple domains of diabetes self-management. Programs that simplify educational content, use plain language, incorporate visual aids, and emphasize interactive learning have been shown to improve adherence to medication regimens, accuracy of blood glucose monitoring, and consistency in dietary practices. Importantly, these improvements are not limited to knowledge acquisition but extend to the practical application of self-care behaviors in daily life [48].

Medication adherence is one of the most consistently improved outcomes following health literacy interventions. Patients with diabetes often struggle to understand dosing instructions, timing, and side-effect management, particularly when treatment regimens are complex. Literacy-sensitive education that focuses on clear explanations, teach-back techniques, and personalized counseling has been shown to significantly improve adherence, thereby reducing treatment errors and enhancing overall disease

control [49].

Dietary self-management is another domain strongly influenced by health literacy. Understanding nutrition labels, portion sizes, carbohydrate counting, and meal planning requires both literacy and numeracy skills. Health literacy interventions that incorporate practical demonstrations, culturally relevant examples, and simplified nutrition concepts have demonstrated improvements in dietary behaviors and healthier food choices among adults with diabetes. These behavioral changes play a critical role in supporting long-term glycemic control [50].

Self-monitoring of blood glucose (SMBG) is a technically demanding task that requires patients to interpret numerical data and adjust behaviors accordingly. Studies show that individuals with limited health literacy are less likely to perform SMBG correctly or to use results effectively in decision-making. Health literacy educational interventions that include hands-on training and structured feedback have been associated with improved SMBG frequency, accuracy, and appropriate response to abnormal glucose readings [51].

Problem solving and coping skills represent higher-order self-management behaviors that are particularly sensitive to health literacy levels. Patients must be able to recognize symptoms, respond to hypoglycemia or hyperglycemia, and adapt self-care behaviors during illness or stress. Literacy-focused interventions that explicitly teach problem-solving strategies have been shown to enhance patients' confidence and autonomy, leading to better self-management outcomes and reduced diabetes-related distress [52].

Evidence also suggests that improvements in self-management behaviors mediate the relationship between health literacy interventions and clinical outcomes such as HbA1c. Meta-analytic findings indicate that health literacy has both direct and indirect effects on glycemic control, with self-care behaviors serving as a critical pathway. This reinforces the conceptual model in which health literacy educational interventions improve outcomes not simply by increasing knowledge, but by enabling sustained behavioral change [53].

Despite these positive findings, variability exists in the effectiveness of interventions across different populations and settings. Interventions that are not tailored to patients' literacy levels, cultural context, or socioeconomic conditions tend to yield weaker behavioral outcomes. This highlights the necessity of designing health literacy educational programs that are patient-centered, culturally sensitive, and responsive to real-world barriers to self-management [54].

Overall, the evidence supports health literacy educational interventions as effective strategies for improving diabetes self-management behaviors in adults. By strengthening patients' capacity to understand and act on health information, these interventions address a fundamental determinant of self-care performance. Integrating health literacy principles into diabetes education programs is therefore essential for enhancing self-management, improving clinical outcomes, and reducing health disparities among people living with diabetes [55].

Effects of Health Literacy Educational Interventions on Patient-Reported Outcomes (Quality of Life, Self-Efficacy, Empowerment, and Diabetes Distress)

Patient-reported outcomes (PROs) are increasingly recognized as essential endpoints in diabetes care because they capture how people live with diabetes day-to-day, beyond laboratory indicators such as HbA1c. From a public health and community medicine perspective, improvements in quality of life, confidence, coping, and reduced distress are not "soft outcomes"; they influence long-term self-management, healthcare utilization, and sustainability of behavioral change. Diabetes education that is aligned with health literacy needs is particularly relevant because it reduces confusion, fear, and misinterpretation of self-care instructions, thereby improving the lived experience of diabetes and supporting equitable care delivery across diverse adult populations [56].

Quality of life is a core PRO that reflects physical, psychological, and social functioning, all of which can be disrupted by the continuous demands of diabetes self-care. Evidence from randomized controlled trial synthesis indicates that structured diabetes self-management education can improve quality of life outcomes, particularly when education is ongoing, collaborative, and adapted to patient needs. Health

literacy–sensitive educational interventions strengthen the likelihood that education translates into meaningful daily functioning because patients better understand instructions, feel more capable of acting on them, and experience fewer avoidable crises that erode well-being over time [57].

Beyond general quality of life, health literacy educational interventions can improve diabetes-specific well-being by strengthening the patient's sense of control and competence in self-management. Systematic review evidence indicates that education programs that include behavioral and psychosocial components can produce beneficial changes in patient-centered outcomes, especially when interventions go beyond information provision and incorporate practical skills, feedback, and coping strategies. This supports the view that health literacy–tailored education is most impactful when it integrates psychosocial reinforcement alongside clinical self-care training, rather than treating diabetes education as purely biomedical instruction [58].

Self-efficacy, defined as the belief in one's ability to perform behaviors required to achieve desired outcomes, is a major determinant of sustained self-management and is strongly responsive to educational design. Diabetes education that matches an individual's literacy and numeracy abilities can reduce feelings of overwhelm and replace uncertainty with mastery experiences (e.g., successfully using a glucometer, interpreting readings, or planning meals). Such improvements are particularly important in community practice, where boosting confidence can translate into more consistent self-care behaviors, greater engagement with follow-up, and reduced dependence on emergency services [59].

Empowerment is a related PRO that reflects patients' perceived agency, participation in decision-making, and ability to integrate diabetes management into real-life contexts. Research focused on empowerment in adults with type 2 diabetes highlights that psychosocial determinants and education-related factors are key predictors of empowerment outcomes. Health literacy–oriented interventions align naturally with empowerment goals because they aim to make information usable, strengthen communication, and support autonomy in problem solving, which are especially needed among adults with limited literacy who may otherwise disengage from care due to shame, misunderstanding, or low confidence [60].

Diabetes-related distress is a frequent and clinically relevant problem that can undermine adherence, worsen glycemic control, and reduce quality of life. Position statements on psychosocial care emphasize that emotional burden, the constant demands of self-management, and fear of complications can significantly hinder diabetes care. Health literacy–sensitive education can reduce distress by clarifying expectations, simplifying complex tasks, and improving patient-provider communication, thereby decreasing uncertainty and fostering a more supportive, person-centered care experience that is critical for sustained engagement [61].

Healthy coping is a central mechanism linking literacy-sensitive education to better PROs, because it supports resilience, motivation, and persistence with lifestyle and medication plans. A systematic review focused on interventions to facilitate healthy coping in diabetes indicates that structured psychosocial approaches can improve coping-related outcomes, reinforcing the need to embed coping and emotional support within education. For adults with limited health literacy, supportive coping-focused education is particularly valuable because it can mitigate stigma, reduce avoidance behaviors, and enable patients to seek clarification and support rather than withdrawing from care when challenges arise [62].

At a delivery level, communication strategies used in health literacy interventions influence PROs directly, not only through downstream behavioral change. Evidence indicates that healthcare providers experience challenges communicating with patients with low health literacy and identify actionable strategies such as simplifying language, using visual supports, and verifying comprehension. When these strategies are applied in diabetes education, patients are more likely to feel respected, understood, and safe to ask questions, which improves satisfaction, trust, and perceived quality of care, and may reduce distress and strengthen self-efficacy over time [63].

Taken together, the evidence indicates that health literacy educational interventions can improve patient-reported outcomes in diabetes by enhancing understanding, strengthening confidence and empowerment, reducing distress, and supporting healthier coping. For public health impact, these

improvements matter because they can drive sustained self-management behaviors, reduce avoidable complications, and support equity by ensuring that adults with limited literacy are not systematically disadvantaged in their ability to benefit from diabetes care. Embedding health literacy principles into DSMES and routine primary care delivery is therefore a pragmatic strategy to improve both clinical outcomes and the lived experience of diabetes at scale [64].

Public Health and Health System Implications

Health literacy–focused diabetes education has implications that extend well beyond individual behavior change, because diabetes is a high-prevalence chronic condition and small improvements in self-management can translate into large population-level benefits. From a community medicine lens, embedding health literacy principles into routine diabetes education strengthens the effectiveness of primary care, improves continuity of care, and supports prevention-oriented service delivery rather than crisis-driven utilization [65].

At the health system level, limited health literacy is associated with higher healthcare utilization and spending, reflecting avoidable emergency department visits, inpatient admissions, and inefficient use of services. Evidence indicates that health literacy is strongly linked to national healthcare utilization patterns and expenditures, suggesting that addressing literacy barriers is not only clinically relevant but also a system efficiency priority for diabetes and other chronic diseases [66].

Economic analyses and policy-focused syntheses emphasize that inadequate health literacy contributes substantially to healthcare system costs and inefficiency. Estimates suggest large aggregate financial burdens attributable to limited health literacy, reinforcing the public health argument that health literacy interventions, including diabetes education tailored to literacy and numeracy needs, can be viewed as investments that may yield downstream savings through improved outcomes and reduced service overuse [67].

Hospitalization is a particularly important health system outcome because diabetes-related admissions often reflect preventable deterioration in glycemic control, delayed recognition of complications, or poor understanding of medication and self-care instructions. A major systematic review found that low health literacy is associated with increased hospitalization, avoidable readmissions, and higher use of acute care, highlighting why health literacy–sensitive education is relevant to hospital avoidance strategies and chronic disease management programs [68].

Health literacy also shapes diabetes-related patient safety and transitions of care, which are common failure points that drive readmissions and medication errors. Evidence from emergency care research shows that limited health literacy is associated with adverse emergency department outcomes, supporting the need for clear discharge communication, teach-back, and simplified written and non-written instructions as part of diabetes education and post-discharge planning [69].

Diabetes self-management education and support (DSMES) has demonstrated system-level value by reducing acute care use and improving preventive service uptake, which is highly relevant to public health planning and resource allocation. Longitudinal evidence among newly diagnosed beneficiaries shows that DSMES participation is associated with improved care patterns and outcomes over a year, supporting the scalability of structured education models when implemented as part of routine health services [70].

Health literacy is also closely tied to health equity, because limited literacy is more common in socially vulnerable populations and can amplify disparities through reduced access, poorer communication, and lower effectiveness of standard education approaches. Clear communication and health literacy–responsive care are increasingly framed as actionable tools to reduce inequities, making health literacy–tailored diabetes education a practical equity intervention within both clinical and community settings [71].

From a global and policy perspective, strengthening health literacy is aligned with national and international strategies to address noncommunicable diseases and advance health-related development goals. The World Health Organization has highlighted health literacy as a strategic instrument for achieving health promotion objectives and broader development targets, supporting the inclusion of

health literacy education within national diabetes control programs and primary healthcare strengthening efforts [72].

Finally, the public health impact of health literacy educational interventions depends on implementation quality, sustainability, and "health-literate" system design. Conceptual and policy work emphasizes that health literacy is not solely an individual trait but a social determinant that requires system-level responses, including simplified communication environments, workforce training, culturally appropriate education, and community partnerships—conditions that can enhance the reach and long-term effectiveness of diabetes education interventions [73].

Conclusion

Health literacy educational interventions represent a critical and actionable strategy for improving diabetes outcomes from both clinical and public health perspectives. The evidence synthesized in this review demonstrates that adults with diabetes who receive education tailored to their health literacy and numeracy needs experience meaningful improvements in glycemic control, self-management behaviors, and patient-reported outcomes, including quality of life, self-efficacy, empowerment, and reduced diabetes-related distress. These benefits are particularly pronounced among populations that are traditionally underserved or at higher risk of poor outcomes, highlighting the role of health literacy as a lever for advancing health equity in diabetes care.

Beyond individual-level effects, health literacy–focused education has important implications for health systems and population health. By improving patients' capacity to manage their condition effectively, such interventions can reduce preventable complications, decrease avoidable hospitalizations and emergency care use, and enhance the efficiency of healthcare delivery. When integrated into diabetes self-management education and support programs, primary care services, and community-based initiatives, health literacy principles strengthen the sustainability and reach of diabetes care, aligning with prevention-oriented and patient-centered models of chronic disease management.

Importantly, this review underscores that health literacy should not be viewed solely as an individual skill deficit but as a shared responsibility between patients, healthcare providers, and health systems. Educational interventions are most effective when supported by clear communication practices, culturally appropriate materials, trained healthcare teams, and health-literate organizational environments that reduce unnecessary complexity. Addressing health literacy in diabetes care therefore requires coordinated action across clinical practice, public health policy, and community settings.

In conclusion, embedding health literacy educational interventions within comprehensive diabetes management strategies offers a pragmatic and equitable approach to improving outcomes at scale. Strengthening health literacy can empower individuals, support self-management, and contribute to reducing the growing global burden of diabetes, making it a cornerstone of effective public health and community medicine responses to this chronic disease.

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