SYSTEMATIC REVIEW

Interventions to Prevent Diabetes in Latin America: A Systematic Review of the Literature

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BACKGROUND | More than 40 million people living in Latin America have been diagnosed with diabetes, and this number is expected to increase. As the risk of diabetes and diabetes mortality increases, diabetes interventions tailored specifically for individuals in Latin America are essential.

PURPOSE | To identify components of diabetes interventions that effectively reduce diabetes risk to inform interventions for Latin American populations.

DATA SOURCES | Systematic review of PubMed, CINAHL, LILACS, and Web of Science was performed from 2013 to 2025.

STUDY SELECTION | Studies testing interventions to prevent diabetes in Latin America were included. Studies were assessed for bias using the Critical Appraisal Skills Programme.

DATA EXTRACTION | Intervention elements and outcomes, including HbA_{1c} and other obesity markers, were collected. No pooling of findings was possible.

DATA SYNTHESIS | The analysis included 11 articles. The majority significantly reduced the risk of diabetes, as assessed by markers including HbA_{1c}, glucose, weight, and BMI. Studies that included multiple aspects, including diet, exercise, and lifestyle education, were more likely to report significant changes.

LIMITATIONS | Studies that did not contain the keywords used for the search or were indexed only in other databases may have been missed. Heterogeneity of study interventions and outcomes prevented a quantitative synthesis of effect sizes. Half of the included studies did not test interventions against a control or comparison group, limiting conclusions about their effectiveness.

CONCLUSIONS | Although more rigorous studies are needed, interventions with interdisciplinary teams and multiple phases can potentially reduce diabetes risk. Interventions that follow participants for an extended period may be more successful over the long term.

More than 40 million people living in Latin America have been diagnosed with diabetes (1). Although rates of diabetes vary from 5% in Ecuador to 13% in Guatemala, its overall prevalence has increased in the past decade and is expected to continue to do so (2). Indeed, diabetes prevalence may be underestimated because of limited access to health care or screening services. An estimated 35–50% of individuals with diabetes in Latin America are undiagnosed (1).

Lifestyle changes and medication for glucose intolerance can reduce the risk of diabetes (3). Diabetes prevention interventions for individuals typically follow those of the Diabetes Prevention Program (DPP) research study, which was published in 2002 and updated in 2015 (4,5). These cost-effective interventions have been designed to improve health outcomes significantly. Public health policy changes, such as sugar taxes, have shown mixed results, although most have had positive effects on diabetes risk

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(3). Nevertheless, many studies of interventions to reduce the risk of diabetes have been conducted in higher-income countries, and their findings may not be transferable to Latin American countries, where individuals may have fewer resources or less access to medications (6).

In 2024, the Centers for Disease Control and Prevention (CDC) issued an updated evidence-based National DPP lifestyle change program curriculum based on the original DPP research study and its follow-up studies (7). The National DPP curriculum materials include guidance on when to present each intervention topic, as well as educational handouts. Topics include nutrition, exercise, coping with stress, and sleep. All components are available in Spanish and are accessible free of charge. In a 2017 review of results for 14,747 U.S. participants in the first 4 years of the National DPP, Ely et al. (8) reported that participants lost a mean 3.1% of their weight and increased their regular exercise; only 35% of participants achieved the program's goal of 5% weight loss. This modest weight loss may not be sufficient to significantly decrease the risk of developing diabetes.

In a 2022 systematic review, Carrillo-Larco et al. (9) investigated risk scores for type 2 diabetes in Latin America. The most common predictors of type 2 diabetes were higher age, greater waist circumference, and family history. Laboratory tests to assess glycemic control, such as fasting blood glucose (FBG) or 2-h postprandial glucose, were less frequently used in the studies reviewed. In a subsequent systematic review by Carrillo-Larco et al. (10), the estimated risk of mortality among people with type 2 diabetes in Latin America was indicated by a pooled relative risk of 2.49 for all-cause mortality. In a scoping review of diabetes prevention programs in Latin America, Heisler et al. (11) discussed health policies encouraging diet changes and five interventions that included health professional-led, face-to-face behavioral counseling sessions. The findings of this review, which was conducted almost 10 years ago, were inconclusive, and the authors stated that more rigorous research was needed to inform effective interventions.

It is timely to update the review of literature to include articles reporting on tailored interventions for diabetes in Latin America in the past 10 years. In this systematic review, we identified components of diabetes interventions that effectively reduce the risk of developing diabetes for people in Latin American countries.

Research Design and Methods

This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement for design, conduct, and reporting (12). In February 2025, the PubMed, CINAHL, LILACS, and Web of Science databases were searched. Keywords, including prediabetes, Latin American countries, weight loss, diet, and exercise, were used in combination with MeSH (Medical Subject Headings) terms and specific modifiers.

Publications included for review were peer-reviewed studies of primary empirical diabetes prevention interventions, published in any language, conducted in Latin America, and including participants with prediabetes and outcomes pertinent to diabetes risk reduction (e.g., weight loss, lower glucose levels, and increased exercise). Studies written in English, Spanish, and Portuguese were included. Protocol studies, measurement testing studies, gray literature (e.g., preprints and dissertations), opinion articles, and studies solely focused on diabetes management rather than prevention were excluded. Studies were also excluded if they reported findings using qualitative data. An ancestry search was conducted by hand-searching the references of relevant reviews and selected studies to identify additional studies that might have been missed in the electronic search.

The Covidence online software platform for systematic reviews (https://www.covidence.org) was used to facilitate screening and full-text review of the articles. Results from the database searches were entered into Covidence, and duplicates were removed. The titles and abstracts of unique studies were then screened against the inclusion and exclusion criteria by at least one team member. The full text of the remaining studies was screened by at least two team members. If there was a disagreement regarding inclusion, the team met and reached consensus.

Data for each study, including sample characteristics, interventions, and diabetes self-management outcomes, were extracted and presented in Table 1. Study information included authors, year of publication, purpose(s), study design, and study setting. Information about the sample included the sample size and participants' age, sex, and race and ethnicity. Intervention information included components, control conditions, duration, and professions of the interventionists. Two team members checked the accuracy of these extractions. Table 1 summarizes the characteristics of the included studies (13–23). The studies were compared and contrasted based on results, identifying standard variables that may have contributed to positive or negative findings. Educational elements were presented in Table 3 to provide greater detail on the topics. It was not possible to pool results because of the heterogeneity of study findings and intervention elements.

Quality Assessment

The Critical Appraisal Skills Programme tool for randomized controlled trials (RCTs), which includes 11 questions about methodology and risk for bias, was used to assess the quality of each study (24). Each question in this tool was answered with "yes," "no," or "can't tell" (Table 2), and discrepancies were discussed among the team. Each study was given a summative total score.

TABLE 1 Characteristics of included studies

First author, year, reference no.	Design, location, and setting	Data collection time points	Participant no. and characteristics	Intervention, control condition, and interventionists	Results
Armenta-Guirado, 2019 (19)	Design: quasi-experimental Location: Mexico Setting: five urban public clinics	Baseline and 6 and 12 months	*N* = 133; age 45.8 years, female sex 52.3%, mean BMI 34.4 ± 5.4 kg/m^2, mean HbA_{1c} NR, blood glucose 90.5 ± 16.5 mg/dL	Intervention: first 3.5 months, weekly group meetings with a Lifestyle Balance behavior change protocol; months 3.5–6, biweekly meetings in group session with a nutritional consultation; months 6–12, group sessions with a nutritional consultation each month. Interventionists: primary care physicians and certified nutritionists	Significant mean reduction in weight of −4.4 kg at all sites at 6 months ($P < 0.05$)
Barengo, 2019 (21)	Design: RCT Location: Columbia Setting: urban area, Juan Mina and Barranquilla, northern Colombia	Baseline and 24 months	*N* = 390; age 52.84 years, female sex NR, BMI >30 kg/m^2, HbA_{1c} NR, blood glucose 100.1 mg/dL	Intervention: tailored program including 6 months of nutrition training, 6 months of exercise, and 12 months of both Control: usual treatment Interventionist: nutritionist and physical activity specialist	No significant change in FBG among the three groups at 24 months
Castro-Juarez, 2020 (18)	Design: one-group pilot Location: Sonora, Mexico Setting: rural community	Baseline, 6 months, and 1 year	*N* = 93; age 39.5 ± 11.2 years, female sex 75 (80.6%), male sex 18 (19.4%), obesity 65 (69%), BMI 33.2 ± 5.2 kg/m^2, blood glucose 109.6 mg/dL, HbA_{1c} NR	Intervention: National DDP adapted for the Yaquis community; phase 1 was 16 weekly group sessions on diabetes education, and phase 2 was 6 monthly sessions reinforcing previous education Control: NA Interventionists: lifestyle coaches with a bachelor's or master's degree in nutrition	Significant reduction in biomarkers of insulin resistance in the obesity group ($P < 0.05$)
Durán, 2021 (17)	Design: pilot Location: Ecuador Setting: urban area, Pontifical Catholic University of Ecuador	Baseline and 6 months	*N* = 33; age 41–66 years, female sex 70%, male sex 30%, mean weight 71.3 kg, mean BMI 27.5 kg/m^2, mean HbA_{1c} in the prediabetes range (5.7–6.4%)	Intervention: National DDP core sessions tailored for the community Control: NA Interventionists: family medicine physicians	Mean weight loss of 3.4 kg, mean A1C of 5.31%, increase in physical activity from baseline for all participants
Ferreira Junior, 2020 (13)	Design: one-group pilot Location: Brazil Setting: urban area	Baseline and 1 and 3 months	*N* = 48; age 47.8 years, female sex 48 (100%), weight 88.1 ± 12.12 kg, HbA_{1c} NR, blood glucose 103.8 ± 10.7 mg/dL	Intervention: walking exercise program of self-selected intensity for 12 weeks (3 times/week, totaling 36 sessions) Control: NA Interventionist: fitness trainer	No differences between groups for blood glucose, blood insulin, or HOMA-IR ($P > 0.05$)
González-Rivas, 2022 (14)	Design: RCT Location: Merida, Venezuela Setting: urban area	Baseline and 2 and 6 months	*N* = 94; age 52.4 ± 12.1 years, female sex 71 (75.5%), male sex 18 (19.4%), FBG 86.7 ± 7.6 mg/dL, BMI 33.2 ± 5.2 kg/m^2, HbA_{1c} NR	Intervention: phase 1 was total meal replacement with a liquid diet consisting of a low-energy drink for 2 months, followed by structured reintroduction of foods for 2 weeks, supervised by a nutritionist. Phase 2 was medical nutrition therapy using a locally adapted transcultural diabetes nutrition algorithm toolkit, supervised by a nutritionist. Throughout this period, standard care with a DPP Group Lifestyle Balance curriculum was provided, supervised by a coach. Control: DPP Group Life Balance content provided in 16 sessions over 6 months Interventionists: physicians	Significant weight loss and improved systolic and diastolic blood pressure ($P < 0.05$)

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TABLE 1 Characteristics of included studies (Continued)

First author, year, reference no.	Design, location, and setting	Data collection time points	Participant no. and characteristics	Intervention, control condition, and interventionists	Results
Lew, 2017 (22)	Design: pre-experimental with mixed methods Location: Bluefields, Nicaragua Setting: urban church-based clinic	Baseline and 3 and 6 months	N = 42; age 57.8 ± 12.0 years, female sex 33 (78.6%), male sex 9 (22.4%), HbA_{1c} 8.8%, FBG NR, BMI NR, body weight NR	Intervention: eight weekly classes of 60 min in duration plus four 30-min one-on-one sessions, providing a total of 10 h of intensive diabetes prevention/self-management education Control: NA Interventionist: registered nurse diabetes educator/coach	Mean HbA_{1c} significantly improved from baseline to 3 months from 8.8% to 8.3% (t = −2.19, P = 0.04). At 6 months, change in HbA_{1c} was not significant (t = −1.8, P = 0.08)
Sevilla-Gonzales, 2022 (15)	Design: pilot Location: Mexico City, Mexico Setting: urban area	Baseline and 3 months	N = 77; age 48.45 ± 11.23 years, female sex 54 (70%), male sex 23 (30%)	Intervention: participants accessed a virtual platform where they received eight lifestyle modules and nutrition and physical activity modification counseling, with some individuals also prescribed metformin Control: NA Interventionist: dietitian	12% of participants (9 of 77) reverted to normal glucose levels, and 82% (64 of 77) continued to have prediabetes. 56% (44 of 77) met the goal of >3% weight loss, with an average loss of 2.92 ± 2.77 kg
Vargas-Ortiz, 2020 (16)	Design: one-group Location: Guanajuato, Mexico Setting: urban area	Baseline and 6 and 12 months	Individual intervention group: n = 65; age 46 ± 12 years, female sex 33 (50.7%), BMI 30.2 ± 5.3 kg/m^2, HbA_{1c} 5.3 ± 0.5% Family intervention group: n = 57); age 44 ± 13 years, female sex 32 (56.1%), BMI 30.2 ± 5.3 kg/m^2, HbA_{1c} 5.1 ± 0.7%	Individual intervention: tailored nutrition and exercise program plus 850 mg metformin twice daily Family intervention: same as for individuals but with family members included in monthly meetings Control: NA Interventionists: interdisciplinary team	Both groups had significantly lower BMI, glucose levels, and markers of insulin resistance at 6 months (P < 0.05)
Velázquez-López, 2013 (23)	Design: RCT Location: Mexico City, Mexico Setting: urban area	Baseline and 6 and 12 months	N = 86; female sex 47 (55%), male sex 39 (45%), obesity 43 (50%), glucose intolerance 48 (53%)	Intervention: nutrition therapy that included a 500 calorie restriction with a 50% reduction in carbohydrate intake, 20% protein intake, and recommended fiber intake of 25 g/day Control: NA Interventionists: registered dietitians	At 12 months, a significant reduction in body weight was noted in participants with overweight, and lipid profiles significantly improved (P < 0.05)
West-Pollak, 2014 (20)	Design: pilot Location: Villa Juana City, Santo Domingo, Dominican Republic Setting: urban area	Baseline and 6 and 12 months	N = 59; age 42 ± 12 years, female sex 38 (52%), male sex 35 (48%), HbA_{1c} 6.0 ± 0.2%, FBG NR	Intervention: group education on lifestyle modification Control: NA Interventionists: nurse practitioner, exercise physiologist, nutritionist, and diabetes educator	After 6 months, there were significant improvements in systolic (P = 0.001) and diastolic (P = 0.000002) blood pressure and HbA_{1c} (P = 0.015). There were no significant improvements in weight or waist circumference at the end of the study

HOMA-IR, HOMA of insulin resistance; NA, not applicable; NR, not reported.

Results

The search yielded 3,022 nonduplicate journal articles. After the titles and abstracts were screened against the inclusion criteria, 70 articles were eligible for full-text assessment, after which 54 were excluded. The articles were excluded because of an incorrect study design (*n* = 13), patient population (*n* = 19), or setting (*n* = 19). An additional 16 studies were excluded during data extraction because the patient population (*n* = 6) or setting (*n* = 10) was wrong (Fig. 1). The final sample comprised 11 articles.

Quality Assessment

The studies were of relatively high quality. Because most studies had quasi-experimental designs, the most significant risks of bias were a lack of randomization of assignment and a lack of blinding of interventionists or data collectors. Many studies had no control group. The nature of these interventions restricted the ability to blind the participants or interventionists. All studies demonstrated adequate quality, and none were excluded for poor quality.

Study Characteristics

Of the 11 studies included, eight had single-group designs without a control group (Table 2). The studies were conducted in Mexico (*n* = 5), Brazil (*n* = 1), Columbia (*n* = 1), Venezuela (*n* = 1), Dominican Republic (*n* = 1), Ecuador (*n* = 1), and Nicaragua (*n* = 1). Intervention durations ranged from 3 months to 2 years. The interventions were conducted by professional and nonprofessional personnel (physicians, nurses, nutritionists, lifestyle coaches, and fitness trainers), with six implemented by an interdisciplinary team of providers. The studies were conducted in rural (*n* = 1) and urban (*n* = 10) settings, with one offered in a church and two in community clinics. The interventions differed not only in duration, but also in intensity and follow-up.

Intervention Content

The studies tested interventions to reduce diabetes risk with a focus on exercise, diet, and education. Only two studies had a single intervention component of exercise (13) or diet (14). Two included medication taking as part of the intervention (15,16).

Education

Six studies tested educational diabetes prevention programs. Two implemented and tested the CDC's National DPP (17,18), one tested a version of the DPP created by the University of Pittsburgh (19), one tested a program created by the University of Virginia's Diabetes Cardiovascular Clinic (20), and two used researcher-created DPP-based programs (21,22). The interventions addressed diet, exercise, negative consequences of diabetes, biomarkers, and psychosocial issues (Table 3).

The CDC's DPP was tailored for two different communities. Castro-Juarez et al. (18) conducted a single-group, pre- and post-test pilot study (*N* = 93) in Sonora, Mexico; the intervention consisted of 16 weekly educational meetings and 6 months of follow-up training delivered monthly. The culturally adapted CDC intervention incorporated the community of interest's food and activity preferences. The authors reported a significant decrease in obesity biomarkers at 1 year. Durán et al. (17) conducted a pilot study (*N* = 33) in Ecuador. They offered a culturally tailored program with 16 sessions over 6 months. Participants had a mean weight loss of 3.4 kg.

Three studies used interventions developed by U.S. universities and adapted for use in Latin America. Armenta-Guirado et al. (19) tested an intervention

TABLE 2 Quality appraisal of included studies

First author, year, reference no.	Clear aim	Randomized	Attrition	Blinded	Similar groups	Effects	Precision of effects	Results applied locally	Outcome	Benefits worth cost	Similar treatment
Armenta-Guiardo, 2019 (19)	Y	Y	Y	U	Y	Y	Y	Y	Y	Y	Y
Barengo, 2019 (21)	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Castro-Juarez, 2020 (18)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Durán, 2021 (17)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ferreira Junior, 2020 (13)	Y	N	Y	Y	Y	Y	Y	Y	Y	U	Y
González-Rivas, 2022 (14)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Lew, 2017 (22)	Y	N	Y	Y	Y	Y	Y	Y	Y	U	Y
Sevilla-Gonzalez, 2022 (15)	Y	N	Y	Y	Y	Y	U	N	Y	Y	Y
Vargas-Ortiz, 2020 (17)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Velázquez-López, 2013 (23)	Y	N	Y	N	NA	Y	Y	Y	Y	Y	NA
West-Pollak, 2014 (20)	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y

N, no; NA, not applicable; U, can't tell; Y, yes.

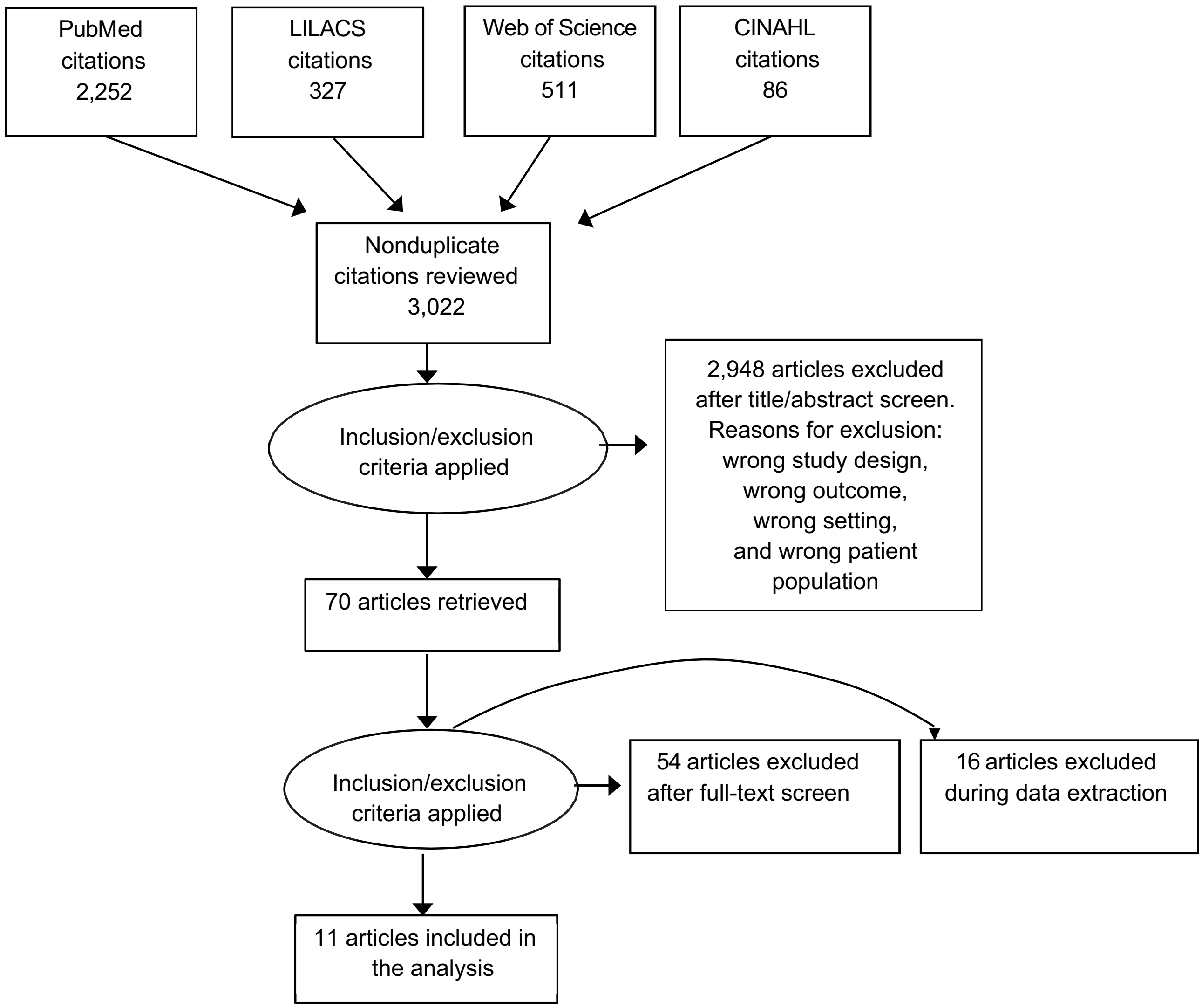

FIGURE 1 The PRISMA flowchart details the search and selection process used for the review.

(*N* = 133) in Brazil that included 12 monthly meetings with participants in public clinics in Mexico. They adapted the program culturally and incorporated additional components, including food weighing, food groups, portion sizes, designing a menu, and diabetes prevention. Participants' weight decreased significantly across all study sites. However, the authors did not provide details about the adaptation. West-Pollak et al. (20) conducted a pilot study (*N* = 59) with an interdisciplinary team of interventionists in Santo Domingo, Dominican Republic. The intervention consisted of six small-group sessions. Participants significantly improved blood pressure and HbA_{1c} but not weight or waist circumference. Local community leaders were trained to lead sustainability programs after the study concluded.

In three studies, researchers created their own DPP-based program. Lew et al. (22) included participants with and without diabetes (*N* = 42). The program consisted of eight weekly classes held in an urban church in Bluefields, Nicaragua. Although participants significantly reduced their HbA_{1c} from 8.8% to 8.3% at 3 months, the decrease was not sustained at 6 months. In cities in Columbia, Barengo et al. (21) tested a program that focused on diet and exercise (*N* = 390). There was no significant reduction in FBG at 24 months. In urban Guanajuato, Mexico, Vargas-Ortiz et al. (16) conducted an RCT of an intervention with six educational sessions that focused on physiological aspects of diabetes, diet, and exercise. Participants significantly decreased their weight and improved their lipid profiles.

Exercise

Education about the importance of exercise was included in almost all studies (*n* = 9). However, only two studies used physical exercise as their primary intervention component. In Brazil, Ferreira Junior et al. (13) tested a walking intervention with a fitness trainer as the interventionist (*N* = 48). In urban Columbia, Barengo et al. (21) tested their intervention with 6 months of diet and 6 months of exercise (*N* = 390). Neither intervention significantly improved FBG levels or other diabetes risk

TABLE 3 Educational elements included in DPP-based interventions

Educational element	Content
Nutrition	• Cooking demonstration • Food weighing • Food groups • Portion sizes • Designing a menu • Conscious eating • Eating away from home • Eating high-volume, low-calorie foods • Nutrition myths
Negative impact of diabetes	• Obesity risk • Cancer risk
Diabetes risk biomarkers	• Blood pressure • Cholesterol
Exercise	• Getting active • Finding time to exercise • Stretching • Tracking activity • Strength training • Walking
Psychosocial issues	• Motivation • Stress and coping • Self-control • Cultural health beliefs • Family support • Relaxation • Mindfulness

markers. However, mean FBG was ~100 mg/dL in both studies.

Nutrition and Weight Loss

Nine studies addressed nutrition and weight. Of these, eight included a nutritionist as an interventionist, with all but Barengo et al. (21) reporting significant improvement in glucose levels. The study by Velázquez-López et al. (23) was the only one to test an intervention that addressed nutrition alone. The participants learned to restrict calories by increasing fiber and reducing carbohydrates and demonstrated a significant weight reduction at 12 months, with a mean weight loss of 7.5 kg for participants with overweight and a mean weight loss of 12.7 kg those with obesity. Sevilla-Gonzalez et al. (15) also included calorie restriction tailored to participants' weight loss goals. Lipid profiles improved significantly in their study.

Medication

In two interventions, oral glucose-lowering medications were administered to participants. In the intervention tested by Vargas-Ortiz et al. (16), participants received metformin, a tailored exercise program, and nutrition instruction. The family intervention group included family members as social support partners, who received the same exercise recommendations and nutrition instruction. The individual intervention group received the same components, but without family members included. HbA_{1c} was significantly reduced in both groups at 6 months. Family members' risk was also reduced in the family intervention, whereas the family members' risk increased in the individual intervention. Sevilla-Gonzalez et al. (15) tested a web-based intervention in which one arm received metformin and the other arm did not. Both arms had identical access to the web-based platform. The authors did not report findings for those with versus without metformin; however, those who used the web-based intervention improved their glycemic control, and 56% of participants met weight loss goals.

Conclusions

In this systematic review, we have identified components of interventions for preventing diabetes in Latin American countries. The 11 studies included implemented and tested interventions that addressed nutrition, exercise, education, and medication. Many of the studies were small or pilot projects, indicating a need for a robust methodology to test the effectiveness of interventions that includes control groups and rigorous protocols.

Study Characteristics

The studies included in this review were conducted in several Latin American countries and took place in community-based settings in both urban and rural areas. All studies were at least 3 months in duration, which would be sufficient to demonstrate improvement in HbA_{1c}, if collected (25). However, 3 months may be insufficient to demonstrate an intervention's ability to produce sustained behavior change. A systematic review of the cost-effectiveness of DPP-based programs found that longer interventions are more cost-effective (26). A longer follow-up period of up to a year would demonstrate participants' ability to maintain changes. Weight loss is often temporary and difficult to sustain (27).

Most studies were conducted by interdisciplinary teams comprising nurses, physicians, nutritionists, physical activity specialists, and diabetes educators. Interdisciplinary weight loss interventions are more likely to significantly improve outcomes (28). Interdisciplinary team care for medically complex patients decreases emergency room visits and hospitalizations, which ultimately leads to lower health care costs (29). However, in Latin America, interdisciplinary approaches are not always feasible (30). Health care systems should aim to create an environment that fosters interdisciplinary collaboration to ensure the highest quality of care and improve health outcomes. One of the reviewed studies included community health workers on the intervention team. Offering multidisciplinary training and ongoing mentorship to community health workers may enhance the impact and long-term sustainability of interventions in resource-constrained settings.

Only one study tested a technology-assisted program with a web platform (15). Participants who used the diabetes education app more frequently were more likely to reduce risk factors. However, the use of mobile technology is inconsistent because of costs and generational preferences; thus, the sample may have been predisposed to mobile app use. In addition, participants who were motivated to make a lifestyle change may have used the web platform more frequently or for longer sessions. The American Diabetes Association recommends technology-assisted programs for diabetes prevention or delay, particularly for hard-to-reach participants such as those in rural areas or those whose work precludes in-person attendance at diabetes education sessions (31). The majority of diabetes apps were designed for diabetes management rather than prevention (32).

Intervention Elements

Of the seven studies that reported the use of designated DPP-based interventions, six reported that these interventions reduced the risk of diabetes. Barengo et al. (21) was the only study to report no change in FBG at 6 months; however, the baseline FBG in this study was 100.1 mg/dL, which is almost within the normal range (70–99 mg/dL). It may be challenging to detect significant decreases in FBG among individuals at risk for diabetes because the prediabetes range is relatively narrow. Using biomarkers to measure insulin resistance may be more helpful in patient populations at risk for diabetes because it is a direct measure of risk (33). Other aspects of diabetes prevention that are addressed in DPP-based interventions, such as diabetes-related knowledge, nutrition, and exercise, should also be measured to evaluate program success.

Education

Educational interventions are frequently used and can be cost-effective (34). Tailored educational programs can be offered online or in person, with written or verbal materials to fit participants' learning needs. In communities with low literacy, educational programs with accessible communication that is spoken rather than written are empowering; those that incorporate preferred languages and cultural tailoring are more likely to improve health literacy for diabetes self-management (35). We found that the eight educational interventions in this review were generally successful, with reported improvements in biomarkers, including HbA_{1c}, markers of insulin resistance, and blood pressure, perhaps because these interventions fostered support and motivation rather than merely imparting factual information.

Exercise

Exercise is an effective strategy for preventing diabetes and reducing insulin resistance (36,37). However, only two studies tested an exercise intervention, and neither produced significant changes in FBG (13,21). FBG changes may have been nonsignificant because the samples' glucose levels were already relatively low, leaving little room for improvement. Alternatively, 6 months of exercise may be insufficient to produce significant long-term benefits. Exercise may need to be combined with other intervention components such as education on nutrition and weight loss, along with medications, in an interdisciplinary approach to be maximally effective in reducing diabetes risk.

Access to exercise opportunities and societal norms around exercise vary across Latin America, just as in the U.S. Structural barriers to exercise must be addressed. For example, many Latin American communities have no sidewalks or walking paths conducive to running or walking (38). Seasonal changes in physical work requirements result in variable levels of physical activity for farmers and manual laborers, and climate-related impacts may restrict outdoor activities (e.g., rainy seasons or periods of extreme heat). Additionally, cultural norms may not encourage exercise. One study reported that Latina women in the U.S. give priority to caregiving over exercise, and cultural body shape standards were an additional barrier (39). Exercise interventions in Latin America must be adapted to their setting and to the needs and preferences of their target community.

Nutrition and Weight Loss

Weight loss is challenging to maintain. A systematic review of determinants of weight loss maintenance identified psychological and cognitive determinants, including stress, mood/depression, quality of life, motivation, self-efficacy, perceived barriers, body image, self-concept, disinhibition/impulse control, and reinforcement (40). However, the studies in the present review that included a nutritionist on the interdisciplinary team reported significant reductions in weight and glucose levels. These studies may have been successful due to the duration of the surveys, which were mostly 1 year, and the use of an interdisciplinary team with a nutritionist as a key member. These findings are consistent with those from a systematic review of diets for weight management in adults with diabetes (41), which reported that diet type was less critical, with no differences among the diets, and that calorie-deficient eating was the most important factor for weight loss.

Medication

The two studies that included glucose-lowering medicines as part of the intervention protocol (15,16) reported reduced BMI, glucose levels, and insulin resistance. However, neither study included a control group that did not receive medication. Thus, it is difficult to determine whether outcomes were attributable to medication or to other factors (e.g., diet or activity). Providing medication as part of a diabetes prevention intervention has slowed the transition from prediabetes to diabetes in populations at high risk for diabetes (42). However, participants may not have access to the same medication after a research study ends, so the results of such an intervention may not be sustainable. Limited access to medication and medication costs are barriers in Latin America, so people with diabetes must be prioritized over those with prediabetes to receive medications (43).

Limitations

Although the PRISMA guidelines informed this systematic review, specific issues may have limited its findings. Articles that did not contain the keywords used in the search or that were indexed only in other databases may have been missed. A meta-analysis would provide a stronger quantitative synthesis of the studies. However, the heterogeneity of the interventions and their outcomes prevented a quantitative synthesis of effect sizes. Indeed, half of the studies did not test their interventions against control or comparison groups, which limited the conclusions that might be drawn about their effectiveness. These interventions require more rigorous testing in RCTs. Studies should use the gold standard HbA_{1c} as an outcome measure to improve comparability and enable meta-analysis. Notably, most studies demonstrated improvements in health outcomes. Taking into account the current trajectory of diabetes in Latin America, upstream interventions can effectively slow the progression of the disease.

Conclusion

Diabetes prevention research is urgently needed to address the risk and growing prevalence of diabetes in Latin America. This systematic review examined 11 studies from across Latin America. Almost all of these studies reported a reduction in diabetes risk, particularly those that used multipronged approaches that incorporated exercise, education, nutrition, and interdisciplinary team care. Moving forward, more rigorous methodologies, including the collection of HbA_{1c} data, should be adopted to strengthen evidence for these impactful interventions.

DUALITY OF INTEREST

No potential conflicts of interest relevant to this article were reported.

AUTHOR CONTRIBUTIONS

J.Z. reviewed articles, extracted data, and wrote the manuscript. W.K., M.C., E.M., and Z.H. reviewed articles, extracted data, and contributed to the discussion. H.C. researched data, contributed to the discussion, and wrote the manuscript. R.C. contributed to findings and discussion and reviewed and edited the manuscript. A.A.G., M.E.G., R.A., E.T.-R., V.B., and T.M. reviewed and edited the manuscript. A.B.-A. contributed to discussion and reviewed and edited the manuscript. J.Z. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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