

Barriers and Limitations to Obstacle Diabetes Self-Management with a Focus on Nutritional Literacy: Solutions and Opportunities. Critical Review and Research Synthesis

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ABSTRACT

Background: Researchers should seek applicable solutions and appropriate opportunities to solve or ravage barriers and limitations that worsen diabetes self-management and outcomes.


Objectives: The aim of this critical review and research synthesis was to explore whether the enhancement of nutritional literacy can optimize diabetes self-management and to identify barriers and limitations that obstacle diabetes self-management and to suggest the best available solutions and opportunities that were tailored to eliminate these barriers.

Methods: Data sources were PubMed and Medline databases. Studies were authorized if they were in English, used an observational or interventional design and were tailored based on the individual's nutritional knowledge or literacy in diabetes management among patients with diabetes. Databases were searched from February 1988 to December 2018. In order to evaluate the studies' quality, the abstracts that met PICO criteria for qualitative studies underwent dual review for data extraction. A qualitative synthesis was also conducted and the GRADE criteria were used to evaluate the quality of studies.

Results: A structured inventory consisted of six constructs (socioeconomic determinants, cultural determinants, education, access to health care services, family structure, and thoughts and personal practices) was designed based on the barriers and limitations. As a result, 151 solutions and opportunities were proposed. Most repeated solutions that were frequently suggested to eliminate the existing barriers, were: "The access to optimal nutrition and health literacy", "Improved health care services", "Health policies of governments", "Sustainable lifestyle-based healthcare system", "Proper implementation of nutritional intervention programs", and "Comprehensive culturally sensitive diabetes education, and care programs".

Conclusion: Identification and classification barriers and limitations to obstacle diabetes self-management are critical advances in accomplishing the interventions that can improve optimal diabetes outcomes, for different diabetic societies. Well-designed nutrition literacy intervention programs and preventive procedures may ameliorate the health status in diabetic population.

Key words: Nutritional literacy; Diabetes self-management; Barriers; Limitations; Solutions; Opportunities.

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Introduction

The prevalence of type 2 diabetes mellitus (DM) was 14.4% among the Iranian older adults. Given the high prevalence of diabetes among adults, more population-based research is needed



to measure the complications of diabetes, and to monitor the effects of prevention and health system strengthening strategies on the prevalence, treatment, and control of type 2 DM [1]. However, socioeconomic inequalities exist in diabetes prevalence and self-management. Future interventions to control diabetes and improve diabetes management should be tailored to address socioeconomic factors [2]. Caballero [3] reported that multiple factors influence the development and course of the diabetes such as acculturation, clinician's cultural awareness, depression and diabetes-specific emotional distress in patients with diabetes, educational level, nutrition and health literacy, patients' knowledge about the disease, language, medication adherence, nutritional preferences, socio-economic and financial status [3]. Social support is perceived to be helpful for people with diabetes in order to improve diabetes self-management and to give support for changes in lifestyle habits. Social support given by general practitioners and practice nurses play a crucial role for people with type 2 diabetes and is an additional component of social care. However, awareness about the influence of social support on the diabetes self-management should be increased by general practitioners and practice nurses [4]. Due to a substantial gap between knowledge and the taught issues in the current educational program with regard to the importance of postprandial glucose, clinicians should be more active in patient education [5]. Self-efficacy impacts the adherence to treatment and therefore plays a role in the clinical outcome. The practical implication is that assessment of the self-efficacy in people with diabetes may be the first step in developing the individually tailored interventions [6].

Understanding the importance of lifestyle modification is also a major concern. Effective lifestyle interventions include dietary pattern modification, an increase of physical activity, smoking cessation and the reduction of psychosocial stress [7].

Due to the rapid growth of type 2 DM in the world, it is important to understand how barriers and limitations worsen the diabetes outcomes. Furthermore, effective strategies in diabetes management should be improved and modified in diverse regions and populations. Hence, researchers should seek applicable solutions and appropriate opportunities to solve or ravage these barriers and limitations. Therefore, the first aim of this critical review and research synthesis was to explore whether enhancement of nutritional literacy can optimize diabetes self-management. The second aim was to identify the barriers and limitations that obstacle diabetes self-management and to suggest the best applicable solutions and appropriate opportunities tailored to eliminate these barriers. The third aim was to choose the most important solution or opportunity in implementing optimal diabetes self-management.

Material & Methods

Data Sources and Eligibility Criteria

PubMed and Medline databases were searched from February 1988 to December 2018 using the following search strategy: (((nutrition* knowledge [Title/Abstract]) OR nutrition* literacy [Title/Abstract])) AND diabetes* [Title/Abstract]. Abstracts that met the population, intervention, comparison and outcome (PICO) criteria for qualitative studies underwent dual review for data extraction to evaluate the study quality and details. The title of this article was the question that includes the PICO elements.

A two-dimensional prevention question was entitled "Can enhancement of nutritional literacy optimize diabetes self-management? Identify barriers and limitations to obstacle diabetes self-management". The "P" was the people with diabetes mellitus. The "I" was nutritional literacy, applicable solutions, and appropriate opportunities to optimize diabetes self-management. The "C" was the barriers and limitations that worsen or obstacle diabetes self-management, and applicable solutions and appropriate opportunities to solve or ravage these

barriers and limitations. The "O" was diabetes self-management. Qualitative research synthesis was also conducted. Studies were authorized if they were in English, used an observational or interventional design, and were tailored based on the individual's nutritional knowledge or literacy in diabetes management among patients with diabetes.

The evidence for all other correlates was graded as being of low quality. The strength of the evidence based on population, intervention, comparison, and outcome which should be appropriately similar across studies was reasonable and was rated using the GRADE methodology [8]. The relative importance of the outcomes was also complete.

According to GRADE methodology, quality of evidence that reflects the extent of confidence (4 = High, 3 = Moderate, 2 = Low, and 1 = Very low) was scored. The scores ranged from -2 to +2. The factors that decreased the quality of evidence included studies limitations, inconsistency, deviance, publication bias, and imprecision. The factors that increased the quality of evidence included the large magnitude of the effect of intervention and reasonable confounding.

After 73 articles screened and reviewed of, 21 articles were irrelevant to the subject and so were removed from appraisal and evaluation. As a result, 19 articles fitted the critical appraisal. Of the remaining 52 articles, 39 full articles were evaluated word by word to detect the proposed barriers and limitations by researchers or authors (Figure 1). The majority of included articles focused on nutrition/health knowledge and literacy.

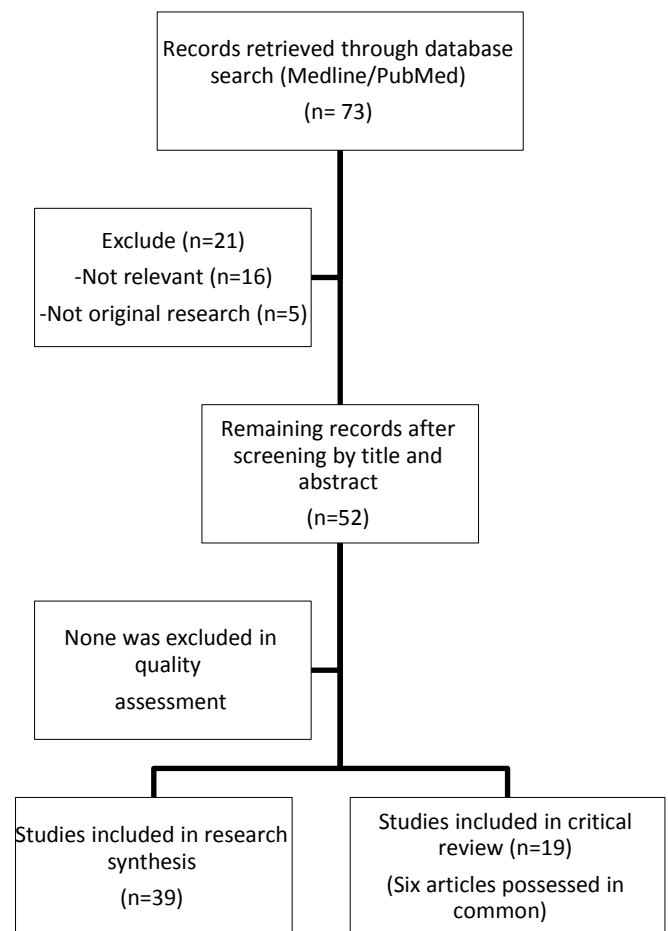


Figure 1. Flowchart of the study selection process

Results

A Structured Inventory and Access to Optimal Nutrition Literacy

The structured inventory consisted of six constructs that were designed based on the barriers and limitations extracted from the relevant published articles. This structured inventory consisted of socioeconomic determinants (11 barriers), cultural determinants (10 barriers), education (9 barriers), access to health care services (4 barriers), family structure (3 barriers), as well as thoughts and personal practices (7 barriers) constructs. Forty-nine different solutions and opportunities were suggested for forty-four barriers and limitations that obstacle diabetes self-management. Therefore, major barriers and limitations to obstacle diabetes self-management; and solutions and opportunities which can eliminate these barriers were investigated (Table 1). Figure 2

shows a framework regarding the overlapping relationships of barriers and limitations to deal with diabetes self-management.

Table 1. Major barriers and limitations to obstacle diabetes self-management; and solutions and opportunities which can eliminate these barriers.

Barriers and Limitations	Solutions and Opportunities [Ref.]
Socioeconomic determinants	
Not having suitable exercise facilities at local communities	“Health policies of governments” [9]
Difficulty cooking separate meals for family members with and without diabetes	“The need to improve a method of nutrition education both for the patients and their families” [10]
Time limitations and not knowing what/how to exercise	“Enjoying new foods and exercise” [11], “Individual and cultural preferences” [12, 13]
Insufficient to implement effective prevention and treatment plans	“Greater confidence in ability to maintain a healthy dietary pattern” [14], “Comprehensive culturally sensitive diabetes education, and care programs” [15], “Sustainable lifestyle-based healthcare system” [16], “Improved health care services” [17, 18]
Vulnerable groups	“The need to improve a method of nutrition education both for the patients and their families” [10], “Changing dietary habits and physical activity” [16], “Proper implementation of nutritional intervention programs” [19], “The access to optimal health literacy” [3, 17, 20-23]
Inappropriate/low socio-economic status	“Social support and accessibility of financial funds” [17, 24], “Proper implementation of nutritional intervention programs” [19]
Food insecurity in patients with diabetes	“Improving food security in patients with diabetes” [25], “Social support and accessibility of financial funds” [17, 24], “Improve nutrients intake and nutritional status of the population” [18, 25], “Proper implementation of nutritional intervention programs” [19], “Changes in food literacy alongside food supply” [26], “The access to optimal nutrition literacy” [3, 17, 20-23]
Failure to access health care services due to lack of money	“Improved health outcomes with lower cost of care” [27], “Improved continuity of care and self-management” [17, 28, 29], “Improved information systems and income for patients” [17], “Sustainable lifestyle-based healthcare system” [16], “Improved health care services” [17, 18], “Health policies of governments” [9], “The access to optimal health literacy” [3, 17, 20-23]
Ignorance related to where to seek educational program and nutrition counselling	“Strategies for patient programs including culturally appropriate dietary counseling” [30], “Sustainable lifestyle-based healthcare system” [16], “The access to optimal nutrition literacy” [3, 17, 20-23]
Undesirable quality of life	“Comprehensive culturally sensitive diabetes education, and care programs” [15], “The access to optimal nutrition and health literacy” [3, 17, 20-23]
Nutritional preferences	“Plant-based dietary pattern by advancing culinary literacy” [14], “Changing dietary habits and physical activity” [16], “Improve the nutrients intake and nutritional status of the population” [18, 31], “Enjoying new foods and exercise” [11], “The access to optimal nutrition literacy” [3, 17, 20-23]
Cultural determinants	
Language in illiterate/immigrant patients	“The government needs to improve literacy rate of citizens” [10],

	<i>"Designing a picture-based nutrition resource for carbohydrate counting of foods" [32], "The community-based interventions in low-literate people" [33, 34]</i>
Acculturation of immigrants	<i>"Self-efficacy related to managing diabetes and maintaining dietary changes" [14, 33], "Sustainable lifestyle-based healthcare system" [16], "Health policies of governments" [9], "Proper implementation of nutritional intervention programs" [19], "Enjoying new foods and exercise" [11], "The cultural acceptability of the recommended diet by population subgroups such as racial/ethnic and immigrants minorities" [35], "The access to optimal nutrition and health literacy" [3, 17, 20-23]</i>
Clinician's cultural non-awareness	<i>"Comprehensive culturally sensitive diabetes education, and care programs" [15], "Individual and cultural preferences" [12, 13]</i>
Medication adherence	<i>"The community-based interventions in low-literate people" [33, 34], "Adherence to treatment and medical recommendations" [36, 37]</i>
Adherence to religion and faith	<i>"The cultural acceptability of the recommended diet by population subgroups such as racial/ethnic and immigrants minorities" [35], "Elimination of extensive gap between knowledge and practice" [22, 26]</i>
Lack of comprehension and evaluation	<i>"Educational programs can improve understanding and use of nutrition labels" [21], "Designing a picture-based nutrition resource for carbohydrate counting of foods" [32]</i>
Poor understanding of preventive care facts	<i>"Health care providers' perceptions of care responsibilities and resources related to reducing type 2 diabetes risk" [23], "Sustainable lifestyle-based healthcare system" [16], "Improved health care services" [17, 18], "The access to optimal nutrition and health literacy" [3, 17, 20-23]</i>
Adherence to alternative medicine	<i>"Improved health care services" [17, 18], "Adherence to treatment and medical recommendations" [36, 37]</i>
Perception of body image	<i>"Changing dietary habits and physical activity" [16], "Improve the nutrients intake and nutritional status of the population" [18, 25]</i>
Lack of access to nutritionists	<i>"Cost- effective personalized tool such as mobile phone apps" [38], "Improved health care services" [17, 18], "Proper implementation of nutritional intervention programs" [19], "The access to optimal nutrition and health literacy" [3, 17, 20-23]</i>
Education	
Insufficient knowledge/awareness about nutritional content of food	<i>"Interest in nutrition education" [10, 21], "Educational materials for patients" [17], "Educational programs can improve understanding and the use of nutrition labels" [21], "Improving consumer ability to understand nutritional information" [21], "Changes in food literacy alongside food supply" [26], "The access to optimal nutrition literacy" [3, 17, 20-23]</i>
Educational level	<i>"Attending above primary education" [10], "The government needs to improve literacy rate of citizens" [10], "Proper implementation of nutritional intervention programs" [19]</i>
Lack of knowledge about the diabetes	<i>"Educational materials for patients" [17], "Comprehensive culturally sensitive diabetes education, and care programs" [15], "Improved health care services" [17, 18], "Health policies of governments" [9], "The community-based interventions in low-literate people" [33, 34]</i>

Poor nutrition and health literacy	“Strategies for patient programs include culturally appropriate dietary counseling” [30], “Interest in nutrition education” [10, 39], “Receiving nutrition education” [10, 39], “The government needs to improve literacy rate of citizens” [10], “Improved health care services” [17, 18], “Health policies of governments” [15], “Proper implementation of nutritional intervention programs” [19], “The access to optimal nutrition and health literacy” [3, 17, 20-23]
Lack of document and numeracy literacy	“Attending above primary education” [10], “The community-based interventions in low-literate people” [33, 34]
Lack of English proficiency	“literacy demand and learning motivation” [40]
Inappropriate communication for the patients, mainly due to inadequate literacy	“Improve effectiveness of treatment through promoting the patient-physician relationship” [29], “The community-based interventions in low-literate people” [33, 34], “The access to optimal health literacy” [3, 17, 20-23]
Lack of in-depth knowledge about diabetes outcomes	“Consolidated guidelines for patients” [17], “Comprehensive culturally sensitive diabetes education, and care programs” [15], “literacy demand and learning motivation” [40], “Sustainable lifestyle-based healthcare system” [16], “Health policies of governments” [9]
Insufficient knowledge of physicians about nutrition	“Consolidated guidelines for physicians” [17], “Improving nutrition literacy among physicians” [41], “General and specialized nutrition knowledge” [21], “literacy demand and learning motivation” [40], “The access to optimal nutrition literacy” [3, 17, 20-23]
Access to health care services	
Failure to provide dietary/cultural information by healthcare providers	“An interdisciplinary community-based practical course to prepare new health care providers for educational and preventive programs” [42], “Improved information systems and income for patients” [17], “Sustainable lifestyle-based healthcare system” [16], “Improved health care services” [17, 18], “Proper implementation of nutritional intervention programs” [41], “Changes in food literacy alongside food supply” [26], “The access to optimal nutrition and health literacy” [3, 17, 20-23]
The suboptimal quality of provided health care	“Strategies for patient programs including culturally appropriate dietary counseling” [30], “Sustainable lifestyle-based healthcare system” [16], “Improved health care services” [16, 18], “Health policies of governments” [9], “The access to optimal nutrition and health literacy” [3, 17, 20-23]
Gender disparity in health literacy and access to health care	“Comprehensive culturally sensitive diabetes education and care programs” [15], “Health policies of governments” [9], “The access to optimal nutrition and health literacy” [3, 17, 20-23]
Inappropriate access to protective care services	“Attempt to provide tools and resources aimed at helping patients to manage their disease” [37], “Sustainable lifestyle-based healthcare system” [16], “Improved health care services” [17, 18], “Health policies of governments” [15], “The access to optimal nutrition and health literacy” [3, 17, 20-23]
Family structure	
Trouble with managing their diabetes while caring for family members	“Attempt to provide tools and resources aimed at helping patients to manage their disease” [37], “Adherence to treatment and medical recommendations” [36, 37]
Lack of intimacy and sexual dysfunction	“Specialized human support” [14]

Lack of family Support	"Having family support"[10, 31, 43]
Thoughts and Personal practices	
Lack of self-will to resist eating sweets, especially during weddings/festivals	"Educational materials for patients" [17], "Receiving nutrition education" [10, 39], "Plant-based dietary pattern by advancing culinary literacy" [14], "Greater confidence in ability to maintain a healthy dietary pattern" [14], "Changing dietary habits and physical activity" [16]
Fear of being singled out at social	"Positive attitudes" [17], "Individual and cultural preferences" [12, 13]
Lack of motivation to exercise	"Regular exercise by lifestyle skill acquisition" [14]
Fear about being unable to control diabetes	"Positive feelings about their ability to control their diabetes" [11], "Self-efficacy related to managing diabetes and maintaining dietary changes" [14, 33], "The access to optimal nutrition and health literacy" [3, 17, 20-23]
Confusion about diabetes self-management	"Greater health literacy requires patient-centered care models" [23], "Improved continuity of care and self-management"[16, 28, 29], "Improved healthcare services" [18, 23], "Health policies of governments" [9]
Depression and diabetes-specific emotional distress	"Stress management, self-empowerment, create motivation" [16], "Adherence to treatment and medical recommendations"[36, 37]
Perception of disease consequences and impact of disease on daily life	"Positive attitudes" [17], "Improved continuity of care and self-management"[16, 28, 29], "Changing dietary habits and physical activity" [16], "Enjoying new foods and exercise" [11], "Adherence to treatment and medical recommendations" [36, 37]

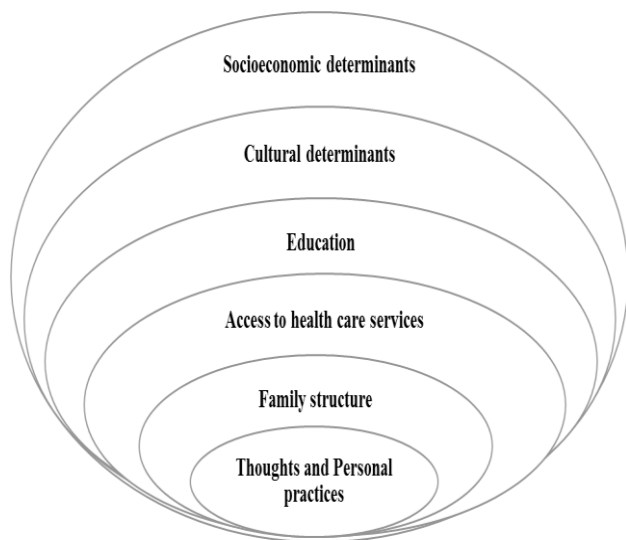


Figure 2. Framework for overlapping relationships between barriers and limitations to obstacle diabetes self-management.

A total of 151 solutions and opportunities were proposed from 49 recommended solutions. Most of the frequently repeated solutions suggested to eliminate the existing barriers included "The access to optimal nutrition and health literacy" (18 times), "Improved health care services" (11 times), "Health policies of governments" (10 times), "Sustainable lifestyle-based healthcare system" (9 times), "Proper implementation of nutritional intervention programs" (8 times), "Comprehensive culturally sensitive diabetes education, and care programs" (6 times), "Adherence to treatment and medical recommendations" (5 times), "Changing dietary habits and physical activity" (5 times), and "The community-based interventions in low-literate people" (5 times) ([Table 2](#)).

Table 2. Frequency of the repeated solutions that are frequently suggested to eliminate existing barriers

No.	Solutions and opportunities	No. of repetition
1	Adherence to treatment and medical recommendations	5
2	An interdisciplinary community-based practical course to prepare new healthcare providers for educational and preventive programs	1
3	Attempt to provide tools and resources aimed at helping patients to manage their disease	2
4	Attending above primary education	2
5	Changes in food literacy alongside food supply	3
6	Changing dietary habits and physical activity	5
7	Comprehensive culturally sensitive diabetes education, and care programs	6
8	Consolidated guidelines for physicians and patients	2
9	Cost-effective personalized tool such as mobile phone apps	1
10	Designing a picture-based nutrition resource for carbohydrate counting of foods	2
11	Educational materials for patients	3
12	Educational programs that can improve understanding and use of nutrition labels	2
13	Elimination of extensive gap between knowledge and practice	1
14	Enjoying new foods and exercise	4
15	General and specialized nutrition knowledge	1
16	Greater confidence in ability to maintain a healthy dietary pattern	2
17	Greater health literacy requires for patient-centered care models	1
18	Having family support	1
19	Health care providers' perceptions of care responsibilities and resources related to reducing type 2 diabetes risk	1
20	Health policies of governments	10
21	Improve effectiveness of treatment through promoting the patient-physician relationship	1
22	Improved health outcomes with lower cost of care	1
23	Improve the nutrients intake and nutritional status of the population	3
24	Improved continuity of care and self-management	3
25	Improved information systems and income for patients	2
26	Improved health care services	11
27	Improving consumer ability to understand nutritional information	1
28	Improving food security in patients with diabetes	1
29	Improving nutrition literacy among physicians	1
30	Individual and cultural preferences	3
31	Interest in nutrition education	2
32	literacy demand and learning motivation	3
33	Plant-based dietary pattern by advancing culinary literacy	2
34	Positive attitudes	2
35	Positive feelings about their ability to control their diabetes	1
36	Proper implementation of nutritional intervention programs	8
37	Receiving nutrition education	2
38	Regular exercise by lifestyle skill acquisition	1
39	Self-efficacy related to managing diabetes and maintaining dietary changes	2
40	Social support and accessibility of financial funds	2
41	Specialized human support	1
42	Strategies for patient programs including culturally appropriate dietary counseling	3
43	Stress management, self-empowerment, create motivation	1
44	Sustainable lifestyle-based healthcare system	9
45	The access to optimal nutrition and health literacy	18
46	The community-based interventions in low-literate people	5
47	The cultural acceptability of the recommended diet by population subgroups such as racial/ethnic and immigrants minorities	2
48	The government needs to improve literacy rate of citizens	3
49	The need to improve a method of nutrition education both for the patients and their families	2

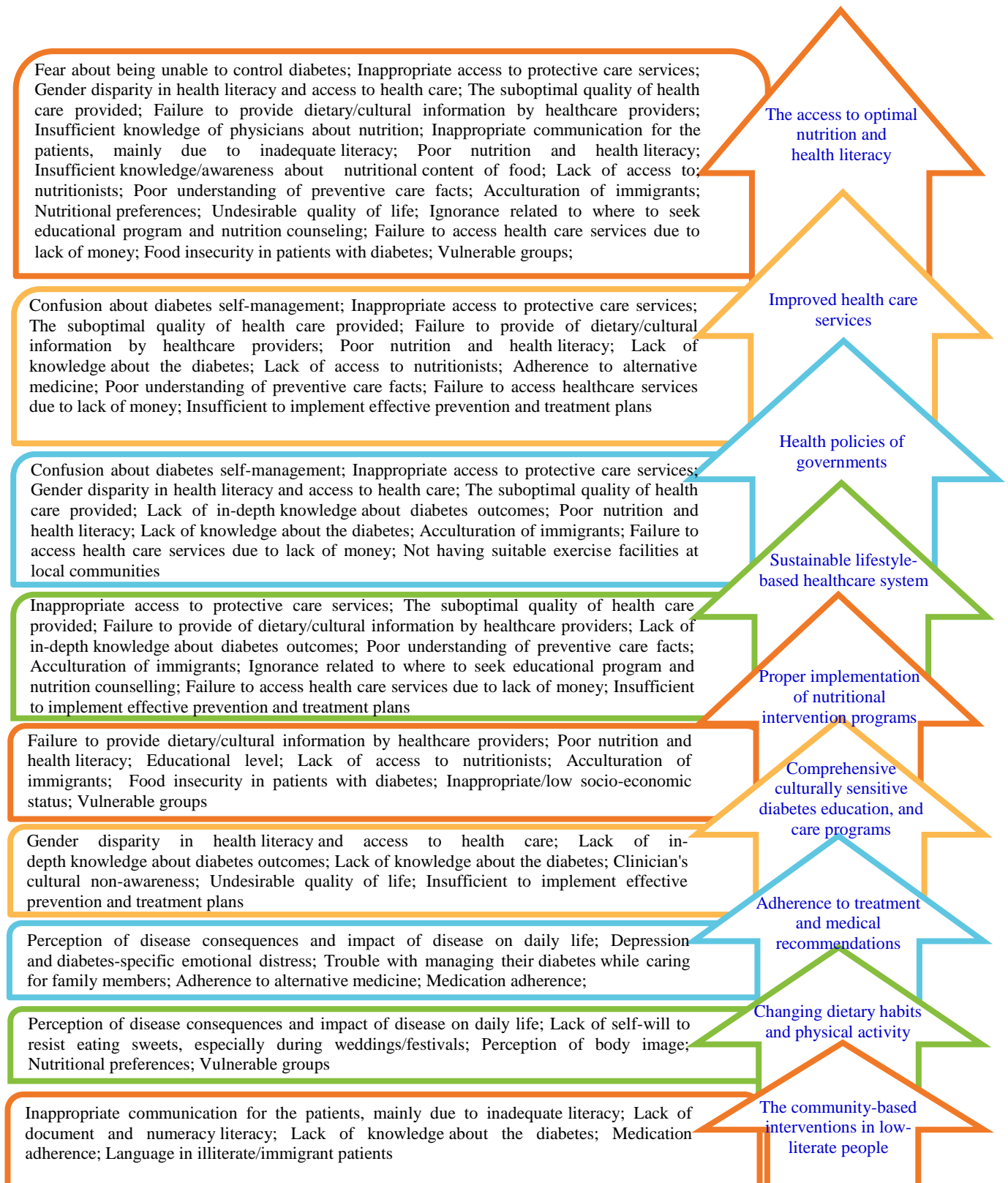


Figure 3. Summary of findings about implementation of solutions and synthesis of evidence. This figure summarizes a part of the findings from implementation of solutions and synthesis of evidence to eliminate barriers and limitations in order to reach “The access to optimal nutrition and health literacy” and optimal diabetes self-management.

Eventually, the cascade of barriers and limitations to obstacle diabetes self-management could inhibit through a cluster of tailored and appropriate solutions and opportunities. Therefore, [Figure 3](#) illustrated a summary of a part of the findings from implementation of solutions and synthesis of evidence to eliminate barriers and limitations in order to reach “The access to optimal nutrition and health literacy” and finally optimal diabetes self-management.

Discussion

Association between Nutritional Literacy and Diabetes Self-Management

Lower health literacy is significantly associated with less diabetes knowledge, higher HbA1c level, less self-management of glucose level, and less physical activity [44]. Diabetes knowledge is regarded as a mediator in the association between health literacy and glucose self-management. Therefore, higher health literacy may contribute to participation in intervention programs that promotes diabetes self-management [44]. Consequently, modification of the nutritional and health behaviors depends on increasing nutritional and health literacy in patients with diabetes by health care providers and physicians. One of the most important tasks of health care providers particularly nutritionists is the implementation of learning activities to increase nutritional literacy and awareness for patients with DM who have low literacy. Diabetes self-management activities must be directed to improve behaviors such as selecting healthy foods, identifying food restrictions and prohibitions, understanding serving sizes, planning a meal based on the exchange method, having appropriate dietary pattern adherence, and regulating the dietary intakes.

The perception of patients with type 2 DM about barriers to diabetes self-management were lack of awareness about the glycemic index. Furthermore, limited health literacy could augment the barriers to self-management of diabetes [28]. Hence, patients' understanding of the disease process and effects of the medication regimen, support from their family and community, as well as health policies set by the

governments, and offering improved health care services can influence diabetes self-management.

A cross-sectional study on the role of nutritional knowledge and the process of intentional behavior change toward glycemic control in 232 patients with type 2 DM revealed that low health literacy was significantly associated with poor glycemic control. Moreover, the researchers of this study found that increased nutritional knowledge significantly motivates patients to change their health behavior, which per se improved the outcome of glycemic control through interventions by encouraging diabetes self-management [45]. The results of a systematic review revealed that modifying communication and behavioral interventions to the individual health and numeracy literacy level may be an effective approach in improving the knowledge and determinants of disease management in selected clinical situations [46]. To measure general health literacy, several health literacy dimensions were conducted in 174 participants with DM [20]. Numeracy and document literacy were two dimensions that were identified as the factor structure of this survey required for assessing health literacy in greater detail for patients with type 2 DM [20]. In another research, six focus group discussions were carried out among patients with type 2 DM to determine whether barriers to diabetes awareness and self-help differed in South Asian participants of different demographic characteristics [47]. The illiterate and the literate groups reported language and non-specific information to their diet/culture which provided by healthcare providers were as the major barrier to improved diabetes awareness and self-help, respectively. Therefore, lack of culturally appropriate diabetes educational/awareness programs in the community and time limitation in most participants were among the major barriers, respectively [47]. The general aim of these interventions was to determine the effect of community-based or individual-based programs on the intensive lifestyle change by enhancing food and nutrition literacy. The aim was to establish a healthy plant-based dietary pattern, physical activity, and glycemic control self-

management.

Interventions that strengthen and support diabetes self-management of patients offered by health care providers should include mental health support, integrate formal and informal patient support, and nutritional literacy to alter dietary regimens of patients with diabetes for social interactions [11]. Capability of diabetes self-management is influenced by some factors which are different between controlled and uncontrolled patients with diabetes [11]. On the one hand, in spite of distinguishing healthy eating and nutrition knowledge, many patients with diabetes have poor regimen quality. On the other hand, according to some patients with DM despite appropriate family support for their health care, the financial burden of medication and healthy diet is a critical problem.

Variation in cultural practices, including dietary patterns, creates exclusive situations for patients with DM [31]. The role of family support is critical in maintenance of diabetes self-management. Integration of alternative medicine, such as Chinese herbal medicine together with modern medicine is one of the best cultural adapted strategies [31]. Barriers such as language, health literacy, and acculturation were all among exclusive aspects affecting cultural approaches to diabetes management in different regions and populations. It is important to understand such cultural determinants to improve outcomes of DM [31]. For example, there are multiple barriers to effective diabetes management in limited English immigrants compared to the general population. Non-English language speaking was one of the critical barriers in improving diabetes self-management, nutrition knowledge and literacy, and proper physical activity among this population.

Food insecurity was prevalent in a sample of patients with type 2 DM who were of low socio-economic status. Food insecurity was associated with low adherence to the recommended self-care behaviors such as appropriate diet and medication as well as poor glycemic control [48]. Food insecurity may worsen some cardio metabolic biomarkers such as glycosylated hemoglobin, diastolic blood pressure, low-density lipoprotein cholesterol (LDL-

C), and visceral obesity in type 2 diabetes. Improvement of food security in patients with DM may reduce cardiovascular diseases [25]. Nutrition interventions programs should emphasize a diversity of minimally processed nutrient-dense foods in appropriate serving sizes as part of a nutritious eating pattern and provide the individuals with DM with practical tools for planning daily food and behavior change that can be maintained over the long time [12]. The inappropriate quality of health care offered to the racial/ethnic minorities as vulnerable groups in society, results in worsening patient-related outcomes such as insufficient to implement effective prevention and treatment plans.

Principles of diabetes prevention programs for community minorities are similar to general diabetes prevention programs and rely on dietary pattern modification and increase in physical activity level [13]. In contrast to the general programs, these preventive interventions have much emphasis on nutritional literacy needs, cultural preferences as well as the language spoken by the minorities [13]. To meet nutritional requirements of the community minorities, dietary intervention programs must be designed based on the cultural framework and traditional foods with appropriate properties [49]. The nutrition educators must use a variety of tools and educational practices appropriate to the culture and literacy of ethnic/racial patients and their families [49]. The findings indicated the need to improve a nutrition education technique for patients and their families together with the government support to improve the literacy level of inhabitants [10]. Independent predictors of the good dietary practice were high education, having family support, and receiving nutrition education [10]. Social and motivational strategies to provide educational intervention programs are culturally sensitive to patients with low health literacy. Community awareness of diabetes is inadequate in most societies.

We need tools for translating information from traditional diabetes educational programs and related resources into effective self-care [50]. The content of these tools such as the Diabetes Literacy and Numeracy Education Toolkit (DLNET) was

designed for patients with lower literacy and numeracy skills and had special characteristics including simplicity of application by adhering to a lower text reading level and using photographs for key perceptions, and color-coding and other compatibilities to guide patients by self-care instructions [50]. Health care providers and clinical nutritionists can offer additional support by mobile phone apps, E-mail, web-based programs, and telephone. These methods can result in higher self-efficiency and confidence in patients' ability to manage their disease and maintaining the dietary changes.

An action research was carried out using qualitative methods to design pictographs for increasing the adherence in low literate and illiterate patients with diabetes mellitus [36]. In this study, the researchers designed some pictographs to help patients with diabetes. They concluded that pictographs might be beneficial and valuable for increasing the adherence in illiterate or low literate patients who had problems with written instructions [36]. A web-based diabetes education program is an educationally comprehensive and effective program in transferring educational interventions about diabetes management to both professionals and non-professionals [51]. Web access from non-clinic settings could also improve access to high-quality education for improving the knowledge level of all learners [51]. In a review of 17 randomized trials and cohort studies the effect of educational courses and web-based educational programs on improvement of understanding and using of nutrition labels was confirmed [21]. Acceptable nutritional literacy could be influenced by the capability of successfully different diabetes management dimensions. Poor or insufficient nutritional literacy results in reduced ability to prepare nutritious dietary patterns, take nutraceuticals properly, and interpret nutrition facts and nutrition texts.

The most important strength of the present study was to collect all fundamental and basic socioeconomic-cultural determinants as well as the effective limitations that influenced diabetes self-management in patients with DM. Furthermore, the

suggested solutions were included. However, our study had some limitations that should be considered. The most important limitation was application of two databases for exploring various determinants. We did not review clinical studies following an intervention that resulted in changes in weight, body mass index, glycemic control, lipid and lipoprotein profiles, and other clinical parameters. Our goal was to search for all of the underlying factors affecting diabetes self-management that improved all biochemical and clinical parameters of these patients.

In the future, studies should be designed to explore and distinguish the relationship between these various determinants in a global community to eliminate the deterioration outcomes and non-communicable diseases. The findings of our study provided strategies for public policymakers who play a key role in designing, planning, and administrating of practical training programs.

Conclusion

This critical review and research synthesis highlighted solutions/opportunities to eliminate fundamental and basic limitations that deteriorate diabetes self-management. In this regard, identifying and classifying barriers and limitations to obstacle diabetes self-management are critical advances in accomplishing interventions for different societies that can improve optimal outcomes in DM. However, well-designed nutrition literacy intervention programs and preventive procedures may ameliorate the health status in the patients with type 2 diabetes. Modifications in nutrition literacy along with food supply will contribute to the long-term positive effects on reducing the occurrence of non-communicable disease. Therefore, designing appropriate questionnaires based on the classified findings of this study is essential to identify the key limitations and barriers in each society that influence diabetes self-management.

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None

Author's Contributions

MRM contributed in conception of the original

idea, study design, data interpretation, offering models and research methodology. Furthermore, he drafted, revised, and approved the final version of the manuscript. NK helped in the methodology of the critical review and revised the draft, as well as approved the final version of the manuscript.

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Conflict of interest

The authors have declared no potential conflicts of interest.

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