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Community-Based Intervention for Type 2 Diabetes Management in Developing Countries: A Systematic Review

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Abstract

Type 2 Diabetes Mellitus (T2DM) poses a significant public health challenge, especially in developing countries with limited healthcare resources. There is a critical need for community-based interventions (CBIs) to promote healthy lifestyles for individuals with T2DM. This study explores CBIs to improve health behavior among T2DM patients in developing countries. It systematically reviews articles from PubMed, Scopus, CENTRAL, and CINAHL databases. The search strategy employed specific keywords following the PRISMA Extension for Systematic Reviews. The quality of the included articles was appraised using the Joanna Briggs Institute (JBI). A narrative synthesis summarized the key findings across the selected articles. The inclusion criteria were full-text primary research reporting randomized controlled trials (RCTs) conducted in developing countries, focusing on community-based interventions, and published between 2014 and 2023. A review of twelve articles, with sample sizes ranging from 54 to 12,140 participants, explored interventions such as exercise, empowerment, peer support, and web-based programs. These interventions showed significant effectiveness: six articles reported improvement in health behavior, two in medical adherence, three in physical activity, four in positive attitudes, and two in quality of life (QoL). Five articles reported a consistent trend toward reduced HbA1c levels. This review highlights the potential of CBIs as effective strategies for addressing the complex challenges of T2DM in developing countries. Community health nurses may play a pivotal role in implementing and leading these interventions, particularly those involving technology-based approaches, to enhance self-care practices and improve glycaemic outcomes among individuals with T2DM.

Keywords: community-based intervention, chronic disease, developing countries, healthy behavior, type 2 diabetes mellitus

Abstrak

Intervensi Berbasis Komunitas untuk Manajemen Pasien dengan Diabetes Mellitus Tipe 2 di Negara Berkembang: Tinjauan Sistematis. *Diabetes Mellitus Tipe 2 (DMT2*) *merupakan tantangan kesehatan yang signifikan, terutama di negara berkembang dengan sumber daya kesehatan yang terbatas. Intervensi berbasis komunitas sangat diperlukan untuk meningkatkan perilaku hidup sehat individu dengan DMT2. Tinjauan ini mengeksplorasi intervensi berbasis komunitas untuk meningkatkan perilaku kesehatan pasien* T2DM *di negara berkembang. Tinjauan literatur sistematis dilakukan menggunakan basis data* PubMed, Scopus, CENTRAL, *dan* CINAHL. *Strategi pencarian menggunakan kata kunci khusus mengikuti* PRISMA Extension *untuk Tinjauan Sistematis. Kualitas studi yang disertakan dinilai menggunakan* JBI. *Sintesis data menggunakan pendekatan naratif, merangkum temuan kunci dari studi yang masuk ke dalam kriteria penyertaan, yaitu merupakan penelitian utama* RCT *teks lengkap yang dilakukan di negara berkembang, berfokus pada intervensi berbasis komunitas, dan diterbitkan antara tahun 2014-2023. Tinjauan terhadap dua belas artikel, dengan ukuran sampel berkisar antara 54 hingga 12.140 peserta, mengeksplorasi intervensi seperti olahraga, pemberdayaan, dukungan sebaya, dan program berbasis web. Intervensi dalam studi-studi tersebut menunjukkan efektivitas yang signifikan, dengan enam artikel melaporkan peningkatan dalam perilaku kesehatan, dua artikel dalam kepatuhan medis, tiga artikel dalam aktivitas fisik, empat artikel dalam sikap positif, dan dua artikel dalam* QoL. *Selain itu, lima artikel melaporkan tren penurunan kadar HbA1c yang konsisten. Tinjauan ini menyoroti potensi intervensi*

berbasis komunitas sebagai strategi yang efektif untuk mengatasi tantangan kompleks dari DMT2 di negara berkembang. Perawat kesehatan masyarakat dapat berperan penting dalam melaksanakan dan menjadi garda depan intervensi ini, khususnya yang melibatkan pendekatan berbasis teknologi, guna meningkatkan praktik perawatan mandiri dan hasil glikemik pada individu dengan DMT2.

Kata Kunci: *diabetes melitus tipe 2, intervensi berbasis komunitas, negara berkembang, penyakit kronis, perilaku sehat*

Introduction

Type 2 diabetes mellitus (T2DM) has emerged as a critical global public health concern, with an increasing prevalence in developing countries (Ibrahim et al., 2016). In 2023, the World Health Organization (WHO) estimated that 463 million individuals worldwide were affected by diabetes, with approximately 79% of these cases occurring in low- and middle-income countries (WHO, 2024). These countries bear the substantial economic implications as approximately 80% of T2DM cases occur in these regions (Ibrahim et al., 2016), and projections indicate that this figure is expected to rise in the coming years (Salvatore et al., 2023). Notably, the burden of T2DM is exceptionally high in Africa, the Middle East, Southeast Asia, and Central America (International Diabetes Federation [IDF], 2021).

Managing T2DM demands sustained attention to multiple lifestyle factors, including adherence to medication, dietary regulation, and regular physical activity, to maintain optimal blood glucose levels and prevent complications (Sreedevi et al., 2017). However, the implementation of effective and equitable diabetes management strategies remains a significant challenge in many developing countries. For example, patients must still bear the full cost of medications, placing a considerable financial burden on individuals and families (Chow et al., 2018; Mohan et al., 2020). The prevalence of T2DM can also be attributed to a lack of awareness about healthcare resources and a fear of medical interventions, which is due to low income and educational background (Unnikrishnan et al., 2018). Inadequate information about diabetes and unhealthy lifestyles (Aung et al., 2018) contributes to failure in achieving optimal diabetes management and preventing complications (Karachaliou et al., 2020).

Amid these challenges, community-based interventions (CBIs) have emerged as a promising strategy to address the gaps in diabetes prevention and management in resource-limited settings. These interventions offer cost-effective, culturally appropriate solutions that can be delivered through local networks and infrastructure (Ibrahim et al., 2016). The resource-efficient and practical interventions often involve educationnal programs targeting lifestyle changes within the community (Shirinzadeh et al., 2019). When effectively implemented, such strategies can reduce disease prevalence over the long term and improve health outcomes across entire populations (Dunkley et al., 2014; Shirinzadeh et al., 2019).

Although previous systematic reviews have examined CBIs for supporting individuals with T2DM, evidence on their effectiveness in developing countries remains lacking. To the best of our knowledge, this is the first systematic review to focus specifically on enhancing healthy lifestyle behavior through CBIs in developing countries. Previous reviews have primarily examined interventions conducted in developed countries (Modesti et al., 2016) and the migrant population in industrialized countries (Rawal et al., 2023). However, developing countries often have strong community-oriented cultures (Rawal et al., 2023), highlighting the need for evidence on CBIs tailored to these contexts. Such interventions have the potential to generate benefits to the community level. Accordingly, this systematic review aims to synthesize existing research to support the development of more

effective CBIs for individuals living with T2DM in developing countries.

Methods

Study Design. This study adopts systematic review design, primarily emphasizing RCTs. The review has been registered with PROSPERO (registration number: CRD42024507143).

Search Strategy. The search strategy for this study followed the PRISMA guideline (Page et al., 2021; Tricco et al., 2018). The guiding research question was: What are the effectiveness and characteristics of CBIs to improve health behaviour in patients with T2DM in developing countries? An extensive search was conducted to identify eligible studies using specific search strings and keywords in four major online databases: PubMed, Scopus, CINAHL, and CENTRAL. The keyword adjusts the Medical Subject Headings (MeSH) term using a Boolean operator, including "AND" and "OR" were used to refine the search string. For example, the search strategy in PubMed was: ("Community-Based Participatory Research" [MeSH] OR "Community participation" [MeSH] OR "Community intervention" OR "Community implementation" OR "Community action" OR "Community development" OR "Community involvement") AND ("Health Behavior" [MeSH] OR "Healthy lifestyle" OR "Lifestyle" OR "Health-related behavior") AND ("Diabetes Mellitus, Type 2"[MeSH] OR "Type 2 diabetes" OR "Noninsulin-dependent diabetes mellitus").

Eligibility Criteria. The inclusion criteria were studies published in English within the past ten years (January 2014 to December 2023), full-text, peer-reviewed articles, reporting studies conducted in developing countries and involving interventions utilizing community-based approaches. Two independent reviewers (LL and IJW) screened the titles and abstracts. Full-text articles were then retrieved and evaluated against predefined eligibility criteria. The exclusion criteria were studies that did not focus on CBIs to improve healthy behaviors. The study selection process was conducted and reported following the PRISMA 2020 guidelines (Figure 1).

The criteria for this study were measured using the PICO framework, which includes: 1) Population: Adult patients aged 18 years and older, diagnosed with T2DM; 2) Intervention: Community-based interventions; 3) Comparison: Usual care; 4) Outcome: The primary outcome focused on improving healthy behaviors in patient with T2DM, including increased medication adherence, enhanced physical activity, positive attitude, improved quality of life (QoL), and decreased HbA1c levels.

Data Extraction. After reviewing the full-text articles, two authors (AZ and FW) independently performed the data extraction. Any discrepancies were resolved by the third author (LL). Data were extracted based on the following criteria: 1) general information, including author(s), title and the year and country of publication; 2) study characteristics; 3) intervention and setting; and 4) outcome data consisting of baseline and follow-up measures. The extraction table was designed to clearly present the review findings.

Quality Appraisal. The quality of the included studies was assessed using the JBI critical appraisal tool, which evaluates the quality of published studies. The JBI checklist was used with permission from The University of Adelaide (Moola et al., 2020). The JBI criteria were adapted to align with the Cochrane RoB and ROBINS standards. The assessment criteria were scored as "yes," "no," "unclear," and "not applicable," with a "yes" receiving 1 point and all other responses receiving 0 points. The total score was calculated to determine each article's overall eligibility.

To be included in the review, studies were required to score above 75%, ensuring the inclusion of only methodologically robust articles. Visual representations of these assessments were generated using Robvis, a web application designed to visualize risk-of-bias assessments

within systematic reviews. Robvis produced "traffic light" plots showing domain-level judgments for each study and weighted bar plots illustrating the distribution of risk-of-bias judgments across different bias domains.

Data Analysis. The full text of the selected articles was analyzed by all authors. A descriptive analysis method was employed. The findings were organized into manual tables following an in-depth analysis of the full texts. The authors then provided a comprehensive description of the systematic review results, allowing for comparison with prior studies. Various interventions were identified, categorized based on their similarities, and discussed accordingly.

Results

Article Identification and Screening. The initial search identified a total of 5,706 articles. After removing duplicates, 5,382 articles remained. Title and abstract screening narrowed this number to 64 articles for closer examination. Following a full-text review, 12 articles were selected for further analysis and underwent rigorous assessment using the JBI critical appraisal tool.

Risk of Bias. The risk of bias evaluation, presented in Figure 2, used the JBI tool to classify studies into three groups. Ten studies scored above 70%, indicating high quality, while two studies scored between 60% and 70% (Maslakpak et al., 2017; Ramadas et al., 2018), indicating medium quality (Rahardian et al., 2024).

Study Characteristics. Table 1 highlighted that the included studies have a comprehensive geographic coverage, encompassing several countries: India (n = 2), Iran (n = 2), Malaysia (n = 2), Indonesia (n = 1), Bangladesh (n = 1), South

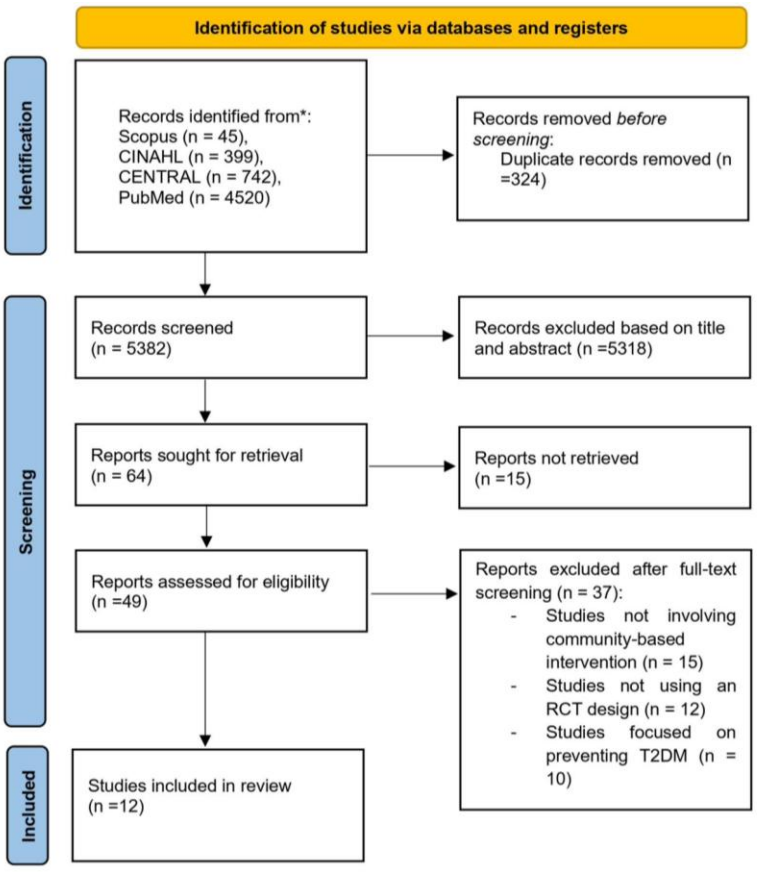

Figure 1. PRISMA Flow Chart for Study

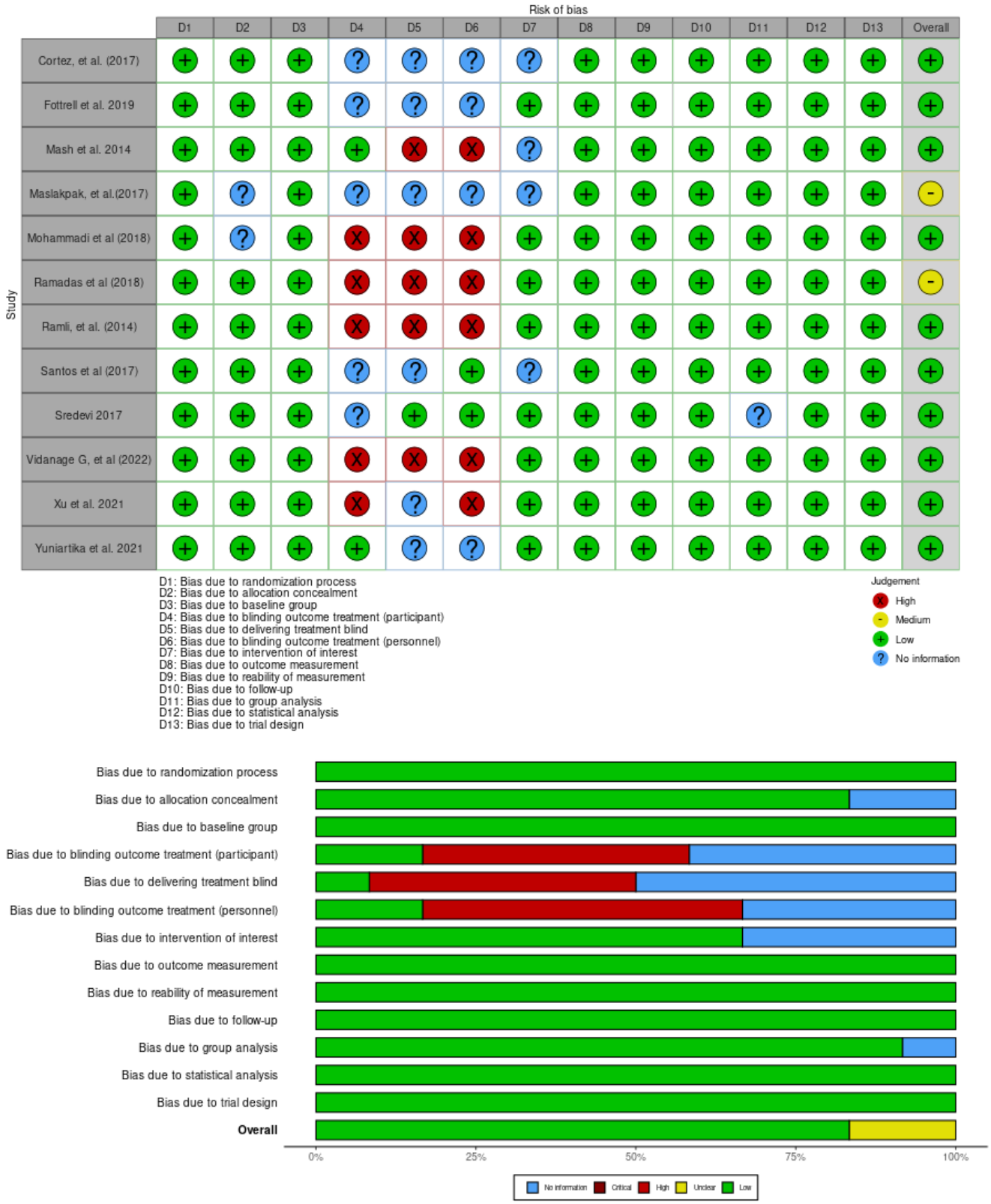

Figure 2. Quality Appraisal Visualization of Included Studies

Table 1. Characteristics of Included Studies

Author	Location	Design	Age	Gender (%)	Sample
Cortez et al. (2017)	Brazil	RCT	C: 57.5 ± 9.7 years I: 58 ± 9.2 years	CG M: 38 (34.2) F: 73 (65.8) IG M: 42 (33.1) F: 85 (66.9)	238
Fottrell et al. (2019)	Bangladesh	RCT	mHealth 30–39: 1329 (33%) 40–49: 1068 (26%) 50–59: 765 (19%) 60–69: 659 (16%) 70–100: 250 (6%) PLA 30–39: 1388 (35%) 40–49: 992 (25%) 50–59: 761 (19%) 60–69: 610 (15%) 70–100: 270 (7%) Control 30–39: 1391 (34%) 40–49: 991 (24%) 50–59: 767 (19%) 60–69: 648 (16%) 70–100: 251 (6%)	mHealth M: 1845 (45) F: 2226 (55) PLA M: 1889 (47) F: 2132 (53) C M: 1950 (48) F: 2098 (52)	12.280
Mash et al. (2014)	South Africa	RCT	C: 56.4 I: 55.8	CG M: 209 F: 650 IG M: 202 F: 508	1570
Maslakpak et al. (2017)	Iran	RCT	C: 50.6± 3.74 Face to Face Group: 49.9 ± 4.98 Telephone Group: 49.46 ± 4.76	CG M: 19 (36.7) F: 11 (63.3) Face to Face Group M: 15 (50) F: 15 (50) Telephone Group M: 17 (56.7) F: 13 (43.3)	90
Mohammadi et al. (2018)	Iran	RCT	30-50 years C: 46 (46%) I: 45 (45%) 51- 65 years C: 54 (54%) I: 55 (55%)	NA	200

Author	Location	Design	Age	Gender (%)	Sample
Ramadas et al. (2018)	Malaysia	RCT	C: 49.6 years I: 51.5 years	CG M: 47 (75.8) F: 15 (24.2) IG M: 41 (62.1) F: 25 (37.9)	128
Ramli et al. (2014)	Malaysia	RCT	C: 57± 0.5years I: 58 ± 0.48years	CG M: 149 (35.7) F: 268 (64.3) IG M: 180 (38.2) F: 291 (61.8)	888
Santos et al. (2017)	Brazil	RCT	57.8 ± 9.4	M: 80 (33.6) F: 158 (66.4)	238
Sreedevi et al. (2017)	India	RCT	C: 51.92 ± 6.57 Yoga: 51.97 ± 7.4 Peer Support: 51.92 ± 8.32	F: 124 (100)	124
Vidanage et al. (2022)	India	RCT	I: 53.20 ± 6.38 years C: 54.70 ± 5.41 years	CG M: 32 (42.6) F: 43 (57.4) IG M: 33 (44) F: 42 (56)	150
Xu et al. (2021)	China	RCT	I: 63.81 ± 9.94 C: 62.91 ± 9.59	CG M: 218 (35.68) F: 393 (64.32) IG M: 186 (31.16) F: 411 (68.84)	1208
Yuniartika et al. (2021)	Indonesia	RCT	Walking 40-50: 2 (11.1) 51-60: 5 (27.8) 61-70: 7 (38.9) >71: 4 (22.2) Yoga 40-50: 8 (44.4) 51-60: 8 (44.4) 61-70: 2 (11.1) >71: 0 C: Yoga 40-50: 8 (44.4) 51-60: 9 (50) 61-70: 1 (5.6) >71: 0	Yoga M: 7 (38.9) F: 11 (61.1) Walking group M: 5 (27.8) F: 13 (72.2) C: M: 8 (44.4) F: 10 (55.6)	54

Abbreviations: C, Control; I, Intervention; F, Female; M, Male; CG, Control group, IG, intervention group

Africa (n = 1), China (n = 1), and Brazil (n = 2). The mean age of study participants ranged from 45 to 58 years, with most studies reporting a mean age of 53.17 years or older. Sample sizes varied from 90 to 12,140 participants, with an average of 1,275 respondents. The synthesis of findings, presented in Table 2, shows the predominant features of the studies. Notably, most of the research (n = 10) is concentrated in Asia, with a significant prevalence of offline interventional methods (n = 8). Furthermore, a substantial portion of the studies are conducted within hospital or clinic settings (n = 6), while others take place in community settings (n = 5).

Synthesis of Findings. Intervention models and outcomes of RCT studies are outlined in Table 3. The outcomes of each study are further classified into four groups, as detailed below:

Empowerment. The EMPOWER intervention demonstrated that a comprehensive year-long intervention could significantly lower HbA1c levels and enhance patient self-care practices in managing blood glucose (Ramli et al., 2014). Cortez et al. (2017) highlighted that a 12-month empowerment program significantly improved self-care behaviors, including dietary habits and physical activity, leading to better metabolic control. This study reported notable improvements in key health metrics such as HbA1c, total cholesterol, HDL, and LDL, underscoring the effectiveness of structured empowerment programs in chronic disease management.

Technology-Based Interventions. Maslakpak et al. (2017) showed that face-to-face and telephone-based education over three months enhanced self-care behaviors such as diet, exercise, blood glucose monitoring, and medication adherence, with comparable efficacy for telephone-based education. Ramadas et al. (2018) reported that a six-month web-based intervention improved dietary knowledge, behaviors, and glycemic control, with significant reductions in fasting blood glucose and HbA1c.

Exercise Interventions. Sreedevi et al. (2017) highlighted that three month of yoga and peer support improved QoL in women with T2DM. Yuniartika et al. (2021) confirmed that both yoga and walking therapies significantly reduced fasting glucose levels over 12 weeks. Vidanage et al. (2022) found that aerobic exercises enhanced taste sensitivity and reduced preference for sweet taste, aiding glycemic control.

Health Education and Peer Support Interventions. Santos et al. (2017) showed that education strategies and home visits over a year improved medication adherence, self-care, and empowerment. Mohammadi et al. (2018) reported that self-efficacy education over three months improved knowledge and QoL in T2DM

Table 2. Summary of Findings

Domain	Number of Studies	n	%
Design			
RCT	12	18.591	100
Location			
South America	1	238	1.2
Asia	10	16.783	90.2
Africa	1	1570	8.6
Intervention model			
Online	1	128	8
Offline	8	1813	11.5
Online and Offline	3	13.818	87.6
Setting			
Home	1	238	1.2
Hospital/Clinic	6	1793	9.6
Community	5	16.560	89.2

patients. In contrast, Mash et al. (2014) found no significant improvement in primary outcomes, except for reductions in blood pressure. Xu et al. (2021) demonstrated that group cognitive behavioral therapy significantly reduced anxiety and depression scores over a year. Fottrell et al. (2019) reported that PLA interventions reduced T2DM prevalence by 48%, while mHealth interventions improved knowledge but had no significant impact on disease outcomes.

Table 3. Intervention Models and Outcomes of RCT Studies

Author	Intervention	Number of Sessions	Follow-up	Duration	Instruments	Findings
Cortez et al. (2017)	Empowerment program for self-care	• pre- education • sensibilization • myths and facts • attitudes and self-care • post education test • laboratory examination	1 month after session 1 Follow-ups at 3-month intervals × 3 1 months after follow-up 3	a year	The questionnaire that evaluates knowledge (DKN), The questionnaire about user attitudes (ATT)	Self-care practices (eating habits and physical activity) and metabolic control improved in IG. (HbA1c 7.5% vs 8.1%; TC 171.5 vs 180.8; HDL 46.2 vs 47.5; LDL 89.6 vs 95.9) with $p < 0.001$.
Fottrell et al. (2019)	Participatory learning and action (PLA) through mHealth	3 (mHealth Intervention, PLA Intervention, Follow up)	18 months	2 Years	N/A	The PLA intervention reduced the prevalence of type 2 diabetes by 48% compared to the CG (305 [8%] of 3,757 vs. 493 [13%] of 3,821; adjusted odds ratio [stratified by cluster and wealth design] 0.52, 95% CI: 0.38–0.71; $p < 0.0001$).
Mash et al. (2014)	Group diabetes education	4 monthly sessions	1 follow up after 12 months	4 months	• questionnaires on self-efficacy • locus of control • self-care activities and QoL	No significant improvements were found in any of the primary or secondary outcomes, except for a significant reduction in mean systolic blood pressure (-4.65 mmHg, 95% CI: 9.18 to -0.12; P = 0.04) and diastolic blood pressure (-3.30 mmHg, 95% CI: -5.35 to -1.26; P = 0.002).
Maslakpak et al. (2017)	Face-to-face and Telephone-Based Family-Oriented Education on Self-Care Behavior	• education, • intervention • follow up	Twice a week in the first and second months and once a week in the third month	3 months	Summary of Diabetes Self-Care Activities (SDSCA)	Lest cost intervention and improving diet (I: 30.5 ± 9.59 vs C: 12.96 ± 6.91). Exercises (I: 10.73 ± 2.71 vs C: 3.8 ± 3.18)

Author	Intervention	Number of Sessions	Follow-up	Duration	Instruments	Findings
						Blood glucose monitor (I: 8.63 ± 3.46 vs C: 74 ± 1). Foot ulcer prevention (I: 29.93 ± 5.28 vs C: 11.23 ± 8.5). Medication adherence (I: 21 ± 0.001 vs C: 20.46 ± 2.92) significantly different with CG ($p < 0.001$).
Mohammadi et al. (2018)	Self-Efficacy Education	• educational intervention • post-intervention follow-up	Visit to determine the progress of the participants	3 months	Coalition and Diabetes Knowledge Questionnaire (DKQ-24) The Diabetes Quality of Life (DQOL)	Increasing knowledge, health beliefs, and QoL the in IG significantly different with CG. (I: 29.8 ± 2.81 vs C: 22.3 ± 5.91; $p < 0.001$).
Ramadas et al. (2018)	Web-based dietary intervention, health cognitions, and glycaemic control	• education • intervention • post-intervention evaluation	Followed-up with text messages	6 months	International Physical Activity Questionnaire (IPAQ) Dietary Knowledge, Attitude and Behaviour Questionnaire (DKAB-Q)	Significant improvements were seen in DKAB scores (11.1 ± 0.9 vs. 6.5 ± 9.4, $p < 0.001$), Dietary Stages of Change (DSOC) (199.7 ± 18.2 vs. 193.3 ± 14.6, $p = 0.046$), fasting blood glucose (FBG) (7.9 ± 2.5 vs. 8.9 ± 3.9 mmol/L, $p = 0.015$), and HbA1c levels (8.5 ± 1.8% vs. 9.1 ± 2.0%, $p = 0.004$).
Ramli et al. (2014)	EMPOWER Participatory Action Research	• briefing • Intervention • follow up	In the last a year	a year	The site feasibility questionnaire (SFQ)	HbA1C in the IG was found to be lower and improved patient self-care practices to control their blood glucose (I: 8.4% vs C: 8.5%).
Santos et al. (2017)	Education group strategies and home visits	• pre-education • education intervention • post-education	Phone monitoring	a year	Diabetes Empowerment Scale-Short Form (DES-SF)	Both the education group and home visits significantly improved medication adherence, self-care management, and empowerment compared to the CG (Education: 4.25, Home Visits: 4.13, Control: 4.0).

Author	Intervention	Number of Sessions	Follow-up	Duration	Instruments	Findings
Sreedevi et al. (2017)	Yoga and Peer support	• yoga intervention • peer-support intervention follow-up	Every week followed by a phone call	3 months	N/A	The peer support group showed significant increases in social and environmental QOL, with improvements of 7.69 (P = 0.014) and 4.07 (P = 0.019).
Vidanage et al. (2022)	Aerobic exercises and taste perception	• aerobic intervention • taste perception • follow up	Tele-Phone reminders in the second week of each month.	6 months	Labelled Magnitude Scale (LMS)	An increase in taste sensitivity, particularly to sucrose, and a decreased preference for sweet taste were observed in patients with diabetes at 3 months (mean difference for 2.02M: 6.63 ± 2.50, p = 0.048; for 0.64M: +7.26 ± 2.76, p = 0.026) and at 6 months (mean difference for 0.64M: +7.79 ± 4.49, p = 0.044).
Xu et al. (2021)	Group Cognitive Behavioral Therapy	10 Sessions in 10 consecutive days and each session lasted 40-50 minutes + 10 to 15 minutes discussion	Every 3 months	a year	Patient Health Questionnaire-9 [PHQ-9] General Anxiety Disorder questionnaire (GAD-7)	The IG showed significantly greater improvement in GAD-7 and PHQ-9 scores compared to the control group at 2 months post-baseline (GAD-7: T = −6.46, p < 0.0001; PHQ-9: T = −5.29, p < 0.001), 6 months (GAD-7: T = −4.58, p < 0.001; PHQ-9: T = −4.37, p < 0.001), and 1 year post-intervention (GAD-7: T = −3.91, p < 0.001; PHQ-9: T = −3.57, p < 0.001).
Yuniartika et al. (2021)	Yoga therapy and walking therapy	Yoga: 3 sessions/week, 60 minutes each, for 12 weeks. Walking Therapy: 3 sessions/week, 30 minutes each, for 12 weeks.	A checklist of activities and motivated by health cadres each week	3 months	N/A	Both Yoga and Walking therapies significantly reduced fasting glucose levels. Yoga group: 217.00 to 187.72 (p = 0.001). Walking group: 209.89 to 193.83 (p = 0.001). Control group: 221.50 to 225.17 (p = 0.067).

Abbreviations: CG, Control Group; IG, Intervention Group; EG, Educational Groups; HV, Home Visits

Discussion

This systematic review examined the effectiveness of CBIs in managing T2DM in developing countries. The interventions, including empowerment (Cortez et al., 2017; Ramli et al., 2014), health education (Mash et al., 2014; Maslakpak et al., 2017; Santos et al., 2017; Widayanti et al., 2021), web-based programs (Fottrell et al., 2019; Maslakpak et al., 2017; Ramadas et al., 2018), psychological interventions (Xu et al., 2021), and exercises (Sreedevi et al., 2017; Vidanage et al., 2022; Yuniartika et al., 2021), significantly improve health behaviors and self-management among T2DM patients. These findings are aligned with previous studies demonstrating the benefits of empowerment programs in improving metabolic control and better self-care practices (Cortez et al., 2017; Ramli et al., 2014). Empowerment is crucial in resource-limited settings, where scarce healthcare resources require patients to take a more proactive role in managing their conditions.

In contrast, some studies reported less success with group-based diabetes education. Mash et al. (2014) observed only modest improvements in self-management behaviors compared to other educational interventions that yielded more favorable outcomes (Mohammadi et al., 2018; Santos et al., 2017). This discrepancy may stem from variations in delivery methods or cultural barriers that affect patient engagement, highlighting the need for flexible interventions tailored to cultural and contextual factors of the target population.

Technology-based interventions showed mixed results. Ramadas et al. (2018) demonstrated that web-based programs significantly improved dietary knowledge and glycemic control, consistent with findings from other studies (Bretschneider et al., 2023; Stevens et al., 2022). However, Fottrell et al. (2019) reported that mobile health (mHealth) interventions, while effective in spreading information, had less impact on clinical outcomes such as glycemic control. This suggests that although technology offers significant potential, its effectiveness may be influenced by factors such as digital literacy, internet accessibility, and the chosen intervention platform.

Exercise interventions consistently showed positive outcomes across studies. Both Sreedevi et al. (2017) and Yuniartika et al. (2021) found that structured exercise programs, such as yoga and walking, significantly improved glycemic control and overall health. Additionally, Vidanage et al. (2022) reported improvements in taste sensitivity and a reduced preference for sweet tastes in patients following aerobic exercise. These findings underscore the vital role of physical activity in managing diabetes, particularly in community settings where exercise programs can be offered at low cost and adapted to local cultural practices.

The findings have important implications for healthcare strategies, especially in developing countries. Community-based interventions, particularly those focusing on empowerment and education, should be prioritized in managing T2DM. These interventions not only lead to improved patient outcomes but also reduce healthcare costs and empower individuals to take control of their health. Moreover, incurporating culturally relevant approaches enhances the effectiveness of interventions (Rawal et al., 2023; Xu et al., 2021). Based on our analysis, technology-based interventions such as mHealth and phone-based monitoring demonstrated consistent outcomes in improving T2DM management. These interventions are particularly effective in developing countries as they are scalable, cost-efficient, and capable of reaching individuals in remote or underserved areas with limited access to healthcare facilities (Ebekozien et al., 2024).

However, this review also highlights several limitations. The variability in intervention types, duration, and delivery methods across studies may limit the generalizability of the findings. Additionally, some studies relied on self-re-

ported health behaviors, which could introduce bias. Lastly, the review focused exclusively on developing countries, and the findings may not apply to other settings, such as high-income countries with different healthcare infrastructures. Future research should investigate the long-term effects of these interventions and assess their applicability in diverse populations and settings.

Conclusion

CBIs have proven effective in enhancing health behaviors among individuals with T2DM in developing countries. These interventions, such as empowerment programs, structured health education, psychological support, web-based platforms, and physical activity, contribute to better medication adherence, increased physical activity, improved attitudes, enhanced QoL, and reduced HbA1c levels. Among these, interventions centered on empowerment and structureed education, and technology-based interventions have consistently demonstrated significant improvements in self-care practices and metabolic control, making them vital components of diabetes management strategies. Future systematic reviews may benefit from employing meta-analysis to quantitatively evaluate intervention effectiveness. Such analyses would offer clearer insights into which strategies are most effective in promoting healthy lifestyle behaviors and achieving glycemic control among individuals with T2DM in developing countries.

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