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### Community-based participatory research in diabetes prevention programs

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# Community-Based Participatory Research in Diabetes Prevention Programs

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## Community-based participatory research in diabetes prevention programs

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### Abstract

**Background:** The purpose of this study was to determine how community-based diabetes prevention programs utilized the concept and contents of the Community Based Participatory Research approach.

**Methods:** Keyword search in PubMed and Scopus electronic databases from January 1, 2000, to December 31, 2019, was conducted to search and extract peer-reviewed articles that included words “Community-Based Participatory Research (CBPR)” and “diabetes mellitus” in the title, abstract or in the main article. The initial search yielded 1122 articles. After the final screening, a total of 67 articles were extracted for review.

**Results:** Findings suggested that an advisory board was used by most diabetes studies, especially for planning and reviewing the study protocol. However, they were not included in the data analysis and study result dissemination process. Furthermore, the majority of the studies that used CBPR were conducted in North America.

**Conclusion:** Partnership approach to research on community-based diabetes programs that equitably involves community members and researchers can benefit communities. This approach should also be widely adopted globally.

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**Keywords:** Community-based Participatory Research; Diabetes; Diabetes Mellitus; Health Services Research.

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## Introduction

Diabetes prevention programs (DPP) gained popularity in the last two decades (1). More researchers have been working on intervention programs to reduce the burden of diabetes and its complications. Individuals with pre-diabetes and diabetes who take part in a structured lifestyle change program and/or lose weight have shown to be effective in multiple studies (2). Research translation is the process through which basic scientific discoveries are translated into clinical practice and eventually lead to an improvement in the public health sector (3). Westfall et al. proposed “blue highways” on the National Institute of Health roadmap to improve practice-based research. More specifically, there are three translational steps for evidence-based guidelines to improve day-to-day clinical care and population health: T1, T2, T3 (4). Diabetes intervention programs fall under T3 translational research, where knowledge from clinical research is used to implement community-based health activities (4). In recent decades, Community-Based Participatory Research (CBPR) has gained popularity among public health researchers (5). CBPR is an approach to conducting research where the researcher and community work together to develop and implement acceptable and culturally appropriate intervention methods (5, 6). In this paper, the authors discussed how community-based diabetes prevention programs utilized the concept and contents of the CBPR approach.

## Methods

### Data sources and search strategies

A systematic literature search was conducted for this study to identify a comprehensive list of studies in two electronic databases (PubMed and Scopus (7, 8)). Publications were limited to English that were published in the last 20 years (1999-2019). Studies not meeting the aforementioned criteria were excluded from the systematic review. A West Virginia University Health Sciences librarian was consulted to plan search strategies for the two databases in order to obtain a comprehensive list of available studies. Key terms used for the search were “community-based participatory research” and “diabetes mellitus.” The search terms were kept generalized to acquire an ample amount of studies on the topic.

### Data abstraction and screening

Data from individual studies were abstracted and coded into a Microsoft Excel (9) codebook (that was developed by the first author). The two authors independently coded all studies, assessed, and reviewed for accuracy. Disagreements were resolved by consensus. The initial search provided 1122 articles. After the removal of 18 duplicate articles, the titles and abstracts were screened for appropriateness and 88 full-text journal articles were retained for review. After applying the inclusion/exclusion criteria as indicated above as well as lack of information on the topic such as not discussing the CBPR approach and DPP in the study, 67 publications were included in the final analysis. Articles were reviewed to examine how the researchers utilized the concept of the CBPR approach in their research. For this paper, the authors only utilized qualitative synthesis of the screened articles instead of conducting a meta-analysis. The screening process followed the PRISMA recommendation on the literature review (10). The graphical process of the total literature search is shown in Figure 1.

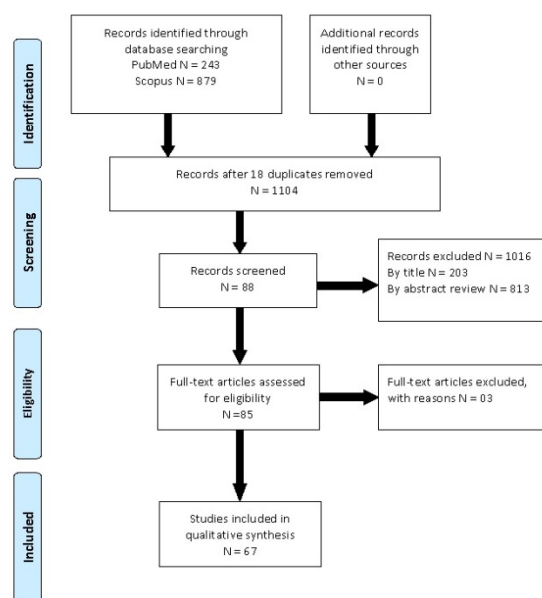


Figure 1. Flow chart of literature selection

## Results

### Study characteristics

A total of 10 studies were conducted during 2000-2010, and 57 during the 2011-2019 period. Thus, around 85% of these studies were conducted in the current decade. A total of 45 studies were conducted in the USA,

eight were in Canada, seven in Asia, three in Europe, two in South America, and two in Australia in the last 20 years. Approximately 79% of these studies were conducted in North America, and only 21% were throughout the rest of the world. A large number of studies conducted in North America were targeted towards minority communities such as African-American, American Indian, Native communities in the Pacific Islands, as well as immigrants and refugees in the US. The objective of most of the studies was to implement the self-management Diabetes Prevention Program (DPP) for the community members. Five studies specifically mentioned to implement a faith-based intervention program (11-15); the rest of the studies did not use a faith-based programmatic approach.

The study design of the review articles varied with several study approaches used for the diabetes programs. Twenty-two articles mentioned using either qualitative or mixed-method approach (5, 11, 16-36), whereas 30 articles reported using either intervention or randomized controlled trials (12, 14, 15, 33, 37-63). Eight studies used cross-sectional design (22, 64-71), four mentioned CBPR in their study protocols (23, 72-74), two studied pooled data from prospective cohort studies (13, 75), and one used a longitudinal survey design (52). Table 1 lists the study locations, and year the reviewed studies were conducted.

#### ***Synthesis of results for utilization of the CBPR approach***

Table 2 shows the summary of the study findings. The formation of a community advisory board or community council was a common approach found in the majority of the studies. Diabetes programs conducted among American-Indians and for other Native communities almost always included community leaders in their advisory boards (21, 28, 32, 38, 39, 47, 56, 69). The composition of the boards included academic

researchers, community or tribal leaders, religious leaders, school board members, as well as healthcare providers servicing the target community. Perrill et al. reported that using community partners such as members/leaders of faith-based institutions helped the researchers achieve trust from the community members (75).

Heterogeneity was noted in the activities of the advisory boards in various studies. In some studies the advisory board members were engaged in planning and finalization of the study protocol (5, 12, 14, 15, 18-20, 23, 25-28, 33, 39, 40, 46, 48, 50, 56, 63, 64, 66, 68, 69, 76). In the study by Brown et al. advisory board were involved in the writing of the grant application (39). Balagopal et al. described opting for the collection of capillary blood instead of venous blood due to the objection of the advisory board members (37). However, several studies lacked detailed information on how advisory board members participated in planning for the study (16, 22, 23, 34, 38, 41, 45, 52). In addition, the majority of the studies failed to mention whether the researchers engaged community advisory board members for data analysis and result dissemination process (5, 12-15, 17, 22, 23, 27, 29-38, 42-44, 47-49, 51-53, 55, 56, 58-62, 65, 69, 70, 72-74, 76, 77). Recruiting community members as health coaches or community health workers was a common CBPR approach that was noted in several studies. More specifically, the health coaches/community health workers participated in recruiting study participants (29, 30, 32, 35, 49, 61, 77), conducting diabetes health education sessions as well as assisting in data collection procedures (34, 37, 40, 41, 43, 47, 48). Table 2 lists the study type, sample size, and the major findings on how the reviewed studies utilized the CBPR approach.

Table 1. Study location and year of the reviewed articles

Authors	Location	Year	Authors	Location	Year	Authors	Location	Year
Ahmadi et al	Iran	2018	McEkfish et al	USA	2016	Palmas et al	USA	2012
Baig et al	USA	2015	McEkfish et al	USA	2016	Parikh et al	USA	2010
Balagopal et al	India	2012	McEkfish et al	USA	2017	Parrill et al	USA	2011
Benyshek et al	USA	2013	McEwen et al	USA	2014	Purnell et al	USA	2016
Brockie et al	USA	2018	Mendes et al	Portugal	2014	Ramli et al	Malaysia	2013
Brown et al	USA	2010	Morales-Alemán et al	USA	2003	Richards et al	USA	2012
Carpenter et al	USA	2018	Mudd-Martin et al	USA	2013	Riediger et al	Canada	2014
Cene et al	USA	2013	Murdoch-flowers et al	Canada	2017	Rosales et al	USA	2017
Chambers et al	USA	2015	Naqshbandi et al	Canada	2011	Rosas et al	USA	2016
Colagiuri et al	Australia	2010	Newman et al	USA	2013	Rosas et al	USA	2016
Cole-Lewis et al	USA	2016	Njeru et al	USA	2015	Ruggiero et al	USA	2011
Deo et al	India	2017	Palmas et al	USA	2012	Mau et al	USA	2010
Depue et al	American Samoa	2013	Parikh et al	USA	2010	West-Pollak et al	Dominican Republic	2014
Devia et al	USA	2017	Parrill et al	USA	2011	Ryabov et al	USA	2010
Faridi et al	USA	2009	Purnell et al	USA	2016	Silva et al	Brazil	2017
Gabarron et al	Norway	2018	Ramli et al	Malaysia	2013	Song et al	USA	2010
Heisler et al	USA	2014	Richards et al	USA	2012	Teufel-Shone et al	USA	2014
Horowitz et al	USA	2008	Riediger et al	Canada	2014	Tran et al	Vietnam	2015
Hurt et al	USA	2015	Rosales et al	USA	2017	Tremblay et al	Canada	2017
Hurt et al	USA	2017	Rosas et al	USA	2016	Vissenberg et al	Netherlands	2016
Kakekagumick et al	Canada	2013	Rosas et al	USA	2016	Webster et al	Australia	2015
kholghi et al	Canada	2017	Ruggiero et al	USA	2011	McEkfish et al	USA	2017
Kitzman et al	USA	2017	McEwen et al	USA	2014	Yazdanpanah et al	Iran	2012
Lin et al	china	2014	Mendes et al	Portugal	2014	Yeary et al	USA	2017
Loskutova et al	USA	2015	Morales-Alemán et al	USA	2003	Yeh et al	USA	2016
Love et al	USA	2017	Mudd-Martin et al	USA	2013	walls et al	USA	2017
Lucke-wold et al	USA	2016	Murdoch-flowers et al	Canada	2017			
Macaulay et al	Canada	2007	Naqshbandi et al	Canada	2011			
Macridis et al	Canada	2016	Newman et al	USA	2013			
Mathew et al	USA	2017	Njeru et al	USA	2015			

Table 2. Summary of study findings

<b>Randomized Controlled Trial</b>			
Authors	Aim of the study	Sample size	Major Findings
Ahmadi et al	To compare the effects of education by the healthcare provider and peer on self-care behaviors among Iranian patients with diabetes	120	<ul style="list-style-type: none"> <li>researchers consulted with physicians and nurses to recruit peers for the intervention group.</li> <li>No mention of whether the physicians, nurses or peers were included in data collection, analysis, interpretation, and dissemination phase.</li> </ul>
Baig et al	To assess the impact of a multi-faceted church-based diabetes self-management intervention on diabetes outcomes among Latino adults	100	<ul style="list-style-type: none"> <li>Researchers formed community partnerships (community advisory boards or CAB) with local churches, catholic service agencies, local leaders and community members.</li> <li>Research assistants were bilingual.</li> <li>Researchers used the CAB's suggestion on revising the intervention strategy. CAB members conducted intervention sessions. Not mentioned whether CAB was included in data collection, analysis, interpretation or dissemination process.</li> </ul>
Heisler et al	To compare outcomes between the community health worker and print educational media	188	<ul style="list-style-type: none"> <li>No CBPR approach was mentioned</li> </ul>
Lin et al	To evaluate the effectiveness of lifestyle intervention	474	<ul style="list-style-type: none"> <li>researchers made collaboration with community members, health clinics.</li> <li>Field workers contributed to screening, participant enrollment, intervention.</li> <li>No indication of whether the collaboration members worked in data collection, analysis and dissemination phase.</li> </ul>
Palmas et al	To describe Community Health Worker mediated DPP	360	<ul style="list-style-type: none"> <li>The study population was Hispanics in Northern Manhattan, USA.</li> <li>The authors shared their proposed protocol of the intervention program but did not describe any application of the CBRP approach in their article.</li> </ul>
Ramli et al	To evaluate the effectiveness of DPP	438	<ul style="list-style-type: none"> <li>Apart from the formation of the Chronic Disease Management (CDM) team with doctors, nurses, pharmacists, the researchers did not utilize the CBPR concept in other steps of the research.</li> </ul>
Rosas et al	to develop dpp program for american indians, alaska natives	204	<ul style="list-style-type: none"> <li>A community-university partnership was formed to make an advisory board.</li> <li>The advisory board reviewed the study protocol for approval, pilot-tested intervention strategies, recruited participants for a randomized controlled trial (RCT).</li> <li>The authors did not mention how the group analyzed and disseminated data together.</li> </ul>
Yeary et al	to assess the effectiveness of the family model of DPP	240	<ul style="list-style-type: none"> <li>researchers included community partnership members in every step of the study.</li> </ul>
<b>Intervention Study</b>			
Authors	Aim of the study	Sample size	Major Findings
Balagopal et al	To describe a lifestyle modification program to prevent diabetes	1638	<ul style="list-style-type: none"> <li>Eight preplanning community meetings were conducted with village elders, and health workers (CHWS) to share the objective of the study as well as to build rapport, trust, and confidence among the stakeholders.</li> <li>The study protocol of using capillary blood was modified to use venous blood as villagers were not comfortable.</li> <li>Participants preferred discussions and demonstration.</li> <li>The authors mentioned that community participation, such as meetings helped the participants understand the objective of the study and adhere to the protocol.</li> </ul>
Benyshek et al	To describe a lifestyle modification program to prevent diabetes	22	<ul style="list-style-type: none"> <li>The study population was urban American Indians, Alaskan natives.</li> <li>The pilot study used native lifestyle coaches to conduct training sessions of lifestyle modification.</li> <li>Did not mention of community participation in study design.</li> <li>The authors did not discuss how they involved the community members in planning and delivering the study.</li> </ul>
Brown et al	To describe cultural specific DPP program	31	<ul style="list-style-type: none"> <li>Reported success in changing behaviors.</li> <li>The study population was American Indians.</li> <li>Community leaders and researchers had meetings to prepare the grant application, study design.</li> <li>Tribal members reviewed the study guide for educational sessions.</li> <li>Participants participated in a focus group session shared their views, experience, and ideas on the study activities.</li> <li>Researchers used the recommendations from the interviews to build the future DPP program from native Americans.</li> </ul>

Cene et al	To describe the feasibility of using a CBPR method to diabetes management	104	<ul style="list-style-type: none"> <li>The study population was rural African Americans.</li> <li>Researchers built academic-community partnerships including the local pastor, local health organization, academics.</li> <li>Researchers planned for the study protocol, wrote the article, used community health ambassadors (CHAS) from the community, reported a high dropout rate of the participants.</li> <li>Researchers did not take participants' feedback on the program activities.</li> </ul>
Chambers et al	Feasibility test of DPP for American Indians	255	<ul style="list-style-type: none"> <li>An advisory board was composed of tribal leaders, researchers.</li> <li>The advisory board had meetings, sessions with community members.</li> <li>Local health coaches were recruited, who trained the participants on diabetes health education</li> <li>The advisory board had biweekly meetings with participants.</li> <li>The authors did not mention if the board members analyzed data together and how it was disseminated.</li> </ul>
Depue et al	To answer key implementation questions for nurse-based CHW mediated dm self-management program	104	<ul style="list-style-type: none"> <li>Nurse Community Health Workers (CHWs) delivered study materials throughout the study population on DM self-management.</li> <li>The authors did not indicate how the local community was utilized for the study except using them as study participants.</li> </ul>
Faridi et al	To assess the impact of community health advisor based DPP	133	<ul style="list-style-type: none"> <li>Researchers formed a participatory community team (CPT) with local church members, community organizations, health department officials.</li> <li>Community health advisors (CHA) were recruited from the community who recruited study participants.</li> <li>CHA training module was developed by CPT members.</li> <li>No mention of how CPT was involved in data collection, analysis and dissemination.</li> <li>The authors described how they built the DPP program using the CBPR approach in detail.</li> </ul>
Lucke-wold et al	To describe researchers experience on a DPP	60	
McEwen et al	to refine and expand culturally tailored individual DPP program to family level intervention	24	<ul style="list-style-type: none"> <li>The study population was Mexican Americans.</li> <li>Researchers recruited DM patients and their family members.</li> <li>The authors did not mention whether there were any CBPR groups to recruit the members.</li> <li>Bilingual speakers conducted focus group meetings on DM self-management behaviors, and authors did not mention if any community members were included to analyze the interviews and share the result with them.</li> </ul>
Mendes et al	To assess the impact of a DPP	43	<ul style="list-style-type: none"> <li>Authors did not utilize CPBPR concept in any step</li> </ul>
Morales-Alemán et al	To describe a DPP	35	<ul style="list-style-type: none"> <li>Researchers built a community coalition with community members.</li> <li>Coalition members developed study modules, recruited Community health workers, trained the CHWs. CHWs conducted the training sessions.</li> <li>No indication of how coalition members contributed to data collection, analysis and dissemination.</li> </ul>
Mudd-Martin et al	To describe a CBPR approach	22	<ul style="list-style-type: none"> <li>Researchers collaborated with Latin community leaders.</li> <li>The team determined the intervention objective through group sessions.</li> <li>Health education was conducted for community members using bilingual trainers.</li> <li>Participants shared their views on the program in focus groups.</li> <li>No indication of how the results were disseminated.</li> </ul>
Parikh et al	To describe a pilot study on DPP	178	<ul style="list-style-type: none"> <li>Partnership groups of researchers and community members conveyed a literature review of existing intervention programs and developed their study materials.</li> <li>Study materials were reviewed by the Latino education subcommittee.</li> <li>The partnership group recruited community members from the study population.</li> <li>Participants shared their feedback on the study in focus groups and interviews.</li> </ul>
Richards et al	To examine the effectiveness of a DPP	77	<ul style="list-style-type: none"> <li>A tribal working group was established that consisted of tribal members, researchers, tribal leaders.</li> <li>The working group developed intervention modules, survey instruments as well as moderated focus group sessions.</li> <li>No information on how the working was involved in data collection, analysis, and dissemination process.</li> </ul>
Ruggiero et al	To describe a DPP for Latinos	69	<ul style="list-style-type: none"> <li>Researchers recruited participants for intervention from the community.</li> <li>Authors prepared culturally suitable materials for the Latinos by consulting with community members; however, they did not mention if they included community members on the board to analyze or disseminate data.</li> </ul>
Ryabov et al	To evaluate the effectiveness of community health workers in DPP	30	<ul style="list-style-type: none"> <li>Apart from recruiting community health workers, the researchers did not utilize the CBPR concept in other steps of the research.</li> </ul>
Teufel-Shone et al	To examine if sessions conducted by community leaders for DPP worked	109	<ul style="list-style-type: none"> <li>The community researcher board completed ten months of assessment to assess local factors for the diabetes prevention program.</li> <li>The board identified key areas to work on, and local leaders worked on the schools to implement the intervention strategies.</li> <li>Authors, however, did not illustrate how the board worked on data collection, analysis, or dissemination together.</li> </ul>
Tremblay et al	To assesses the outcome of a DPP	24	<ul style="list-style-type: none"> <li>Researchers built a stakeholders' group with community leaders, which developed research questions, methodology, as well as collected data and participated in data interpretation and dissemination.</li> </ul>



Vissenberg et al	To describe the steps of a DPP	Not mentioned	<ul style="list-style-type: none"> <li>The authors did not mention how CBPR will be utilized in the intervention program.</li> </ul>
West-Pollak et al	To describe a DPP	222	<ul style="list-style-type: none"> <li>The study population was from Dominican Republic.</li> <li>Community leaders were trained as healthcare champions worked with the participants who were recruited from the community.</li> <li>The authors did not mention how they involved community members/leaders in data collection, analysis, review, or dissemination of the study result.</li> </ul>
Yazdanpanah et al	To describe a DPP	2569	<ul style="list-style-type: none"> <li>The study population was from Iran.</li> <li>Researchers formed a committee consisting of the researchers, policymakers, health care professionals, and community members.</li> <li>The Committee established a research protocol, recruited study participants, collected, and analyzed data and prepared reports together.</li> </ul>
Yeh et al	To describe a DPP	60	<ul style="list-style-type: none"> <li>The study population was Chinese immigrants.</li> <li>The authors did not mention how the community was involved in the intervention except the recruitment of participants from the community.</li> </ul>

**Qualitative Study**

Authors	Aim of the study	Sample size	Major Findings
Cole-Lewis et al	To prepare a knowledge base on diabetes self-management from CBPR activities	Not mentioned	<ul style="list-style-type: none"> <li>Participants included diabetic educators and diabetes patients from the study area.</li> <li>Diabetes Educators were from PBRNs serving the study areas.</li> <li>Patients and educators gave their opinion on the diabetes education material that was prepared using the collaboration.</li> </ul>
Horowitz et al	To build a model to prevent dm in East Harlem	Not mentioned	<ul style="list-style-type: none"> <li>The coalition was formed using clinicians, CHWs, community leaders, researchers.</li> <li>The coalition built trust through community events through meetings.</li> <li>They realized diabetes was an issue for the community, and they built the model of diabetes prevention education for the low-income minority population</li> </ul>
Hurt et al	to assess how race and masculinity influence DPP	20	<ul style="list-style-type: none"> <li>community members assisted in the recruitment of participants and data collection.</li> <li>No other CBPR approach was mentioned.</li> </ul>
Hurt et al	To assess black women's idea on DPP	29	<ul style="list-style-type: none"> <li>community members assisted in the recruitment of participants, focus group facilitation, and in data collection.</li> <li>Researchers also reviewed the focus group data with the participants. No other CBPR approach was mentioned.</li> </ul>
Kitzman et al	To design a faith-based DPP	64	<ul style="list-style-type: none"> <li>The study population was African Americans.</li> <li>Researchers made CAB partnerships with community members.</li> <li>CAB developed the intervention curriculum and recruited community members for the study.</li> <li>The authors did not mention whether CAB was involved in data analysis, report writing or dissemination of the study results.</li> </ul>
Macaulay et al	To document lessons learned from sharing results with the community and analyzing feedback from them	181	<ul style="list-style-type: none"> <li>The multidisciplinary board, including researchers and community members, presented their report on the school diabetes prevention program to the community members.</li> <li>Feedback and review of the presentation were received from the members of the collaboration, and from the audience was recorded.</li> </ul>
Mathew et al	To develop a culturally competent model to treat DM	20	<ul style="list-style-type: none"> <li>The study population was Puerto Ricans.</li> <li>Researchers formed community advisory boards (CAB), including community members.</li> <li>The clinical, educational group consisted of nurses, educators.</li> <li>Clinical educators and CAB groups met several times in the community, developed virtual simulation content based on the feedback from the CAB members</li> </ul>
McEkfish et al	To describe how CBPR was used to design patient-centered research	69	<ul style="list-style-type: none"> <li>The study population was Marshallese in the pacific island.</li> <li>Researchers created collaborative groups of community members, such as patients and their family members, health care providers.</li> <li>Researchers communicated and received feedbacks from stakeholders on planning the intervention</li> </ul>
McEkfish et al	To describe a DPP intervention	31	<ul style="list-style-type: none"> <li>Researchers recruited local Marshallese churches for the health program.</li> <li>Researchers used bilingual materials.</li> <li>In this article, the authors did not describe how they utilized the CBPR method in detail.</li> </ul>
Murdoch-flowers et al	To assess outcomes of CBPR intervention on health and experience on health	17	<ul style="list-style-type: none"> <li>The study population was from Mohawk territory, Canada.</li> <li>Researchers employed qualitative methods to identify themes that emerged from interviewing community members on the diabetes prevention program.</li> </ul>
Newman et al	To understand the meaning of diabetes in the study population	54	<ul style="list-style-type: none"> <li>Researchers recruited community health representatives (CHR), who recruited study participants. Researchers and CHRs facilitated focus group sessions.</li> <li>CHR participants in data collection. The authors did not mention whether CHRs were included in data analysis and dissemination.</li> </ul>

Njeru et al	To develop dm storytelling intervention	37	<ul style="list-style-type: none"> <li>The study population was the refugee immigrants in MN, USA.</li> <li>Researchers built a partnership with the local community organizes.</li> <li>Community partners agreed to conduct surveys, focus groups, digital storytelling.</li> <li>Evaluation of the intervention, data analysis was done by the community partners</li> <li>The partners shared the digital storytelling to the community.</li> <li>Researchers formed an action board with the university research advisory council.</li> <li>Researchers developed the study design and revised it according to the feedback from the council members.</li> <li>Researchers reviewed the protocol, recruited participants, analyzed, and shared data among community participants.</li> <li>Study participants shared their idea, views on diabetes-related issues, barriers to health care with the researchers.</li> </ul>
Purnell et al	To identify strategies for CBPR		<ul style="list-style-type: none"> <li>The authors included study populations to form an advisory board that was involved in adopting culturally suitable lifestyle intervention for diabetes patients.</li> <li>It was not mentioned whether the advisory board was involved in data analysis and dissemination.</li> </ul>
Rosas et al	To describe how CBPR was utilized in adopting DPP	34	<ul style="list-style-type: none"> <li>The authors did not explain how the CBPR approach was utilized.</li> </ul>
Silva et al	To understand the perspective of individuals with type 2 DM	16	<ul style="list-style-type: none"> <li>Researchers formed a collaboration team with aboriginal health workers to recruit study participants.</li> <li>Other steps of the CBPR approach was not mentioned.</li> </ul>
Webster et al	To describe how aboriginal people managed type 2 DM	25	

**Mixed-method**

Authors	Aim of the study	Sample size	Major Findings
Brockie et al	To understand sources of stress and examine their impact on type 2 DM related outcomes	194	<ul style="list-style-type: none"> <li>researchers formed community research councils (CRC) from each tribe to develop and implement study protocols, data collection, interpretation, and dissemination.</li> </ul>
Kholghi et al	To evaluate diabetes education program	23	<ul style="list-style-type: none"> <li>Researchers adopted a mixed-methods approach to evaluate the study.</li> <li>The study team consisted of the researchers, students from the community, high school principals from the community.</li> <li>Researchers periodically shared their study findings with the community collaborators.</li> </ul>
Loskutova et al	To determine the feasibility and acceptability of telephone-based patient navigation for people with type 2 DM	179	<ul style="list-style-type: none"> <li>A coalition of the clinical-community partnership was established with researchers, physicians and community members.</li> <li>Patient navigators were recruited from the study population.</li> <li>No other CBPR approach was mentioned for the rest of the study.</li> </ul>
Macridis et al	To describe DPP at school using CBPR	57	<ul style="list-style-type: none"> <li>The collaboration group consisted of school principals, teachers, community members, researchers. They developed the intervention program; the committee discussed the results of the data analysis.</li> </ul>
Mau et al	To describe the CBPR methods for DPP	239	<ul style="list-style-type: none"> <li>Study partners included researchers, community organizations, and health centers.</li> <li>The researchers recorded information from community members about ideas, concerns about health issues through focus group</li> <li>Community leaders were interviewed about their communities needs on chronic disease, ideas on what can be done to prevent DM in their communities</li> <li>Study partners together analyzed qualitative data and developed themes</li> <li>For the intervention, participants received health education on DM by community peer educators (CHW)</li> </ul>
Song et al	to prepare dietary guideline on dm for the Korean immigrants	79	<ul style="list-style-type: none"> <li>The study population was Korean immigrants.</li> <li>Formative phase- focus group was formed, including researchers, immigrant participants, and their family members to identify a barrier to and strategies to develop a dietary guideline.</li> <li>Researchers constructed a nutrition program using those comments, summative phase- nutrition sessions for the immigrant participants.</li> <li>Researchers did not mention if they used local people as session conductor or implementer, and also did not mention how the participants gave their feedback on the education materials.</li> </ul>

**Cross-sectional study**

Authors	Aim of the study	Sample size	Major Findings
Carpenter et al	To describe strategies on recruiting and collecting data from adults with type 2 DM	100	<ul style="list-style-type: none"> <li>Researchers established a partnership with healthcare providing services to recruit participants, and for data collection.</li> <li>No indication of whether the researchers included the partnership for data analysis, report writing or dissemination.</li> </ul>
Deo et al	To acquire data on type 2 DM patients	1168	<ul style="list-style-type: none"> <li>CBPR approach was not utilized in data collection, analysis, and report dissemination process</li> </ul>

Gabarron et al	To identify the preferences and interests of diabetes social media users	346	<ul style="list-style-type: none"> <li>researchers worked with health professionals and members of the Norwegian diabetes association to build, distribute the survey questions.</li> <li>The coalition also created health intervention modules, data collection, analysis, interpretation, dissemination of results.</li> </ul>
Love et al	To examine perceived food environments associated with diabetes	513	<ul style="list-style-type: none"> <li>Researchers established tribal- university partnership comprising of tribal leaders and the researchers.</li> <li>Tribal employees recruited the study participants.</li> </ul>
Mcekfish et al	To describe a church-based DPP	401	<ul style="list-style-type: none"> <li>Researchers recruited local Marshallese churches for the health program.</li> <li>Researchers used bilingual materials.</li> <li>The authors did not describe how they utilized the CBPR method in detail.</li> </ul>
Naqshbandi et al	to outline lessons learned in CBPR research	885	<ul style="list-style-type: none"> <li>Researchers recruited communities for intervention with the help of research assistants who were from the participating communities.</li> <li>Community leaders joined the CBPR board.</li> <li>CBPR boards prepared study methods and instruments, revised the study methods based on feedback from the community members such as recruiting and collecting consent forms, modification of communication methods among the community leaders.</li> <li>CBPR board shared the results of data analysis among the communities.</li> </ul>
Riediger et al	To assess incidents of diabetes	171	<ul style="list-style-type: none"> <li>A Community Diabetes Advisory Group was established that included members of the community health center, community members and university researchers.</li> <li>The advisory group was involved in the design, data collection, analysis, interpretation, presentation and publication of the study results</li> </ul>
Walls et al	To describe a CBPR approach for DPP	192	<ul style="list-style-type: none"> <li>The study population was Native Americans.</li> <li>Researchers formed a community research council (CRC), including tribal members.</li> <li>CRC members approved the article manuscript.</li> <li>Focus group of tribal members on health issues and a survey was conducted by clinic staff, but not by CRC members.</li> <li>The authors did not report on if the CRC members participated in data collection, analysis, or dissemination of the result.</li> </ul>

**Study protocol**

Authors	Aim of the study	Sample size	Major Findings
Colagiuri et al	To describe the study protocol	1550	<ul style="list-style-type: none"> <li>Authors did not mention how CBPR will be utilized for analyzing data and disseminating the report</li> </ul>
Kakekagumick et al	To describe strategies in educating community members on diabetes	Not mentioned	<ul style="list-style-type: none"> <li>the research included community partnership members in multiple activities but did not mention the involvement in data collection, analysis, dissemination process</li> </ul>
McElfish et al	To compare the effectiveness of two DPP programs	384	<ul style="list-style-type: none"> <li>The authors described plans to incorporate CBPR concepts at every step of the planned intervention.</li> </ul>
Tran et al	To assess the effectiveness of a DPP	600	<ul style="list-style-type: none"> <li>Aside from assigning a walk leader from the participants to lead each walking group, the study did not describe the plan for utilizing the CBPR approach as a whole.</li> </ul>
Devia et al	to examine the role of two CBPR case studies	35	<ul style="list-style-type: none"> <li>CBPR approach was not utilized in data collection, analysis, and report dissemination process of the two reviewed studies</li> </ul>
parrill et al	To review studies on the use of faith-based institutions for community-based health partnership programs	Not mentioned	<ul style="list-style-type: none"> <li>Authors recommended the use of the pastor to gain the trust of the community members</li> </ul>
Rosales et al	To describe a coalition between community and university	1623	<ul style="list-style-type: none"> <li>Although the authors described the health needs of the US-Mexico border community over 12 years, they did not mention how CBPR was applied during that period.</li> </ul>

DPP: Diabetes Prevention Program; CBPR: Community-Based Participatory Research; CHW: Community Health Worker; DM: Diabetes Mellitus; CAB: Community Advisory Board

**Discussion**

The current study assessed the utilization of the CBPR approach in diabetes prevention programs. To the best of the authors' knowledge, this is the first systematic review to evaluate how community-based diabetes prevention programs utilized the concept and contents of the CBPR. On the basis of the summary data for the reviewed studies, a variety of study designs and methods were

utilized. Approximately 13% of the reviewed studies utilized a randomized controlled trial, which is called the gold standard of research study methods (78), and 31% of studies were intervention studies.

Diabetes is a chronic disease, and evidence-based prevention programs, such as the DPP, are implemented for several weeks/months for providing the competencies and skills to individuals for lifestyle modifications and

weight loss/maintenance that is needed for delaying the early onset of diabetes. Since the DPP training modules are usually multifaceted that require time for the study participants to learn the lifestyle modifications (79), it explained why 45% of the reviewed studies were intervention studies or randomized controlled trials. Approximately 44% of the reviewed studies utilized qualitative or mixed-method design. In the studies that used mixed-methods, researchers integrated quantitative and qualitative methodology for the diabetes research project. The elements of qualitative research approaches in these studies included in-person interviews, phone interviews, and focus group sessions. Our review also found that there is an increase in DPP programs using CBPR methodology in the last decade. For example, only 15% or ten studies were conducted between 1999-2010, and 85% or 57 studies were conducted between 2010-2019, which indicates CBPR for diabetes prevention is gaining popularity among the researchers and policymakers. The diabetes self-management intervention program is an innovative and exemplary approach that utilizes the concept of NIH's proposed "blue highway" of knowledge translation, which was established in the scientific arena in the last decade (4). The idea of involving community members at each step of public health research came into light at the same time as the "blue highway" approach (80). Such community-academic collaboration or CBPR became widely popular in the current decade among studies that wanted to implement diabetes programs.

In the reviewed articles, we observed a sharp rise of such community-based intervention programs; more than a 5-fold increase in number from that of the last decade. Although these review articles attempted to incorporate components of CBPR, the findings also noted that there is a lack of inclusion of some CBPR components in many studies. According to Horowitz et al., a CBPR approach should include community partners in planning and developing study protocols using insights and community priorities, developing grant proposal, implementation of intervention in community, collection and analyzing study statistical data and dissemination of study result among community members, and build long-term relationship for future endeavor (80).

In the majority of studies, the advisory board worked at the beginning of the study for planning and reviewing of the study protocol. In most of the studies, the review did not find the inclusion of a community advisory board in data analysis and result dissemination step. Furthermore, no information was provided as to whether the academic-community collaboration will sustain with a long-term partnership with the community advisory boards. It is also noteworthy that very few CBPR interventions were conducted outside North America, and many of the studies conducted in North American were dedicated to the minority population. The use of health coaches/community health workers recruited from the study population was found as a common CBPR element that was incorporated in several studies. An ideal CBPR diabetes intervention program should include community participation at every stage of the program. However, involving community partners in data analysis may pose a challenge to researchers as community partners may not possess academic proficiency (e.g., the statistical skills and competencies) necessary to critically examine the data and study findings. The inclusion of community members from different occupational sectors could solve such an issue.

Dissemination of study findings among community partners is an important task for a CBPR diabetes intervention, and researchers should include community advisory members in this step. Adequate training on formal and informal presentations and research methodology, depending on the academic level of the audience, can help community partners share the study result among their fellow members. Researchers should also indicate how they want to continue the academic-community relationship even after the end of the study. Additionally, research studies should indicate proposed strategies for sustaining successful collaboration activities.

The utilization of the CBPR approach in DPP is currently limited to a few countries, such as the USA and Canada. Very few countries in Asia (i.e., China, India, Iran, and Vietnam) and Europe (i.e., Netherlands, Norway, and Portugal) have published studies for DPP that have utilized the CBPR components. In addition, no DPP study in Africa had utilized the CBPR approach. This is surprising as the prevalence of diabetes is increasing globally,

particularly in Asian and African countries. A review by Rhee noted that by 2030 two continents, Asia and Africa, would have the largest proportions of people suffering from diabetes (81). Our review also noted that except Brazil, no other countries in South America had academic-community engagement for diabetes programs. Successful community-based diabetes interventions among immigrant communities in North America have the potential for translated and culturally adopted in their native home nations (25, 43, 45, 51). Figure 2 graphically shows in which countries the reviewed studies were conducted, which indicates the lack of global adoption of the CBPR approach.

It is imperative that the CBPR approach in diabetes prevention programs should be sought as a necessary component of those programs.

There were a number of strengths of the current review. For example, a large number of studies were reviewed for inclusion and analysis was based on studies from several

different countries. Thus, the risk of country bias may have been minimized. However, the results also need to be viewed with respect to the following potential limitations. This review did not use the comprehensive meta-analysis of the available articles. Second, there was a large amount of heterogeneity in the details of the CBPR components listed by the authors. However, the review was the first aggregative literature review that has evaluated the current practices of the CBPR approach in diabetes prevention programs.

In conclusion, our overall results suggest that community-based DPPs should include the concept of CBPR at every stage of the program activity. Worldwide adoption of community collaborations in diabetes intervention programs in the public health sector can reduce the rate of diabetes or delay the early onset and improve participants' overall health in communities burdened by this preventable chronic disease

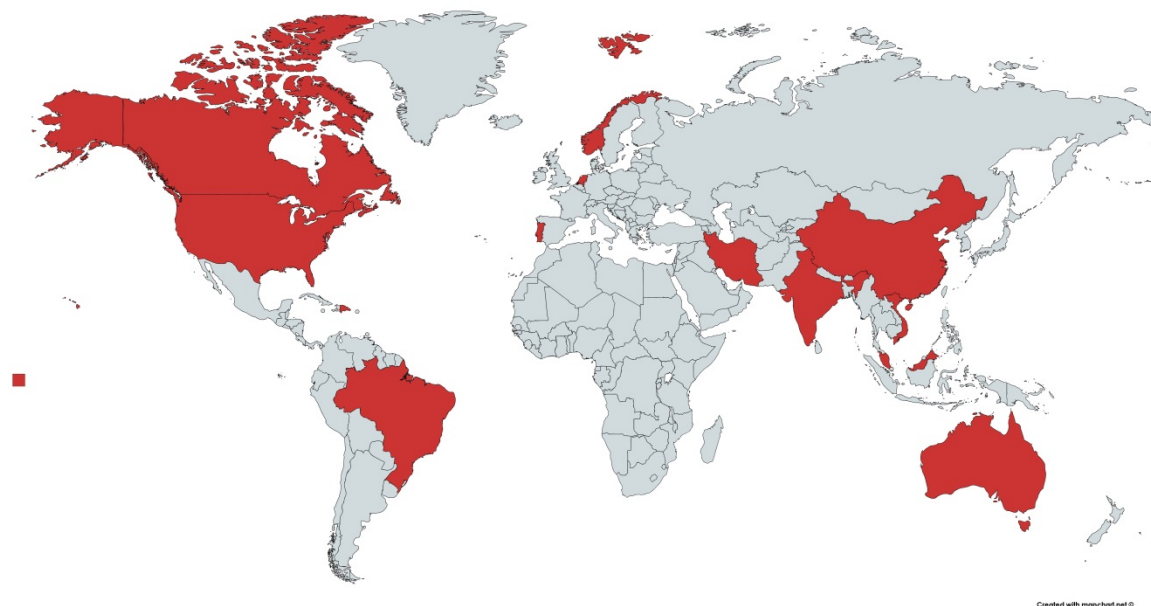


Figure 2. Location of the countries where the reviewed studies were conducted (red color indicates the countries)

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#### *Conflict of interest*

Authors declare no conflict of interests.

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