The effect of culturally- adapted health education interventions among culturally and linguistically diverse (CALD) patients with a chronic illness: A meta-analysis and descriptive systematic review

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Abstract

Objective: Review the effectiveness of health education interventions adapted for culturally and linguistically diverse (CALD) populations with a chronic illness.

Methods: A systematic review and meta-analysis were conducted. Eligible studies were identified across six databases. Data were extracted and intervention effect was summarized using standardized mean difference. If insufficient data for meta-analysis, a descriptive summary was included. Modifying effects of intervention format, length, intensity, provider, and self-management skills taught, and behavioral change techniques (BCTs) utilized were examined.

Results: 58 studies were reviewed and data extracted for 36 outcomes. Most interventions used multiple delivery modes; and were delivered by bilingual health care professionals (HCPs). On average, interventions used 5.19 self-management skills and 4.82 BCTs. Interventions were effective in reducing BMI, cholesterol, triglycerides, blood glucose, HbA1C, and depression, and in increasing knowledge. Effectiveness was influenced partly by provider, with HCPs favored over lay providers for increasing knowledge.

Conclusions: Health education interventions are effective among CALD populations, particularly at improving distal outcomes (e.g., anthropometric measures). These interventions may be equally effective in improving proximal patient-reported outcomes (PROs); however, diversity in PROs limited analyses.

Practice Implications: Core outcome sets (COS) are needed to further investigate and compare health education intervention effectiveness on PROs.

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1. Introduction

Initially, immigrants arriving to a new country are often found to be healthier than, or in comparable health to, their native-born counterparts; however, their general health often decreases over time [1-3]. This trend is referred to as the "healthy immigrant effect" attributable in part to inexperience with the health system, lack of understandable health information, and ineffective communication with health care professionals (HCPs). All of these barriers prevent culturally and linguistically diverse (CALD) individuals from accessing or receiving appropriate health care [4, 5]. CALD refers to immigrants or new citizens who are foreign born, whose main language spoken at home is not the dominant one, who are not proficient in the dominant language, and have non-Indigenous status [6]. These barriers might further account for the finding that CALD populations suffer from an increased incidence of chronic illnesses compared to their non-CALD counterparts [1], and report greater anxiety and depression, poorer quality of life (QoL), and a higher incidence of side effects [7, 8].

Chronic illnesses are the leading cause of death worldwide [9], with chronic illness diagnoses increasing at a rate of 14% every year [10]. This growth in chronic illnesses places an immense burden on health care systems worldwide, accounting for more than half of all direct health care costs [9, 10]. Research suggests that this financial expenditure is increased among CALD patients, whose treatment is estimated to cost nearly 20% more than their non-CALD counterparts [11, 12]. With chronic illness and net international migration on the rise in most countries, the number of CALD patients accessing health care services for the management and treatment of chronic illnesses increases annually. Nonetheless, meeting the needs of this vulnerable sub-group of the population remains sub-optimal [13].

Health education interventions have been shown to be a critical component in achieving optimal disease control and mitigating the progression of chronic illnesses and the development of multi-morbidities [14, 15]. Health education interventions often focus on helping patients acquire the knowledge, skills, and/or attitudes they need to effectively cope with the daily demands of their illness(es) [16]. Reviews among non-CALD patients with chronic illnesses have found that health education interventions often result in positive outcomes including greater treatment adherence, improved QoL, reduced health care costs, and fewer hospital readmissions [15]. CALD patients often do not have access to health education interventions as a result of their limited proficiency in the dominant language(s) [17]. However, in recent years, there has been increased attention to developing culturally and linguistically accessible health education interventions. Therefore, the objectives of this systematic review and meta-analysis are to: (a) describe the culturally-adapted health education interventions published to date by mode, format, intensity, and content; (b) evaluate the short- and long-term effects and cost-effectiveness (if reported) of these interventions; and (c) determine whether their effect varies across intervention types, mode of delivery, and cultural or disease sub-groups.

2. Methods

2.1 Methodological framework

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [18] statement was used to report the methodology of this review (PROSPERO registration: CRD42016047467). See Figure 1 for the PRISMA flow chart.

2.2 Criteria for considering studies for this review

2.2.1. Types of studies. Studies considered were randomized controlled trials (RCTs) or quasi-RCTs in which: (a) a health education intervention was provided to a group of CALD

adults living with a physical chronic illness; and (b) at least one of the following outcomes was reported: patient reported knowledge, physical and/or psychosocial changes, or behavioral, financial, and/or health care services utilization. No limits were placed on the follow-up period or the methodological quality of the studies; however, the quality of the studies was appraised. Abstracts were excluded due to the limited information included. Eligible studies were published or in-press within the last 15 years, in English or French.

2.2.2. Types of participants. The interventions included participants over the age of 18 diagnosed with a physical chronic illness (regardless of time since diagnosis, and severity). To limit the heterogeneity of the sample, studies targeting patients with mental health conditions, developmental delays (e.g., autism), or progressive degenerative disorders (e.g., dementia) were excluded. To be included, studies had to evaluate an intervention intended for participants from a CALD group. CALD was defined as: (a) born in a country other than that of the study; (b) speak a language distinct from the dominant language(s) of the country where the study took place; and/or (c) self-identified with a cultural, ethnic, or racial group with cultural traditions distinct from the country where the study took place [19]. Studies evaluating interventions exclusively for African American or Indigenous participants were not included in the review (unique political historical context). However, studies examining these populations concurrently with a CALD population were included as long as CALD population data could be extracted.

2.2.3. Types of interventions. Health education interventions were defined as any planned activities focused on helping patients acquire the necessary knowledge, skills, and/or attitudes to effectively manage their illness(es) [16]. Included interventions were specifically designed for CALD patients or were an adaptation of an evidence-based intervention. Studies were excluded if the intervention focused on primary prevention or was purely pharmacological.

2.2.4. Control groups. Those accepted were 'usual' health education, active or attention control, or wait-list control.

2.2.5. Types of outcome measures. Outcome measures included: knowledge, physical, psychosocial, behavioral, and/or financial outcomes; and/or health care services utilization. Differences between the control and intervention groups on at least one of these outcomes needed to be included.

2.2.6. Intervention effect modifiers. The following variables were examined in terms of their modifying effect on the interventions: (a) intervention format; (b) duration of intervention; (c) type of provider; (d) ethnic group; (e) content (information only, information and skills training); (f) self-management skills taught; (g) behavioral change techniques (BCTs) included; and (h) length and intensity of the intervention.

2.3. Search Methods for Identification of Studies

2.3.1. Electronic searches. The search strategies were developed through an iterative process in consultation with an academic librarian. Six electronic databases were searched: CINAHL, MEDLINE, PsycInfo, EMBASE current, Cochrane, and Global Health. Three key concepts with distinct keywords and medical subheadings (MeSH) were used: (a) terms related to health education (e.g., communication, health education, psychoeducation, self-help); (b) terms related to the target CALD population (e.g., immigrants, ethnic groups); and (c) to methodology (e.g., RCTs, quasi-experimental, crossover, control group). See Electronic Supplementary Material S1 for the complete search strategy. All titles and abstracts were initially downloaded to Endnote where duplicates were removed.

2.3.2. Selection of studies. Titles and abstracts were reviewed independently by at least two trained research assistants (RAs). Full-texts were then examined independently by at least

two of the RAs to confirm inclusion or exclusion. Disagreements were resolved through discussion during team meetings with the RAs and principal investigator.

2.4. Data Collection

2.4.1. Data extraction and management. Data were extracted using a standardized Excel form [20]. The data extraction form has been used across other reviews conducted by the team [14, 21]. The extraction of data was performed by one RA and confirmed by two other RAs. Study authors were contacted, if the details of the data were unclear. Disagreements were discussed and resolved at regular team meetings.

2.4.2. Data items and coding. The data extraction form documented: (a) authors' name and year of publication; (b) country; (c) design; (d) goals; (e) theoretical framework; (f) sample characteristics; (g) assessment of the three CALD criteria; (h) recruitment setting; (i) summary of control and intervention groups; (j) intervention details; (k) intervention delivery mode (interactive, passive, or both); (l) intervention format (face to face or other); (m) intervention provider (HCPs = providers with formal training in care delivery; paraprofessionals = those requiring a certain level of training to be qualified to deliver an intervention; or lay providers = including peer coaches with no formal training matched based on their culture and/or disease experience); (n) self-management skills addressed [22]; (o) BCTs used [23]; (p) intervention intensity; (q) fidelity; (r) adherence; (s) uptake rate; (t) outcomes; (u) measurements; (v) findings; and (w) attrition.

2.4.3. Time points. The outcomes were categorized into three timeframes: Short-term outcomes (T1 = baseline to ≤ 6 months post-baseline), medium-term outcomes (T2 = 6 to ≤12 months), and long-term outcomes (T3 = >12 months).

2.4.4. Quality assessment. The methodological quality of studies was assessed by pairs of trained RAs based on 11 criteria (all criteria considered equal) [20, 24]: (a) a priori power calculations; (b) eligibility criteria specified; (c) psychometric properties of measures reported; (d) description of baseline sample characteristics; (e) comparison of baseline sample characteristics; (f) adequate sequence generation; (g) allocation concealment; (h) assessment of blinding; (i) intention to treat; (j) 80% of sample retained; and (k) the reason(s) for data losses and exclusions explained. Each item was scored as either 1 = yes or 0 = no. Studies were considered to be of high methodological quality if at least 9/11 criteria were met, moderate quality if 6-8 criteria were met, and low quality if ≤ 5 criteria were met.

2.5. Data Analysis

2.5.1. Meta-analysis. For each outcome measured in a similar way across at least three studies, a meta-analysis was conducted by calculating the pooled effect size of the interventions at T1 and T2. The standard mean difference (SMD) was used to express the size of the intervention effect, calculated as the mean difference at end point divided by pooled standard deviation [25]. The magnitude of the SMD was interpreted as follows: small, SMD = 0.2; medium, SMD = 0.5; and large, SMD = 0.8 [26]. The Higgin's statistic (I^2) [27] was calculated to measure the total variation across studies. For meta-analysis with non-substantial heterogeneity (I^2 <25%), the pooled effect size was computed using a fixed effects model. However, when the heterogeneity was substantial ($I^2 \geq 25\%$) the pooled effect size was computed using a random effects model. To assess the potential role of publication bias on findings, inspection of the funnel plot and the Egger test [28] were performed for meta-analyses with more than five studies. To assess the effects of intervention modifiers on intervention

effectiveness, meta-regressions [28] were performed if categorical sub-groups included a minimum of 4 studies [29].

2.5.2. Descriptive analysis. Descriptive analyses were conducted for two sets of outcomes. First, for studies that reported on outcomes selected for meta-analysis but could not be included in the meta-analysis due to missing data. Second, a set of outcomes could not be included in the meta-analysis, because of high heterogeneity. Not to lose the data, a descriptive analysis was favored if the outcome had been reported in at least 10 studies, to ensure enough data to report on. For these outcomes, the effect of the intervention was based on statistical significance ($p<0.05$) and a Cohen's effect size (ES) of at least $d = 0.2$, whereby if > 50% of interventions had an effect on that outcome, it was concluded that health education interventions were effective on that outcome. Cost-effectiveness was also examined descriptively. Inflation was considered using the country-specific yearly average consumer price index provided by the World Outlook 2018 Database [30]. All monetary data were then converted to USD for cost comparison, using the average 2019 exchange rates reported by the Internal Revenue Service [31]. Cost data was calculated for the year of intervention recruitment/delivery. If the intervention recruitment/delivery was not specified, the publication year was used.

2.5.3. Analysis of intervention effectiveness. Last, if an intervention was effective for at least 50% of the primary outcomes, it was concluded that the intervention was overall effectiveness across outcome (as opposed to by outcome). If primary outcomes were not specified, all outcomes measured were taken into consideration.

3. Results

3.1. Flow of studies through review

The electronic search identified 15,415 eligible citations. Of these, 189 manuscripts underwent full-text review, whereby 131 were subsequently excluded (see Figure 1 for reasons). As a result, 58 studies were reviewed [32-89]. Each study is summarized in Table 1.

3.2. Overview of Studies

3.2.1. Types of studies. Most studies (n = 52, 89.7%,) were conducted in the United States of America (USA) and were two-armed RCTs (n = 55, 94.8%).

3.2.2. Types of participants. Sample sizes ranged from 17 to 1665 ($\bar{x}$ = 243, Total = 12,731), with 72.4% of participants identifying as female. Participants' mean age was 54.6 years (SD = 10). More than half of studies examined participants with diabetes (60.3%, n = 35).

Studies rarely mentioned whether or not CALD participants had low proficiency in the dominant language; and/or whether or not participants were foreign-born. Participants were predominantly of Hispanic (n=48, 82.8%) ethnicity. A third of studies recruited Spanish-speaking participants (n = 22, 37.9%), and delivered the intervention in this language. An additional 22 studies (37.9%) offered the option to participate in either Spanish or English based on their preference. Other languages included Punjabi, Urdu, Hindi, Mirpuri, Bengali, or Sylheti [n =5, 8.5%], Korean [n = 2, 3.4%], or a mixture of Vietnamese, Chinese, Italian, or Greek languages [n = 2, 3.4%].

3.3. Description of interventions

3.3.1. Delivery modes and format. 51 interventions (87.9%) used multiple modes (e.g., interviews, activities, workshops, phone calls). The seven interventions choosing one mode were delivered using DVDs or videos (n = 2, 3.4%) [39, 70], face-to-face contacts (n = 2, 3.4%) [32, 41], phone calls (n = 2, 3.4%) [35, 71], or the Internet (n = 1, 1.7%) [46]. All interventions (except [65]) included an interactive format with the intervention provider, whereby participants

and providers met one-on-one (n = 26, 44.8%) [32-36, 39-41, 47, 48, 52, 54, 60, 67, 70-73, 76-78, 85, 87-89] or during group sessions (n = 14, 24.1%) [38, 42-44, 46, 50, 51, 58, 61, 62, 66, 68, 70, 80, 82, 86] or a combination of these (n = 17, 29.3%) [43, 51, 55, 59, 61-65, 69, 70, 75, 80, 81, 85, 87, 89, 90]. Some interventions (n = 14, 23.7%) also included a passive component, such as educational videos or brochures [39, 44, 48, 51, 57, 64, 67, 68, 71, 72, 78-80, 93].

3.3.2. Intervention provider. For almost all interventions, the provider was bilingual (n = 51, 89.4%). Although most studies specified the language of their interventionist, the language(s) in which the intervention was delivered was often not explicit. The majority of interventions were delivered by one to five HCPs (n = 33, 56.9%) [38, 39, 42, 44-46, 48-52, 54-56, 58-63, 67, 68, 72, 73, 75, 78-81, 85, 91, 93-95] with complementary backgrounds. The most common interprofessional teams consisted of nurse(s) paired with dietician(s)/nutritionist(s) (n =10) [48, 49, 55, 61, 62, 72, 81, 91, 93-95]. Bilingual lay providers were the next most common providers (n = 15, 25.9%) [42, 43, 57, 64-66, 70, 74, 77, 82, 86-88, 92]. Eight interventions (13.8%) were delivered by paraprofessionals [40, 41, 47, 53, 69, 76, 83, 84]. Seven interventions incorporated both HCPs and lay providers [45, 48, 49, 61, 63, 75, 80]. One intervention was self-directed, and had no provider (automated mailings and tailored computer generated feedback) [71]. Two interventions did not have sufficient details on the intervention provider [89, 90].

3.3.3. Intervention setting and intensity. Most interventions took place in the participant's home (n = 13) [40, 41, 52, 54, 66, 71, 73, 77-79, 82, 84, 91] or primary care clinics (n = 11) [38, 45, 46, 51, 60, 67-69, 86, 92, 93]. Some took place in community centers (n = 7) [72, 74, 76, 88-90, 94, 95] or hospitals (n = 2) [39, 55]. The remaining interventions were delivered across multiple settings (n = 24, 41.4%) [42-44, 47-49, 53, 56-59, 61-65, 70, 75, 80, 81, 83, 85, 87]. Most commonly, face-to-face components were delivered in the community or a

clinic, with follow-ups typically conducted over the phone at home. The mean number of intervention sessions was 13.55 sessions (SD = 10.76), ranging from 1 to 48 sessions (median = 9) and the mean total duration of contact with intervention provider(s) was 32.06 weeks (SD = 39.82, n = 56), with interventions lasting from 1 week to 5 years (median = 24 weeks). Providers had an average of 988.48 minutes (SD = 898.74) of contact with participants with some having as little as 20 minutes and some as many as 3564 minutes (median = 795).

3.3.4 Self-management skills. The self-management skills coded in each intervention can be found in the Electronic Supplementary Material S2. Of a possible 10 self-management skills, the mean number of skills implemented in the interventions was 5.19 (*SD* = 2.17, range = 2-10). The most commonly included self-management skills were lifestyle change (n = 48, 82.7%), problem-solving (n = 40, 69.0%), symptom management (n = 37, 63.8%), partnership with healthcare provider (n = 37, 63.8%), and taking action (n = 31, 53.4%).

3.3.5 Behavior change techniques. The BCTs coded in each intervention can be found in Electronic Supplementary Material S2. Of a possible 16 clusters of BCTs, the mean number implemented in the interventions was 4.82 (*SD* = 2.10). There was a minimum of one BCT cluster (n = 1) [45] in each intervention, with as many ten clusters (n = 1) [50] included. The most common BCT clusters were: social support (n = 53), goals and planning (n = 44), feedback and monitoring (n = 39), shaping knowledge (n = 29), and regulation of behavior (n = 21).

3.3.6 Fidelity and adherence. Only 23 studies reported on intervention fidelity [40, 43, 45, 50, 51, 53, 54, 56, 61, 63, 65, 69, 70, 73, 74, 76, 77, 81-83, 86, 91, 93]. Fewer studies (n=13) reported on adherence [40, 42, 51, 53, 56, 59, 68, 70, 76, 81, 86, 91, 93]. Fidelity and adherence were assessed based on reports from the individual study authors.

3.4. Methodological Quality Assessment

The methodological quality score of each study is presented in Table 1 (see Electronic Supplementary Material S3 for detailed scoring). Eight studies were of high methodological quality [46, 57, 58, 62, 66, 70, 73, 82], 28 of moderate quality [39, 40, 43, 45, 47, 53, 54, 56, 61, 63, 65, 67-69, 74, 76, 77, 79-81, 83, 85, 87, 89, 91, 92, 94, 95] and 22 of low quality [38, 41, 42, 44, 48-52, 55, 59, 60, 64, 71, 72, 75, 78, 84, 86, 88, 90].

3.5. Outcomes: Meta-Analysis

Across studies, data were extracted for 36 outcomes. Of these, 10 outcomes (mostly physiological/anthropometric measures) were similarly measured in at least three studies to be included in the meta-analysis. Across these 10 outcomes, the meta-analysis results are supplemented by descriptive analyses for studies where insufficient data were reported for inclusion in the meta-analysis. Findings of the meta-analysis are summarized in Table 2. The results are summarized for T1 and T2, as there were insufficient data for T3.

3.5.1. Blood pressure. 17 studies [46, 50, 51, 54, 61-63, 70, 73-77, 81, 87, 94, 95] reported systolic and/or diastolic blood pressures at T1 and/or T2, and neither pooled effect sizes were significant. The three studies not included in the meta-analysis, mostly confirmed these findings [43, 45, 82].

3.5.2. BMI. T1 = -0.13 (95% CI = -0.23, -0.04) [46, 48, 50, 51, 56, 62, 68, 74, 75, 81, 87, 92, 95] and T2 = -0.19 (95% CI = -0.36, -0.01) [48, 50, 62, 68, 74-76] pooled effect sizes were small but significant for the14 studies included in the meta-analysis. Of the four studies not included in the meta-analysis [42, 45, 49, 84], two reported findings in line with the meta-analysis [42, 49].

3.5.3. Cholesterol (total, LDL HDL). 10 of the 12 studies examining total cholesterol were entered in the meta-analysis [48, 50, 51, 54, 62, 63, 73-75, 81]. A small significant effect size was noted at T1: SMD = -0.18, 95% CI = -0.36, -0.01. At T2, the pooled effect size was not significant: SMD = -0.12, 95% CI = -0.29, 0.03 [48, 50, 62, 63, 73-75]. Of the additional two studies [45, 59] retained for descriptive review, one [59] reported findings in line the meta-analysis. The pooled effect sizes for LDL and HDL cholesterol were not significant [50, 51, 54, 62, 63, 70, 73, 74, 76, 77, 81, 87]. The remaining study retained for descriptive review [59] reported a significant finding.

3.5.4. Blood Glucose (random or fasting). For the six studies entered in the meta-analysis, the effect sizes were significant, but still in the low range [48, 51, 62, 63, 73, 92]: T1 (n = 6): SMD = -0.35, 95% CI = -0.49, -0.20 [48, 51, 62, 63, 73, 92], and T2 (n = 4) SMD = -0.31, 95% CI = -0.46, -0.16 [48, 62, 63, 73].

3.5.5. HbA1C. HbA1C was examined in 30 studies. The pooled effect size of -0.29 (95% CI = -0.40, -0.18) at T1 (n = 19) [48, 51, 54, 62-65, 69, 73, 74, 77, 80, 81, 83, 85, 87, 89, 92, 95] was small but significant, as was the pooled effect size at T2: SMD = -0.25, 95% CI = -0.38, -0.13 (n = 12) [48, 62, 63, 70, 73, 74, 76, 80, 82, 83, 89, 94]. Of the eight studies not included in the meta-analysis [42, 45, 49, 59, 72, 76, 84, 90], five studies were in line with the meta-analysis findings [42, 49, 59, 76, 84].

3.5.6. Triglycerides. All studies examining triglycerides were entered in the meta-analysis (n = 11) [50, 51, 54, 62, 63, 73-76, 80, 81]. A small effect size was observed at both T1 (n = 9) [50, 51, 54, 62, 63, 73-75, 81] and T2 (n = 6) [50, 63, 73, 75, 76, 80]: SMD = -0.12, 95% CI = -0.24, -0.00 and SMD = -0.13, 95% CI = -0.25, -0.01, respectively.

3.5.7. Waist Circumference. Waist circumference was examined in 5 studies. The 4 studies [50, 51, 56, 81] entered in the meta-analysis did not result in a significant pooled effect size at T1. The remaining study [45] confirmed this finding.

3.5.8. Weight. The six studies entered in the meta-analysis [50, 51, 56, 68, 73, 92] did not result in significant pooled effect sizes. However, the additional study not entered in the meta-analysis [67] found a significant difference between the intervention and control groups in weight at T2 ($p < 0.001$).

3.5.9. Depression. Of the twelve studies examining depression, nine were entered into the meta-analysis, whereby the pooled effect size at T1 (n = 8) [40, 57, 61, 62, 66, 67, 79, 81] was not significant, but at T2 a small, significant effect size was noted (n = 3) [52, 61, 62]: SMD = -0.27, 95% CI = -0.44, -0.09. None of the three descriptive studies found a significant impact [58, 71, 94].

3.5.9. Knowledge. 12 studies [44, 48, 54, 61-63, 65, 80, 81, 86, 87, 92] evaluated diabetes or hypertension knowledge at T1, with a significant small overall pooled effect size: SMD=0.35, 95% CI=0.22–0.48. The five studies that evaluated knowledge at T2 [48, 61-63, 80] support a persistent, significant effect (SMD = 0.45, 95% CI = 0.28–0.62). Three of the four studies not entered in the meta-analysis supported these findings [42, 58, 84].

3.6. Outcomes: Descriptive review only

An additional five outcomes were included in a descriptive analysis only, as they were reported in enough studies, but the high heterogeneity in how these outcomes were defined and operationalized precluded a meta-analysis. Findings for the descriptive outcomes are summarized in Table 1.

3.6.1. Dietary behaviors. 13 studies examined dietary behaviors as an outcome. At T1 (n = 11 studies) [46, 53, 56, 69, 80, 81, 83, 85, 87, 89, 92], analyses were significant in only four studies [53, 69, 87, 89]. Three studies [80, 83, 89] examined outcomes at T2, with only one reporting significant findings [89]. A final study [90] examined this outcome at T3, reporting significant results. Therefore, health education interventions overall were not effectiveness on dietary behaviors.

3.6.2. Exercise. Exercise was examined in 12 studies. Of the nine studies [64, 68, 71, 75, 81, 83, 87, 89, 92] included at T1, two were statistically significant [68, 89]. None of the three studies [75, 83, 89] at T2 were significant. Finally, Toobert et al [90] reported non-significant changes in exercise at T3. Overall, the interventions had no impact on exercise.

3.6.3. Quality of Life (QoL). QoL was examined in 10 studies, with measures including global and domain-level QoL, as well as disease-specific QoL. At T1 (n = 9 studies) [54, 60, 62, 63, 66, 77, 79, 81, 89], only two studies were significant [63, 66]. At T2 (n = 4 studies) [52, 62, 63, 89], only one study was significant [89]. Overall, the interventions had no impact on QoL.

3.6.4. Self-care. Four studies [62, 77, 87, 89] at T1 (n = 10) [44, 46, 62, 64, 77, 81, 83, 87, 89, 92] showed significant improvements in self-care behaviors. This effect was not maintained at T2 (n = 3) [62, 83, 89]. An additional study [89] showed large improvements in self-care at T3 only (d = 4.1, 95% CI = 3.7 to 4.5). Overall, at T1 and T2, health education interventions had no impact on self-care; however, a significant impact is noted at T3.

3.6.5. Self-efficacy. 13 studies examined self-efficacy [38, 54, 61-64, 77, 81, 84, 87, 89, 90, 92]. Five studies [38, 54, 63, 64, 89] at T1 (n = 11) [38, 54, 61-64, 77, 81, 87, 89, 92] showed significant improvements in self-efficacy. At T2 (n = 3), all three studies [61, 63, 89] showed a

significant improvement in self-efficacy; an effect not maintained at T3 (n = 3) [61, 84, 90]. Overall, health education interventions did not have an impact on self-efficacy.

3.7. Intervention Modifiers. Interventions were more likely to be effective in reducing HbA1C when either a lay provider or a paraprofessional (SMD = -0.44, 95% CI = -0.59, -0.29, n = 10, I^2 = 41%) delivered the intervention as compared to an HCP (SMD = -0.15, 95% CI = -0.25, -0.05, n = 9, I^2 = 0%). Knowledge was more likely to be higher if the intervention was delivered by an HCP (SMD = 0.58, 95% CI = 0.38, 0.77, n = 4, I^2 = 0%) compared to a lay provider or a paraprofessional (SMD = 0.26, 95% CI = 0.14, 0.38, n = 8, I^2 = 14%). Further, peer coaching did not seem to increase the knowledge of participants (SMD peer coaching = 0.16, 95% CI = 0.00, 0.31, n = 5, I^2 = 0% versus SMD no peer coaching = 0.44, 95% CI = 0.30, 0.58, n = 7, I^2 = 26%). All other modifiers were not significant (analysis presented in Electronic Supplementary Material S4).

3.8. Cost-effectiveness of health education interventions

Five studies [45, 48, 57, 64, 82] estimated the cost of delivering their intervention. Costs ranged from $217.90 to $2643.72 ($\bar{x}$ = $985.86, $\tilde{x}$ = $549.74) per participant. Cost per week ranged from $10.57 to $49.84 ($\bar{x}$ = $30.54) per participant. Only Bellary et al. [45] calculated the incremental cost effectiveness ratio per change in quality-adjusted life years (QALY) and reported to be $37,413.26 per QALY gained (concluding that their intervention did not produce enough health-related gains in QoL to make it cost-effective).

4. Discussion and Conclusions

4.1. Discussion

CALD populations face significant health disparities and increased rates of chronic illnesses as compared to their non-CALD counterparts [1]. Access and use of health services

among this group remains low [96]. The provision of effective culturally appropriate services is predicted to improve the success of health service delivery among CALD communities, namely through: promoting disease screening and follow-up, and application of preventative strategies such as self-management [97, 98]. Health education interventions are among the strategies found to improve optimal disease control and to mitigate the progression of chronic illnesses and the development of multi-morbidities [18, 19]. The aim of this meta-analysis and descriptive systematic review was to evaluate the effectiveness and cost-effectiveness (if reported) of 58 health education interventions for CALD individuals with a chronic illness.

Our results provide evidence that health education interventions for CALD patients are effective in reducing BMI, cholesterol, triglycerides, blood glucose, HbA1C, and depression and in increasing knowledge of disease. These effect sizes were of small magnitude, yet comparable to the findings of other meta-analyses not specific to CALD patients. For instance, three meta-analyses among non-CALD patients found a small to moderate effect of diabetes self-management interventions on HbA1C [99-101]. Likewise, two meta-analyses found small effect sizes on blood glucose levels [99, 100]. A meta-analysis by Brady et al. [102] found a comparable small effect of self-management interventions on depression levels among non-CALD patients diagnosed with diabetes. These findings suggest that health education interventions are overall as effective in CALD as in non-CALD populations.

The present review highlighted the great deal of variability in reported outcomes. Such heterogeneity made comparison among studies challenging, including limiting the number of outcomes that could be combined in the meta-analyses. Meta-analyses were predominately possible on physiological outcomes, which might be because standardized measures are available for these outcomes. Conversely, psychosocial and patient-reported outcomes tend to use different

instruments, thus creating inconsistencies in reporting [103, 104]. One possible solution is the concept of the core outcome set (COS), where a set of important outcomes of an intervention are defined, ideally along with the instruments to measure them [105, 106]. Core outcome sets have been developed in a number of areas, overseen by the COMET initiative (http://www.comet-initiative.org) [107, 108]. There is evidence from COS development in rheumatology that this kind of initiative improves reporting quality [109]. To our knowledge, no studies exist outlining the COS for health education interventions, and therefore it remains an area requiring further investigation.

Health education interventions reviewed typically used multiple modes, potentially as a means of reaching patients in a way that they learn best [110] and/or to enhance the cost-effectiveness of the intervention. Although cost-effectiveness was not typically examined. In addition to HCPs, bilingual lay providers were common providers. A large emphasis has been put for CALD populations on recruiting peer coaches and lay providers who are culturally and linguistically matched to participants to bridge the gap in the provision of culturally competent care [1]. Non-CALD research also support that health education interventions do not have to be guided by highly trained professionals to be effective [111, 112]. The adds to this literature by suggesting that lay providers might be particularly useful in providing culturally adapted lifestyle advice that is associated with improvements in diabetes management. However, these providers may lack the necessary skills, expertise, or access required to provide education to CALD patients on the most up-to-date knowledge of disease processes, treatments, and management of chronic illnesses. These findings are in line with a recent qualitative study performed by our team on the information needs of CALD patients that revealed that HCPs were the preferred source of medical information (attributed mostly to their level of expertise) [113]. Conversely,

lay persons were favored for lifestyle-practical related illness management concerns (partly due to their real-life experience) [114]. As such, interventions delivered by both HCPs and lay persons may result in the largest objective and subjective knowledge gains among CALD patients managing a chronic illness.

The mean number of intervention sessions was 13.55 sessions (SD = 10.76), a finding that is comparable to other published reviews evaluating the length of health education interventions for chronic illness.[115-117] However, length of the intervention was not found to be a significant modifier. Related to the time commitment of intervention participation is adherence. Few studies reviewed reported on treatment adherence. Treatment adherence is strongly associated with improved patient outcomes, with studies estimating that 26% more patients experience a positive outcome when adhering to treatments compared to non-adherence [118]. This is of particular concern among CALD populations, as retention and treatment adherence are a well-documented challenge [119, 120]. Moreover, research suggests that, in general, health education interventions tend to have low participation rates [121-123]. Participants in a qualitative study recently performed by our team attributed non-adherence to medical advice to the following reasons: a lack of culturally relevant information, low motivation to implement lifestyle changes, and linguistic barriers [114]. This further emphasizes the importance of utilizing interprofessional teams (consisting of both HCPs and lay providers) to translate both the objective and subjective domains of health education required for successful illness management. DiMatteo and colleagues [118] further suggested that adherence impacts disease specific, objective outcomes (i.e. distal outcomes of health education interventions such as HbA1C and blood glucose) and nonspecific or subjective patient-reported outcomes (i.e. proximal outcomes such as knowledge) differently. Specifically, adherence has less of an impact

on objective measures than it has on subjective outcomes. This is potentially consistent with the findings of this review, where few subjective outcomes were found to be significant.

The other modifiers of intervention effects examined were self-management skills and BCTs. None of these were found to be significant; however, analyses were limited by the sample sizes. Some trends were noted for partnership with HCP for depression and needs further exploration in subsequent studies. This is consistent with our recent qualitative study among CALD patients with a chronic illness, which found that often CALD patients did not discuss psychosocial issues with HCPs due to language barriers and cultural mismatch [113]. The most common BCTs were: (a) social support, (b) goals and planning, and (c) feedback and monitoring. A number of reviews [124-126] have identified these BCTs as being commonly applied in self-management programs; and moreover have linked their inclusion to positive health, psychological, and clinical outcomes. The present review did not identify a modifying effect of BCTs; however, this may due to the large degree of heterogeneity of outcomes that limited meta-regressions in the categorical outcome sub-groups. Despite using the PRISMA checklist as well as reproducible methods to identify studies in the present review, a number of limitations warrant discussion. Namely, 22 studies were assessed to be of low methodological quality, thus limiting the conclusions that can be drawn. Another limitation was the significant heterogeneity across studies. As such, for many outcomes, the number of studies evaluated at each time point remained low. Finally, most studies were conducted with individuals of Hispanic ethnicity, limiting the generalizability of the findings. For a similar reason, it is noted that a significant sub-group of participants had diabetes.

4.2. Conclusion

Health education interventions are effective among CALD populations, particularly at improving distal outcomes (e.g., anthropometric measures). These interventions may be equally effective in improving proximal patient-reported outcomes (PROs); however, diversity in PROs limited analyses.

4.3. Practice Implications

Health education interventions are needed to help CALD patients effectively cope with the daily demands of their illnesses. Findings suggest that existing interventions may be effective in reducing physiological markers of disease; however, more research is needed to examine their effects on more subjective, outcomes such as self-efficacy, knowledge, and self-management skills. The heterogeneity in outcomes measured and instruments used suggests that future research should focus on the development of a core outcome set (COS). Researchers support the use of Delphi methods to achieve a consensus among stakeholders in the development of COS [127]. Finally, only one study performed a financial analysis of their intervention and more research in this area is needed.

List of Abbreviations

BCT: behavioral change techniques
BMI: body mass index
CALD: Culturally and linguistically diverse
COS: core outcome sets
ES: Cohen's effect size
HCP: health care professionals
MeSH: Medical subheadings (MeSH)
PRISMA: The Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PROs: patient-reported outcomes
QoL: Quality of life
RA: Research assistants
RCTs: randomized controlled trials
SMD: Standardized mean difference
UK: United Kingdom
USA: United States of America

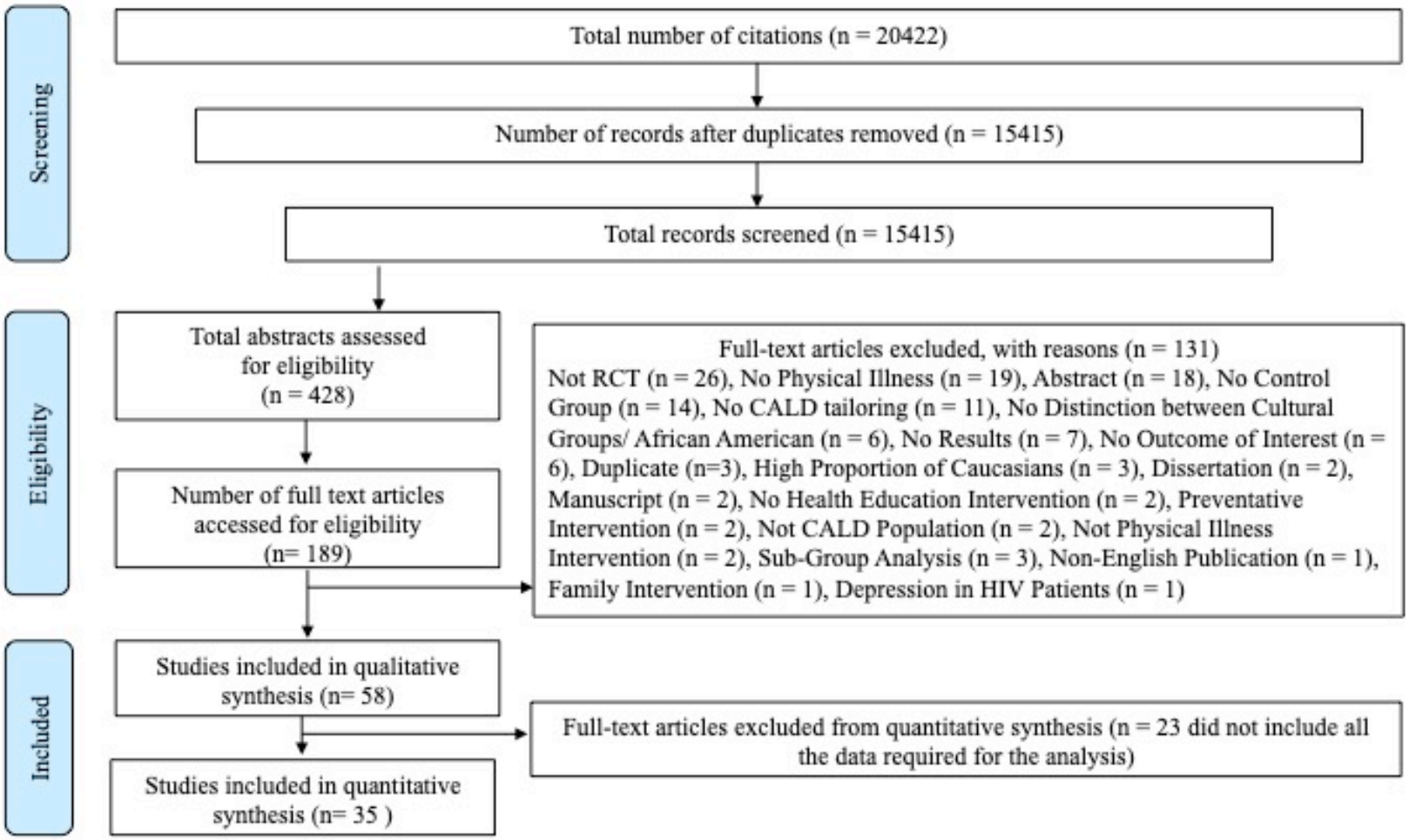

Figure 1. PRISMA

Table 1. *Characteristics of Included Studies (N = 58)*

Author, Year, Country	Goal	Population	Intervention Conditions and Assessments	Outcomes	E*	Quality score (/11)
Alicea-Planas et al., (2013) [38] **USA**	To evaluate the effectiveness of a goal setting intervention in improving health and self-rated health scores among Spanish-speaking patients with chronic diseases.	**N**=184 (T = 91; C = 93); **Mean age** (years): 54.1 (SD = 13.13) **% female:** 71.2% **Population**: Self-identified, Hispanic, Spanish-speaking patients with at least one chronic disease	**T:** Patients created a "healthy changes" action plan, which included goal setting, identifying facilitators and barriers, and rating confidence in their ability to reach their goal + a single follow-up appointment (10-15 minutes) at one month **C:** Usual care; patients were provided with general health education material on their specific disease (available in the centers) and general health messages throughout the nurse-screening process + a single follow-up appointment (10-15 minutes) at one month **Duration**: 4 weeks **Timing of measures:** Baseline and 1-month	**O:** T1= C for self-rated health (*d* = -0.19) T1>C self-efficacy (*d*=0.53)	$\square_{T1}$	5
Anderson et al., (2004) [39] **USA**	To evaluate the effectiveness of a pain education intervention in reducing pain among African American and Hispanic patients diagnosed with cancer.	**N**=101 (T = 50; C = 47) **Mean age** (years): T: 58 (SD = 12.4), C: 55 (SD = 10.3) **% female**: T: 58%, C: 68; **Population**: African American (T: 44% C: 43%) and Hispanic (T: 56%, C: 57%) patients diagnosed with cancer.	**T:** Educational video (20 minutes) and booklet tailored to sex and ethnic group + 30 minute meeting with nurse researcher after the video + one follow up telephone call x 48 to 72 following their visit. **C:** Attention control involving a nutrition education package + 30 minute meeting with nurse researcher to discuss material + one follow-up telephone call to review nutritional plan x 48 to 72 following their visit. **Duration**: 0.42 weeks **Timing of measures:** Baseline, 2-4 weeks, 6-7 weeks, and 8-10 weeks	**P:** T1=C for pain intensity and pain-related interference (◆) **S:** T1=C for QoL, functional status, perceived control of pain, and adherence to analgesics (◆)	$\square_{T1}$	8

Ashing-Giwa (2008) [41] **USA**	To evaluate the feasibility of a CALD-tailored behavior based telephone counseling and group education intervention for improving physical and psychological well-being among Latina cervical cancer survivors	**N** = 23 (T = 15; C = 8) **Mean age** (years): T: 47.9 (SD = 6.9); C: 55.5 (SD = 14.9) **% female:** 100% **Population**: Self-identified Latina women (18+ years) in remission with cervical cancer who self-reported moderate to high emotional/social concerns	**T:** 6 individually- and culturally-tailored telephone counseling sessions (40 minutes each) addressing goal-setting, behavioral modification, and self-help + targeted "Survivorship Kit" education package material **C:** Usual care + targeted "Survivorship Kit" education package material **Duration**: 12 weeks **Timing of measures:** Baseline and 3-months	**O:** T1>C for overall health-related QoL, and physical QoL subscale (◆) T1=C for social/family, emotional, and functional QoL subscales (◆)	$\square_{T1}$	4
Ashing & Rosales (2014) [40] **USA**	To evaluate the effectiveness of a para-professionally delivered, telephonic-based psycho-educational intervention for improving depressive symptoms among Latina adults who were in remission of breast cancer	**N** = 221 (T = 110; C = 111) **Mean age** (years): T: 51.9 (SD = 10.6); C: 53.9 (SD = 10.4) **% female**: 100% **Population**: self-identified Latina adults (18+ year old) who had been diagnosed with breast cancer in the last 6 years but were disease free at time of study	**T:** 8 telephone sessions (biweekly, 40-50 minutes each) with paraprofessional interventionists targeting medical, psychosocial, sexual, and financial concerns + one follow-up session (booster or debriefing session) + survivorship booklet **C:** Usual care + survivorship booklet **Duration**: 4 weeks **Timing of measures:** Baseline and 3-4 months	**P:** T1>C for depression (*d* =0.58)	$\square_{T1}$	7
Babamoto et al., (2009) [42] **USA**	To evaluate the effectiveness of a community health worker (CHW)-led intervention compared to usual clinic-lead diabetes care (either with a	**N** = 189 (CHW = 75; CM = 60; SPC = 54) **Mean age** (years): CHW: 51.0 (SD = 12.5), CM: 50.0 (SD = 12.2), SPC: 50.0 (SD = 11.0) **% female**: CHW: 64%, CM: 52%, SPC: 78%	**T$_{CHW}$:** SPC + Individual educational sessions ($\bar{x}$ = 11.3 sessions) with a CHW addressing diabetes education and self-monitoring. Sessions were tailored to the participants' needs including knowledge, problem solving, goal setting, and self-monitoring progress + follow-up calls as needed to monitor self-management progress, identify barriers, and help problem solve	**O:** $T1_{CHW} > (T1_{CM} = C_{SPC})$ for self-reported health status, medication adherence, fatty food intake, diabetes knowledge (◆)	$\square_{T1CHW}$ $\square_{T1CM}$	5

	case manager (CM), or standard provider care (SPC) for Hispanic persons with type 2 diabetes	**Population**: Self-reported Hispanic/Latino adults, newly diagnosed with type-2 diabetes	**T_{CM}:** SPC + individual diabetes care and education from two linguistically competent and culturally sensitive RNs **C_{SPC}:** Standardized clinical care by MDs/NPs including clinic appointments, lab tests, medication, referrals, and diabetes education packet available in Spanish or English **Duration**: 24 weeks (both intervention arms) **Timing of measures:** Baseline and 6-month	$(T1_{CHW} = T1_{CM}) > C_{SPC}$ for self-reported ED admissions in the previous 6-months, dietary behavior of fruit and vegetable intake (◆) $T1_{CHW} > (T1_{CM} = C_{SPC})$ for $(T1_{CHW} = C_{SPC}) > T1_{CM}$ physical activity (◆) $T1_{CHW} = T1_{CM} = C_{SPC}$ BMI, and HbA1C (◆)		
Balcazar et al., (2009) [43] **USA**	To evaluate the effectiveness of a CHW (Promotora) program in improving hypertension control among underserved Mexican individuals with hypertension (MHTN).	**N** = 98 (T = 58; C = 40) **Mean age** (years): T: 59.4, C: 49.7 **% female:** T: 87.9%, C: 65% **Population**: Medically underserved Mexicans with hypertension	**T:** Spanish version of 6 education modules in *Your Heart, Your Life* (blood pressure information, blood pressure control, lifestyle changes) + new hypertension module including a fotonovela (focuses on family approach to blood pressure control), delivered in Spanish by CHW's in two-hour group sessions during weeks 1, 2, 3, and 8 + individual follow-up telephone calls weeks 4 through 7 to discuss what lifestyle changes (e.g., changes in weight, salt and sodium consumption) were made by participants **C:** Received Spanish educational materials related to overall health issues during week 1. **Duration:** 9 weeks **Timing of measures:** Baseline, 3-weeks, and 9- weeks	**O:** T1>C for dietary behaviors (salt and sodium healthy habits + cholesterol and fat healthy habits) and attitudes and beliefs surrounding HTN control (perceived benefits subscale) (◆) T1=C for BMI, BP, self-efficacy, waist circumference and attitudes and beliefs surrounding HTN control (perceived susceptibility, severity, and barriers subscales) (◆)	$\square_{T1}$	6
Baradaran et al., (2006) [44]	To evaluate the acceptance, effectiveness and sustainability of a	**N** = 145 (South Asian: T = 59, C = 59; Caucasian comparison group = 27)	**T:** 3 group sessions with 6-12 participants (1x dietician-led, 1x podiatrist-led, 1 x educator-led). Lecture and interactive elements were used to teach about pathophysiology of diabetes, complications of	**P:** T1=C for diabetes self-care behaviors (*d* = 0.24), diabetes knowledge (*d* = 0.14), and diabetes-related attitudes	$\square_{T1}$	4

UK	culturally appropriate educational program in improving diabetes knowledge among south Asian patients with type 2 diabetes.	**Mean age** (years): South Asian T: 57.8 (SD=12.7), C: 59.2 (SD=11.3), Caucasian Comparison group: 58 (SD=13.8) **% female:** South Asian-T: 52.5%, South Asian-C: 44%, Comparison group: 52% **Population**: South Asian adults over the age of 30 years with type 2 diabetes	diabetes, blood glucose control, recommendations for appropriate lifestyle changes, foot care, contacting health care professionals about diabetes-related issues. Three versions of the program were implemented for women, two programs for men, and one mixed program. Lectures were completed with other instructional materials, including visual aids, models, booklets and leaflets about diabetes, diet and foot care, and an information video **C**: Usual care **Duration:** 12 weeks **Timing of measures:** Baseline and 6-months	towards complications *(d* = -0.13) and seriousness *(d* = 0.07)		
Bellary et al., (2008) [45] **UK**	To evaluate the effectiveness of a culturally sensitive, enhanced care package in UK general practices for improvement of cardiovascular risk factors among patients of South Asian origin with type 2 diabetes	**N** = 1486 (T = 868; C = 618) **Mean age** (years): 57.0 (SD = 11.9) **% female:** T: 46%, C: 51% **Population**: Patients of South Asian ethnic background (Indian, Pakistani, Bangladeshi, and other Asians) with type 2 diabetes	**T**: Practice nurses provided 4h individualized care to patients every 2 months. Goals were to encourage appropriate prescribing (with primary-care physicians), provide face-to-face patient education in clinic setting, and achieve targets for blood pressure, lipid, and glycemic control. Community link workers supported them by helping with interpretation and providing additional educational input in local languages (Punjabi, Urdu, and Mirpuri) with the aims of increasing compliance/understanding and encouraging dietary and lifestyle changes. **C:** Usual care (practice nurse led diabetes clinic) **Duration:** Unspecified **Timing of measures:** Baseline and 24-months	**P:** T3>C for diastolic BP, mean arterial pressure, and HbA1C (◆) T3=C for systolic BP, total cholesterol (◆) **S**: T3<C for BMI (◆) T3=C for waist circumference (◆)	$\square_{T3}$	7

Beune et al., (2014) [46] **Denmark**	To evaluate the effect of a CALD-tailored patient education and behavioral modification intervention on blood pressure and treatment adherence among Surinamese or Ghanaian adults (20+) with poorly controlled hypertension	**N** = 146 (T = 75; C = 71) **Mean age** (years): T: 53.3 (SD = 10.2); C: 54.6 (SD = 9.5) **%female**: T: 61%; C: 44% **Population**: self-identified Surinamese or Ghanaian adults (20+) adults with poorly controlled hypertension	**T:** Usual care + 3 individual, culturally-tailored counseling sessions (30 minutes each) at 2 weeks, 8 weeks and 20 weeks after baseline + culturally tailored written educational material + referral to local facilities as needed to help patients adopt a healthier lifestyle. **C:** Usual care **Duration**: 20 weeks **Timing of measures:** Baseline and 6-months	**P:** T1=C for systolic BP (◆) (proportion of participants with reduction of at least 10mmHg, OR = 0.42) **S:** T1=C for systolic BP *(d* = -0.14), diastolic BP *(d* = -0.25), dietary behavior of sodium reduction *(d* = -0.18), BMI *(d* = -0.03), self-care (adherence to lifestyle recommendations, d = 0.33)	□T1	9
Borges et al., (2008) [47] **USA**	To evaluate the effectiveness of a CALD-tailored foot self-care intervention in improving foot self-care behaviors and knowledge among Mexican American adults diagnosed with type 2 diabetes	**N** = 167 (T = 55; RA = 55; UC = 57) **Mean age** (years): Total: 61.5 (SD = 11.4) **% female**: T: 69%; RA: 56%; UC: 70% **Population:** predominantly Mexican American adults (40+) diagnosed with Type 2 diabetes	**T:** Brief risk assessment (5-minute) for risk of lower extremity amputation (LEA) + brief educational intervention (15 minutes) aimed at improving foot self-care behaviors involving: (i) pictures i.e. "Foot Care for People with Diabetes" to demonstrate specific recommendations for foot care tailored to patients' risk categories; and (ii) identification of barriers and strategies to overcome identified barriers. **Risk Assessment (RA):** One brief risk assessment (5-minute) for LEA + handwritten foot self-care instruction provided to participants **UC:** Usual care **Duration**: T = 20 minutes; RA = 5 minutes **Timing of measures:** Baseline and 1-month	**O:** T1=RA1=C foot self-care knowledge, diabetes self-efficacy, self-reported foot self-care behaviors, for most observed self-care behaviors (◆)	✕T1 ✕RA1	6
Brown et al., (2002) [48]	To evaluate the effectiveness of a culturally competent diabetes self-	**N** = 256 (T = 126; C = 126)	**T:** 12 weekly 2-h instructional group sessions on nutrition, self-monitoring of blood glucose, exercise, and other self-care topics + 14 biweekly support group sessions aimed at promoting behavioral change. It was	**P:** T1=C for BMI *(d* = -0.12), cholesterol *(d* = 0.16)	□T1	5

USA	management intervention for improving metabolic control and other health outcomes among Mexican Americans with type 2 diabetes	**Mean age** (years): T: 54.7 (SD = 8.2), C: 53.3 (SD = 8.3) **% female**: T:59.5%, C:68.3%; **Population**: Mexican American adults (35-70 years old) diagnosed with type 2 diabetes after age 35 from Starr County Texas	culturally sensitive in terms of language, diet, social emphasis, family participation, and incorporation of cultural health beliefs. **C:** 1 year wait list control; received usual care for 1 year and then received the intervention **Duration**: 52 weeks **Timing of measures:** Baseline, 3-, 6-, and 12- months	T1>C for fasting blood glucose (d= -0.47), HbA1C (*d*= -0.49) T2>C for diabetes-related knowledge (*d*= 0.41), HbA1C (*d*= -0.28) T2=C for BMI *(d* = -0.017), cholesterol *(d* = 0.057), fasting blood glucose *(d* = -0.24), and health beliefs subscales of control *(d* = 0.17), barriers *(d* = -0.25), social support *(d* = -0.14), impact of job *(d* = 0.09), and benefits *(d* = -0.13)	□T2	
Brown et al., (2013) [49] **USA**	To evaluate the effectiveness of a culturally tailored diabetes self-management education intervention for improving leptin levels in Mexican-American adults with type 2 diabetes	**N** =109 (subset of sample outlined in Brown, 2002) **Mean age** (years): 54.9 (SD = 8) **% female:** 64.2% **Population**: Mexican Americans adults from Starr County Texas with type 2 diabetes	**T:** 12 instructional group sessions on nutrition, self-monitoring of blood glucose, exercise, and other self-care topics + 14 biweekly support group sessions aimed at promoting behavioral change. It was culturally sensitive in terms of language, diet, social emphasis, family participation, and incorporation of cultural health beliefs. **C:** 1 year wait list control; received usual care for 1 year and then received the intervention **Duration**: 52 weeks **Timing of measures:** Baseline, 3-, 6-, and 12- months	T1 = C for leptin (◆) T2 = C for leptin (◆)	□T1 □T2	2
Carlos Poston et al., (2003) [50] **USA**	To evaluate the effectiveness of a CALD-tailored pharmaceutical and lifestyle/ behavioral modification intervention on	**N** = 108 (T = 56; C = 52) **Mean age** (years): T: 42.4 (SD = 9.2); C: 43.7 (SD = 9.2) **% female:** 100%	**T:** Pharmaceutical intervention (Orlistat) + 24 weekly intervention sessions + 6 bimonthly + three monthly maintenance classes. Each session lasted 60 minutes, was culturally tailored, and had educational, behavioral modification, and discussion components that centered on nutrition, physical education, and goal setting.	**P:** T1>C for HDL cholesterol (*d*= -0.79), LDL cholesterol (*d*= -0.78), total cholesterol (*d*= -0.83) T1=C for diastolic BP *(d* = -0.19), systolic BP *(d* = -0.20),	□T1	5

	weight among obese Mexican American women	**Population:** Mexican American adult women (21-65 years old) with a BMI above 27	**C:** Wait-list control **Duration**: 52 weeks **Timing of measures:** Baseline, 6- and 12-months	BMI *(d* = -0.13), weight *(d* = -0.10), triglycerides *(d* = 0.11), and waist circumference *(d* = -0.33) T2>C for total cholesterol (*d*= -0.61) T2=C for HDL *(d* = -0.48) and LDL *(d* = -0.40) cholesterol, diastolic BP *(d* = 0.14), systolic BP *(d* = 0.08), BMI *(d* = -0.26), weight *(d* = -0.21), triglycerides *(d* = -0.20), waist circumference *(d* = -0.08)	$\square_{T2}$	
Castejon et al., (2013) [51] **USA**	To evaluate the effectiveness of a community-based, culturally-adapted, pharmacist intervention for improving clinical outcomes among Latinos with type 2 diabetes	**N** = 84 recruited, 43 completed: (T = 19; C = 23) **Mean age** (years): T: 54 (SD = 9), C: 55 (SD = 10) **% female:** T: 58%, C: 79%; **Population:** Diverse origin population of immigrant Latino adults in South Florida with Type 2 diabetes	**T:** One group discussion session (90 minutes) on knowledge, beliefs, and barriers and motivators to clinical and self-management + an educational video (13 minutes) + a self-monitoring blood glucose training session (45 minutes) + new monitors and strips distributed to participants + individual consultations with a pharmacist (60 minutes) at 2-, 4-, and 6-weeks involving action planning and behavioral modification (i.e. teach back method). **C:** Usual care **Duration**: 6 weeks **Timing of measures:** Baseline and 3-months	**O:** T1=C for weight loss *(d* = 0.20), BMI *(d* = -0.27), HbA1C *(d* = -0.62), systolic BP *(d* = 0), diastolic BP *(d* = -0.03), mean random blood glucose *(d* = -0.43), waist circumference *(d* = -0.07), HDL *(d* = -0.08), LDL *(d* = -0.18) and total cholesterol *(d* = -0.15), and triglycerides *(d* = -0.19)	$\square_{T1}$	4
Changrani et al., (2008) [52]	To evaluate the viability of online support groups for improving depression and QoL among	**N** = 68 (T = 48; C = 20) **Mean age** (years): T: 46.2 (SD = 12.1), C: 50.8 (SD = 13.9) **% female**: 100%	**T:** Weekly online support group chat meetings (90 minutes each) facilitated by professionals aimed at improving patients' ability to cope with cancer and their confidence in assessing treatment options.	**O:** T1=C for depression *(d* = -0.20), QoL *(d* = 0.36), attitudes (i.e. personal growth, d = 0.25) and coping with pain *(d* = -0.24)	$\square_{T1}$	5

USA	immigrant Latina women diagnosed with breast cancer	**Population:** Immigrant Latina adults diagnosed with breast cancer	**C**: Usual care **Duration**: 30 weeks **Timing of measures:** Baseline and 7.5 months (30 wk)			
Eakin et al., (2007) [53] **USA**	To evaluate a CALD-tailored lifestyle education and behavioral intervention for Hispanic/Spanish-speaking adults with multiple chronic conditions	**N** = 200 (T = 101; C = 99) **Mean age** (years): T: 50 (SD = 13); C: 49 (SD = 13) **% female**: T: 79.2%; C: 77.8% **Population:** mostly Spanish-speaking new immigrants diagnosed with multiple chronic illnesses	**T:** 2 face-to-face visits (60-90 minutes) scheduled three months apart + 3 follow-up phone calls at (2 and 6 weeks after the initial visit and 2 weeks after the second visit) + 3 individually tailored newsletters. The intervention centered on individual goal-setting and "followed the 5 As approach advocated in multiple behavioral risk factor interventions (Ask, Assess, Advise, Agree, Arrange)" **C:** Usual care (including mailed local community resource guide and three newsletters on financial management) **Duration**: 14 weeks **Timing of measures:** Baseline, 6-weeks (1.5 months) and 6-months	**P:** T1>C: dietary behavior *(d* = -0.38) T1 = C for exercise (◆) **S**: T1>C multi-level support for healthy living (self-management) *(d* = 0.52)	$\square_{T1}$	8
Garcia et al., (2015) [54] **USA**	To evaluate the effectiveness, feasibility and patient satisfaction with a CALD symptom awareness and self-management education program for improving clinical and health knowledge outcomes in Mexican Americans with type 2 diabetes	**N** = 72 (T = 39; C = 33) **Mean age** (years): T: 50 (SD = 8.7), C: 49.1 (SD = 9.7) **% female**: T: 61.5%, C: 72.7% **Population**: Mexican American adults with Type 2 Diabetes, primarily middle-aged, of moderate acculturation level, and well-educated	**T:** Symptom-based diabetes self-management education (DSME) program, consisting of 8 x weekly in-home, interactive educational and behavioral-modification sessions followed by support telephone sessions; educational content and approach was targeted for both group (language, cultural values) and individual **C:** Wait-list control (usual care) **Duration**: 8 weeks **Timing of measures:** Baseline, 2- and 6- months	**P:** T1=C for HbA1C *(d* = -0.33) **S:** T1>C for self-efficacy *(d* = 0.56) and total cholesterol *(d* = -0.58) T1=C diabetes QoL*(d* = -0.22), HDL cholesterol *(d* = -0.04), LDL cholesterol *(d* = -0.44), diastolic BP *(d* = 0.13), systolic BP *(d* = 0.09), diabetes knowledge *(d* = 0.38), triglycerides *(d* = -0.32) and diabetes symptom frequency *(d*	$\square_{T1}$	6

				= -0.38) and severity *(d* = -0.51) T1=C for BMI (◆)		
Gold et al., (2008) [55] **USA**	To evaluate the effectiveness of a multidisciplinary diabetes program consisting of CALD-tailored self-management education and behavioral counseling among Hispanic patients with long-standing poorly controlled type 2 diabetes.	**N** = 44 (T = 23; C = 21) **Mean age** (years): T: 54.3 (SD = 8.6); C: 58.2 (SD = 7.3) **% female:** T: 72.2%; C: 70.6% **Population:** Hispanic diabetic patients with poorly controlled blood sugar control (defined as two consecutive readings of HbAlC values ≥9.5%.)	**T:** Self-management diabetes education group sessions and provider visits with optional individual sessions with a certified diabetes nurse–educator, a dietician, and/or a medical social worker. **C:** Usual care with encouragement by primary physician to attend institution-sponsored diabetes self-care classes **Duration**: 24 weeks **Timing of measures:** Baseline, 3- and 7-months	**P**: T2>C HbA1C (◆)	$\square_{T2}$	2
Greenlee et al., (2015) [56] **USA**	To evaluate the effectiveness of a culturally based dietary change intervention in increasing fruit/vegetable intake and decreasing fat intake among Hispanic breast cancer survivors.	**N** = 70 (T = 34; C = 36) **Mean age** (years): T: 55.1 (SD = 9.1), C: 58.0 (SD = 10.1) **% female:** 100% **Population:** Spanish-speaking Hispanic women with breast cancer who has undergone chemotherapy	**T:** 7 educational sessions including cooking demonstrations and workshops that targeted eating behaviors and provided tools such as culturally appropriate recipes and nutritional information + 2 food shopping field trips to educate patients how to shop for healthy food + educational booklet on healthy eating for breast cancer survivors **C:** Attention control (provided the same basic booklet as T, but received no classes) **Duration**: 12 weeks	**P:** T1=C for change in intake of servings of fruit and vegetable per day (both fruits and vegetables, *d* = 0.50; fruits only, *d* = 0.18; vegetables only, *d* = 0.48) and percent calories from fat *(d* = -0.24). **O**: T1=C for BMI *(d* = -0.55), weight *(d* = -0.36), and waist circumference *(d* = -0.30)	$\square_{T1}$	8

			Timing of measures: Baseline, 3-, 6-, and 12-months (12 month data not presented)			
Griffiths et al., (2005) [57] **UK**	To evaluate the effectiveness of a culturally tailored, self-management intervention in improving disease management among Bangladeshi adults with chronic illness.	**N** = 476 (T = 238; C = 238) **Mean age** (years): T: 48.9 (SD = 9.9), C: 48.0 (SD=9.5) **% female:** T: 56%, C: 58%; **Population**: Bangladeshi adults (+20 years) with diabetes, cardiovascular disease, respiratory disease or arthritis.	**T:** 6-weekly, (3-h) education sessions led by trained lay-persons focused on symptom management, exercise, collaboration with health care provider, managing medications and decision-making. **C:** waiting list control group **Duration**: 6 weeks **Timing of measures:** Baseline and 4-months	**P**: T1>C for self-efficacy *(d* = 0.56) **S:** T1>C for depression *(d* = -0.64) T1=C for self-management (◆), communication with physician *(d* = 0.15), anxiety *(d* = -0.09), pain *(d* = -0.13), fatigue *(d* = 0.06), breathlessness symptoms *(d* = -0.22) and general health status *(d* = 0.01)	$\square_{T1}$	9
Howie-Esquivel et al., (2014) [58] **USA**	To evaluate a CALD tailored self-care education intervention in improving self-care behaviors and heart failure knowledge among Hispanics with heart failure.	**N** = 42 (T = 22; C = 20) **Mean age** (years): T: 60.7 (SD = 14.8), C: 53.7 (SD = 12.3) **% female**: T: 31.8%, C: 55% **Population**: Hispanic adults with heart failure	**T:** One face-to-face individualized health education session (duration unspecified) in Spanish utilizing teach-back method. Telephone follow-up contact every 2-weeks (duration unspecified). Participants were also given education materials (length unspecified), recipes, spices, scales, food diary, and a script to communicate with HCPs. **C:** Attention control (given a scale and educational materials without teaching). **Duration**: 12 weeks **Timing of measures**: Baseline, and 3-months	**O:** T1 > C for self-care management, teach-back scores (after teaching by educator patient asked to teach-back information; study-specific teach-back questions used) (◆) T1 = C for self-care maintenance, self-care confidence, depression, anxiety, and social support (◆)	$\square_{T1}$	9
Joshi et al., (2010) [59]	To evaluate a tailored educational intervention in improving diabetes	**N** = 234 (AA = 110; H = 124) **Mean age** (years): majority for both groups	**T:** 4 x group or individual sessions (duration unspecified) + follow-up phone calls every 2-weeks (10-16 calls/patient) + support groups to reinforce the material and to allow for monitoring and feedback.	*Data for H participants:	$\square_{T3}$	1

USA	care among African American (AA) and Hispanic (H) patients diagnosed with diabetes.	between ages 41-60 years. **% female:** AA: 55% H: 66% **Population**: African American and Hispanic (H) patients diagnosed with Type 1 or 2 diabetes.	Intervention content addressed diabetes complications, exercise, cultural barriers, and preparation of culturally sensitive meals. **C:** Routine care **Duration**: Unspecified **Timing of measurements:** Baseline, 12- and 24-months	**O**: T3> C for HbA1C, total cholesterol, and LDL cholesterol (◆) T3=C for BP, ED visits, hospitalizations, smoking cessation, microalbuminuria, compliance with eye examinations, and pneumococcal and influenza vaccinations (◆)		
Juarez et al., (2013) [60] **USA**	To evaluate the effectiveness of an educational intervention in improving QoL among Latina breast cancer survivors who have completed primary treatment for breast cancer.	**N** = 52 (T = 34; C = 18) **Mean age** (years): T: Not specified (n = 16 between 36-66 years; n = 18 between 50-66 years), C: not specified (n = 12 between 36-66 years; n = 6 between 50-66 years) **% female**: 100% **Population**: Adult Latina breast cancer survivors (18+ years) diagnosed with breast cancer who completed primary treatment	**T**: Four face-to-face individualized sessions (40-60 minutes over 1 month. Monthly telephone support follow-up calls for retention purposes only (number and duration not specified). Educational notebook provided. Intervention content aimed to assist women's transition to survivorship addressing topics such as physical, psychological, social, and spiritual well being. **C:** Attention control group (face-to-face baseline, questionnaires at collection points, monthly phone calls from PI for retention, offered 2 education sessions and bilingual material after 6 months). **Duration**: 6 months **Timing of measurements:** Baseline, 9- and 12-months.	**O**: T2=C for distress (*d* = 0.21), uncertainty (*d* = 0.36), overall QoL (*d* = -0.49), physical well-being (*d* = -0.26), psychological well-being (*d* = -0.60), social well-being (*d* = -0.34)	$\square_{T2}$	5
Kim et al., (2009) [62] **USA**	To evaluate the effectiveness of a CALD-tailored comprehensive diabetes self-management	**N** = 83 (T = 41; C = 42) **Mean age** (years): T: 56.2 (SD = 8.4); C: 56.6 (SD = 7.6) **% female:** T: 37.5%; C:	**T:** Three concurrent intervention components: weekly comprehensive education sessions (2 hrs x 6-weeks) + monthly telephone counseling (24-weeks), + home glucose monitoring with tele-transmission (24-weeks). Content included symptom management and self-care and was delivered by a bilingual nurse and nutritionist.	**P:** T1>C for HbA1C (*d*=-0.48) T2=C for HbA1C (*d*=-0.32) **S:** T1>C for self-care activities (*d*=0.59)	$\square_{T1}$ $\square_{T2}$	9

	intervention for Korean American adults (30+) with poorly controlled type 2 diabetes.	51.3% **Population:** Self-identified Korean American adults (30+ years old) living with poorly controlled type 2 diabetes	**C:** Wait-list control. **Duration**: 24-weeks (8-months). **Timing of measurements:** Baseline, 18-weeks (4.5 months) and 30-weeks (7.5 months).	T1=C for self-efficacy (*d*=0.35), diabetes QoL (*d*=-0.37), HDL cholesterol (*d*=-0.12), LDL cholesterol (*d*=0.03), total cholesterol (*d*=0.02), diastolic BP (*d*=0.16), systolic BP (*d*=0.13), fasting blood glucose (*d*=-0.20), BMI (*d*=0.07), diabetes knowledge (*d*=0.37), triglycerides (*d*=-0.02), depression (*d*=-0.30), and attitudes towards diabetes (*d*=-0.35) T2=C for self-efficacy (*d*=0.38), diabetes QoL (*d*=-0.36), self-care activities (*d*=0.41), HDL cholesterol (*d*=-0.27), LDL cholesterol (*d*=0.003), total cholesterol (*d*=-0.06), diastolic BP (*d*=-0.02), systolic BP (*d*=0.09), fasting blood glucose (*d*=-0.14), BMI (*d*=0.05), diabetes knowledge (*d*=0.32), triglycerides (*d*=0.01), depression (*d*=-0.12), and attitudes towards diabetes (*d*=-0.33)		
Kim et al., (2014) [61] **USA**	To evaluate the effectiveness of a community-based, CALD-tailored self-management intervention for Korean American	**N** = 440 (T = 225; C = 215) **Mean age** (years): 70.9 (SD = 5.3), T: 70.6 (SD = 5.0); C: 71.2 (SD = 5.6) **% female:** 69.9% (T:	**T:** 3 intervention components: weekly education sessions (6 x 2hrs) delivered by bilingual nurses and nutritionists + home BP monitoring with tele-transmission (2x daily – duration unspecified) + telephone counseling sessions delivered by CHW supervised by nurses (frequency unspecified – duration	**P:** T1>C for diastolic BP (*d*= -0.27) and systolic BP (*d*= -0.33) T2>C for diastolic BP (*d*= -0.38) and systolic BP (*d*= -0.32)	$\square_{T1}$ $\square_{T2}$ $\square_{T3}$	7

	seniors (+60) diagnosed with hypertension.	67.4%; C: 72.4%) **Population**: Korean American older adults (60+ year old) diagnosed with hypertension and taking either 2 separate antihypertensives or with blood pressure values (systolic BP ≥140 mm Hg and/or diastolic BP ≥90 mm Hg)	12 months). Content focused on high BP management, diet, medication & problem solving. **C:** Usual care and an educational brochure including list of available community resources (received abbreviated educational session after final data collection). **Duration**: 52 weeks **Timing of measurements**: Baseline, 6-, 12-, and 18-months	T3 = C for diastolic BP *(d* = -0.20) and systolic BP (*d*= -0.17) **S:** T1>C for print literacy *(d* = 0.22), and total health literacy *(d* = 0.21) T1=C for self-efficacy for BP control, depression *(d* = 0), medication adherence, functional literacy *(d* = 0.18) and HBP knowledge *(d* = 0.09) T2>C for self-efficacy for BP control (*d*= 0.35), depression (*d*= -0.31), print literacy *(d* = 0.23), functional literacy (*d*= 0.36), total health literacy *(d* = 0.26), medication adherence (*d*= -0.22) and HBP knowledge *(d* = 0.46). T3>C for medication adherence *(d* = -0.27), print literacy *(d* = 0.33), functional literacy *(d* = 0.29), total health literacy *(d* = 0.33) and HBP knowledge *(d* = 0.23) T3 = C for self-efficacy for BP control *(d* = -0.0526), and depression *(d* = -0.12)		
Kim et al., (2015) [63]	To evaluate the effectiveness of a CALD-tailored chronic illness self-management, skill-	**N** = 250 (T = 120; C =130) **Mean age** (years): T: 59.1 (SD = 8.4); C: 58.3 (SD = 8.5)	**T:** Three intervention components: 1) weekly education sessions (6 x 2hrs), 2) ongoing self-monitoring of glucose (twice daily for 12-months), and 3) monthly individualized counseling using motivational interviewing delivered by bilingual	**P:** T1>C for HbA1C (*d*= -0.37), blood glucose (*d*= -0.48), LDL cholesterol (*d*= -0.40), and total cholesterol (*d*= -0.37)	$\square_{T1}$	7

USA	building intervention on glycemic control and blood lipid levels in self-identified immigrant Korean American adults (>35) diagnosed with type 2 diabetes	**% female**: T: 40.9%; C: 45.2% **Population**: Self-identified immigrant Korean American adults (35+ years old) diagnosed with poorly controlled type 2 diabetes.	nurses/community health workers (for 12-months). Content included addressing diabetes knowledge enhancement, treatment, and risk reduction, coping, and problem solving. **C:** Wait-list control including a brief educational brochure at baseline that highlighted the critical self-management principles of intervention and contact information for available community care and educational resources. **Duration**: 52 weeks **Timing of measurements:** Baseline, 3-, 6-, 9-, and 12-months	T1=C for HDL cholesterol (*d*=0.007), triglycerides (*d*=-0.15), diastolic BP (*d*=-0.19), systolic BP (*d*=-0.05), and attitudes towards diabetes (*d*=0.15) T2>C for HbA1C (*d*= -0.49), blood glucose (*d*= -0.47), LDL cholesterol (*d*= -0.34), and total cholesterol (*d*= -0.34) T2=C for HDL cholesterol (*d*=-0.06), triglycerides (*d*=-0.06), diastolic BP (*d*=-0.24), systolic BP (*d*=-0.11), and attitudes towards diabetes (*d*=0.25) **S:** T1>C for diabetes-related self-efficacy (*d*= 0.74), QoL (*d*= 0.43), and diabetes knowledge (*d*= 0.46) T2>C for diabetes-related self-efficacy (*d*= 0.84), QoL (*d*= 0.75), diabetes knowledge (*d*= 0.77)	$\square_{T2}$	
Lorig et al., (2008) [64] **USA**	To evaluate: 1) the impact of a Spanish Diabetes Self-Management Program (SDSMP) intervention on health status, health behaviors, and self-efficacy; and 2) the	**N** = 417 (T = 219; C = 198) **Mean age** (years): T: 52.9 (SD = 13.2); C: 52.8 (SD = 13.4) **% female:** T: 57.1%; C: 67.2%	**T_{SDSMP}:** The Spanish Diabetes Self-Management Program (SDSMP) intervention included weekly community-based, peer-led group workshop sessions (6 x 2.5 hrs) involving diabetes education and behavioral modification. **$T_{R1/R2}$**: In a second intervention, participants were re-randomized to receive monthly-automated telephone reinforcement (for 15-months) (R1) or no	**SDSMP Intervention:** **O:** T1>C for self efficacy (*d*= 0.25) T1=C for fatigue *(d* = -0.006), self-rated health *(d* = -0.02), symptoms of hypoglycaemia *(d* = -0.10) and hyperglycemia *(d* = -0.20), impact of disease on	$\square_{T1}$	5

	impact of automated telephone reinforcement on maintaining improvements in Spanish American adults (18+) diagnosed with type 2 diabetes	**Population:** Spanish American adults (18+ years) diagnosed with type 2 diabetes	reinforcement (R2). The reinforcement condition involved the option of listening to 2 x 90 second vignettes about various aspects of diabetes management. **C:** Wait-list control receiving usual care. **Duration**: 6-weeks for SDSMP + those without telephone reinforcement (R2); 66 weeks (R1) **Timing of measurements:** Baseline, 6- and 18-months	role activities (symptoms) *(d* = -0.13), distress *(d* = -0.13), days in hospital *(d* = 0.08), emergency visits *(d* = -0.06), physician visits *(d* = -0.03), communication with MD (self-management behavior) *(d* = 0.07), aerobic exercise *(d* = -0.01), stretching/strength exercise *(d* = 0.07), testing glucose *(d* = -0.01), and HbA1C *(d* = -0.14). T1=C for BMI and insulin use (◆) **<u>Telephone reinforcement:</u>** **O:** $T3_{R1}$>$T3_{R2}$ for testing glucose $T3_{R1}$ = $T3_{R2}$ for all other outcomes	$\square_{T3}$	
Lujan, Ostwald, & Melchor (2007) [65] **USA**	To evaluate the effectiveness of a CALD tailored, lay worker led education intervention in improving glycemic control, diabetes knowledge, and health belief among Mexican Americans with poorly controlled Type II Diabetes.	**N** = 150 (T = 75; C = 75) **Mean age** (years): 58 years **% female**: 80% **Population:** Mexican American adults (40+ years) with a diagnosis of type 2 diabetes of at least one year.	**T**: Weekly group sessions (8 X 2hrs) led by bilingual clinic employees who received training (promotoras), addressing diabetes education, self-management, and goal setting, biweekly follow-up telephone calls by promotoras, and inspirational, faith-based postcards pertaining to health behavior change (mailed to participants weekly for 16-weeks post intervention) **C:** Usual care received the usual one-on-one education by clinic staff, which included verbal information and one or two pamphlets on diabetes self-management skill.	**O:** T1>C for diabetes knowledge (*d*= 0.67) T1=C for HbA1C *(d* = -0.14) and diabetes health beliefs *(d* = 0.34)	$\square_{T1}$	6

			Duration: 6-months. **Timing of measurements:** Baseline, 3- and 6-months			
Napoles et al., (2015) [66] **USA**	To evaluate the effectiveness of a peer-delivered, cognitive-behavioral stress management program (Nuever Amanece) in improving stress management and health related quality of life among Latina women with breast cancer.	**N** = 151 (T = 76; C = 75) **Mean age** (years): T: 50.8 (SD = 11.9); C: 50.2 (SD = 9.9) **% female:** 100% **Population:** Spanish-speaking Latinas with breast cancer, 1 year or less since diagnosis.	**T:** Weekly face-to-face modules involving visuals and hands-on exercises (8 x 90 min) delivered by breast cancer survivors (companeras). Content addressed coping skills, social support self-efficacy, and goal setting with the aim of improving health-related quality of life and decreasing distress. **C:** Usual care for 6 months, after which they were offered the intervention. **Duration**: 8 weeks **Timing of measurements:** Baseline, 3- and 6-months	**P:** T1>C for breast cancer specific emotional QoL (*d*= 0.41) T1=C for breast cancer specific overall QoL (*d*=0.25), breast cancer specific physical QoL (*d*=0.23), breast cancer specific social QoL (*d*=-0.17), depression (*d*=-0.14), anxiety (*d*=-0.29), somatization (symptoms) (*d*=-0.25), breast cancer specific distress (intrusive thoughts) (*d*=-0.33)	$\square_{T1}$	10
Nijamkin et al., (2012) [68] **USA**	To evaluate whether a CALD comprehensive nutrition and behavioral modification intervention improves weight loss and physical activity among obese Hispanic American adults post gastric bypass surgery.	**N** = 144 (T = 72; C = 72) **Mean age** (years): T: 44.2 (SD = 12.6), C: 44.8 (SD = 14.4) **% female:** T: 86.1%, C: 80.6% **Population:** Hispanic American adults (18+ years) with obesity who has recently had laparoscopic gastric bypass	**T:** Behavioral–motivational group sessions using didactic teaching and group discussion every two weeks (6 X 90 min) delivered in English or Spanish (based on preference) by a registered dietician. Content focused education about nutrition, physical activity, and social/emotional support. After each session, participants received e-mail or telephone reminders encouraging them to stick to the bariatric diet and monitor their nutrition and exercise. **C:** Usual care and brief guidelines for healthy eating and physical activity at the first assessment. **Duration**: 12 weeks **Timing of measurements:** 6 months post surgery (baseline/pre-intervention), and 12-months post surgery (post intervention, T1)	**P:** T1 > C for excess weight loss (*d* = 0.45), intensity of exercise (*d* = 0.52) and minutes per week spent exercising (*d* = 0.49) T1 = C for frequency of exercise (*d* =0.29) **S:** T1=C for weight (*d* = -0.25), BMI (*d* = -0.16) and daily dietary energy intake and number of meals (◆) T1 >C for intake of protein (◆)		8

Nijamkin et al., (2013) [67] **USA**	To evaluate the effectiveness of two post-bariatric surgery support interventions in improving depressive symptoms among Hispanic Americans who have been treated with Roux-en-Y gastric bypass surgery.	**N** = 144 (T = 72; C = 72) **Mean age** (years): T: 44.2 (SD = 12.6); C: 44.8 (SD = 14.4) **%female**: T: 86.1%, C: 80.6% **Population:** Hispanic-American adults who have undergone a laparoscopic Roux-en-Y gastric bypass surgery.	**T:** Standard care and education group sessions addressing behavior change, motivation strategies, and nutritional counseling conducted every two weeks in English or Spanish (based on preference) delivered by psychologist and a registered dietician (6 X 90 min). **C:** Standard care (pre-op evaluations, post-op meeting with bariatric surgeon and dietician and consult with psychologist, if desired). **Duration**: 12 weeks **Timing of measurements:** 6 months post surgery (baseline/pre-intervention), and 12-months post surgery (post intervention, T1)	**P:** T1=C for depression *(d* = -0.44), **O**: T1 = C for visits with a psychologist (◆)		8
Osborn et al., (2010) [69] **USA**	To evaluate the effectiveness of an Information-Motivation-Behavioral skills model of Diabetes Self Care (IMB-DSC) for improving diabetes self care behaviors and glycemic control among Puerto Ricans with type 2 diabetes.	**N** = 118 (T = 48; C = 43) **Mean age** (years): T: 56.9 (SD = 11.3), C: 58.4 (SD = 10.1) **%female:** T: 79%; C: 70% **Population:** Puerto Rican adults diagnosed with Type 2 diabetes for at least 1 year.	**T:** One group session Information-Motivation-Behavioral skills intervention (90 min) delivered by a medical assistant of Puerto Rican heritage. Content included diet and diabetes information, motivational interviewing, skill-building, teach back strategies, a personal feedback report, and handouts. **C:** Usual care (medical treatment, physician monitoring, optional diabetes support group). **Duration**: 14 weeks **Timing of measurements:** Baseline and 3-months	**O:** T1>C for food label reading (self-care) (*d*= 0.53) T1=C for diet adherence (*d*= 0.41) and HbA1C (*d*= 0.07) T1=C for physical activity (◆)	$\square_{T1}$	6
Palmas et al., (2014) [70]	To evaluate the effectiveness of a community health	**N** = 360 (T = 181; C = 179) **Mean age** (years): T:	**T:** Group visits + at least four one-on-one visits centered on identifying barriers to access to diabetes health, empowerment and goal setting; ten group	**P:** T2=C for HbA1C (*d*=- 0.08)	$\square_{T2}$	10

USA	worker (promotores) led, social support intervention for Hispanic adults with poorly controlled type 2 diabetes.	57.1(SD = 7.7); C: 58.1 (SD = 7.8) **% female**: T: 60.8%; C: 62.6% **Population:** self-identified Hispanic adults (35-70 years) with poorly controlled Type 2 diabetes.	sessions focuses on nutrition (e.g., cooking classes and exercise activities); ten follow-up telephone calls to ensure participants were adhering to tailored plan. All components delivered by community health workers. **C:** Enhanced usual care (four sets of Spanish-language health care diabetes/health education materials as well as quarterly phone calls to ensure that participants had received the materials and that they were appropriate to their literacy level). **Duration**: 12-months **Timing of measurements:** Baseline and 12-months	**S:** T1>C for LDL cholesterol (*d*= 0.26) T2=C for diastolic BP (*d*= 0.16) and systolic BP (*d*= 0.19)		
Pekmezi et al., (2009) [71] **USA**	To examine the effectiveness of a culturally tailored physical activity intervention on physical activity levels of among underactive and overweight/obese Latinas/Hispanic women.	**N** = 93 (T: 45; C: 48) **Mean age** (years): 41.4 (SD = 11.2) **% female:** 100% **Population**: Overweight/obese Hispanic women.	**T:** Monthly mailings of physical activity regimens matched to participants' motivation or activity level + individually tailored, computer generated feedback reports comprising motivational and behavioral strategies based on participants' monthly questionnaire responses. Participants were provided with pedometers, physical activity logs, and tip sheets for stretching. **C:** Monthly mailings of health information pertaining to diet, and cardiovascular disease risk. **Duration**: 24 weeks **Timing of measurements:** Baseline and 6-months	**P:** T1=C for self-reported physical activity *(d* = 0.27) **S**: T1=C for social support, depression, access to physical activity facilities (◆) T1>C: self-efficacy, cognitive and behavioral processes of change, and impact of home environmental factors (i.e. access to equipment) on physical activity (◆)	$\square_{T1}$	5
Peña-Purcell et al., (2011) [72]	To evaluate the effectiveness of a culturally sensitive and empowerment-based self-management	**N** =144 (T = 83; C = 61) **Mean age** (years): T: 59.4 (SD = 9.9); C: 63.9 (SD = 9.9) **%female**: T:71.6%; C:75.4%	**T:** Five weekly (2-hr) culturally appropriate lessons focused on self-efficacy, social modeling and behavioral capability. Lessons included viewing and group discussion of a soap opera video delivering health messages + group activities. Key topics	**O**: T1>C for overall diabetes self-care and diabetes self-efficacy (◆) T1=C for HbA1C (◆)	$\square_{T1}$	5

USA	program, for improving diabetes self-management among Spanish-speaking Latinos.	**Population**: Self-identified Hispanic/Latinos (40 years) diagnosed with type 2 diabetes	included: physical activity, glucose monitoring, and diabetes complications. **C**: Waitlist control **Duration**: 5 weeks **Timing of measurement**: Baseline, 6-weeks for psychosocial measures, and 3-months for HbA1C			
Perez-Escamilla et al., (2015) [73] **USA**	To examine the effectiveness of culturally appropriate counseling for improving the glycemic control among Latino adults diagnosed with type 2 diabetes	**N** = 211 (T = 105; C= 106) **Mean age** (years): T: 55.4 (SD = 11.5); C: 57.3 (SD = 12.1) **% female:** T: 72.4%; C: 74.5% **Population**: Latino adults (21+ years) diagnosed with type 2 diabetes	**T:** Seventeen home-based counseling sessions (weekly x 1 mon + biweekly x 2 mon + monthly x 9 mon) involving education and support pertaining to various topics including: diabetes complications, physical activity, blood glucose monitoring, and medication adherence. Sessions were individually tailored and involved the development of a diabetes self-management plan **C:** Standard of healthcare **Duration**: 52 weeks **Timing of measurements:** Baseline, 3-, 6-, 12-and 18-months	**P:** T1=C for HbA1C *(d* = -0.24) T2>C for HbA1C (*d*= -0.34) **S:** T1=C for HDL *(d* = -0.09), LDL *(d* = 0.09), and total *(d* = 0) cholesterol, systolic BP *(d* = -0.07), fasting blood glucose *(d* = -0.09), weight *(d* = -0.04), and triglycerides *(d* = -0.19) T2=C for HDL *(d* = 0.27), LDL *(d* = 0.05), and total cholesterol *(d* = 0.10), systolic BP *(d* = 0.07), fasting blood glucose *(d* = -0.29), weight *(d* = 0.05), triglycerides *(d* = -0.11)	$\square_{T1}$ $\square_{T2}$	9
Philis-Tsimikas et al., (2011) [74]	To evaluate the effectiveness of a peer-educator led, culturally appropriate diabetes self-management	**N** = 207 (T = 104; C = 103) **Mean age** (years): T: 52.2 (SD = 9.6) C: 49.2 (SD = 11.8) **% female**: T:69% C:77%	**T:** Eight weekly (2-hrs) diabetes self-management classes and subsequent monthly support groups. Classes addressed topics such as diabetes complications, glucose monitoring, diet, physical activity, and cultural barriers to diabetes self-management, and were interactive to allow participants	**P**: T1=C for HbA1C *(d* = -0.05) T2=C for HbA1C *(d* = -0.28) **S:** T1=C for HDL *(d* = 0.039), LDL *(d* = -0.14), and total *(d* =	$\square_{T1}$ $\square_{T2}$	7

USA	education program in improving glucose control among low income Mexican Americans diagnosed with type 2 diabetes.	**Population:** Uninsured Mexican American men and women with type 2 diabetes and HbA1C > .8%	to share their experiences. Support groups allowed for review of topics covered in class and group discussion. **C:** Usual medical care **Duration**: 16 weeks **Timing of measurements:** Baseline, 4- and 10-months	-0.09) cholesterol, diastolic BP *(d* = -0.18), systolic BP *(d* = -0.13), BMI *(d* = -0.28), triglycerides *(d* = -0.12) T2>C for diastolic BP (*d*= -0.37) T2=C for HDL *(d* = 0.01), LDL *(d* = -0.11), and total *(d* = -0.11) cholesterol, systolic BP *(d* = -0.02), BMI *(d* = -0.13), triglycerides *(d* = -0.13)		
Poston et al., (2001) [75] **USA**	To evaluate a culturally tailored, community-based intervention aimed at increasing physical activity among obese Mexican American women.	**N** = 379 (T = 194; C = 185) **Mean age** (years): T: 39.2 (SD = 10.6), C: 40.0 (SD = 6.4) **% female**: 100% **Population**: Mexican American women with a BMI between 25 and 40	**T:** 6 months of weekly (1.5-hr) meetings with bilingual/bicultural health care staff involving: (a) individually oriented culturally and linguistically tailored behavioral strategies for diet and physical activity modification and (b) weekly physical activity activities (brisk walking, moderate aerobic) and exercise contracts + 6 months of weekly peer-led maintenance groups and monthly meetings with intervention staff **C:** Wait-list control. **Duration**: 52 weeks **Timing of measurements:** Baseline, 6- and 12-months	**O:** T1=C for physical activity *(d* = -0.22), total cholesterol *(d* = -0.11), diastolic BP *(d* = 0.01), systolic BP *(d* = 0.05), BMI *(d* = -0.16), triglycerides *(d* = -0.11) T2=C for physical activity *(d* = -0.20), total cholesterol *(d* = -0.15), diastolic BP *(d* = 0.22), systolic BP *(d* = 0.05), BMI *(d* = -0.05), triglycerides *(d* = -0.09)	$\square_{T1}$ $\square_{T2}$	5
Prezio et al., (2013) [76] **USA**	To evaluate the effectiveness of a CHW-led, culturally tailored diabetes self-management education program in improving HbA1C	**N** = 180 (T = 90; C = 90) **Mean age** (years): T: 47.9 (SD = 10.99); C: 45.7 (SD = 10.69) **% female:** T: 66.7%; C: 54.4%	**T:** Three individual educational sessions (1-hr each) addressing: self-monitoring of blood glucose, diet recall, meal planning, medication use, smoking cessation, physical activity, and diabetes complications + 4 individual (1hr) meetings with a CHWs aimed at reinforcing skill, reviewing topics discussed in	**P:** T2>C for HbA1C *(d* = -0.52) **S**: T2>C for triglycerides (*d*= -0.32) T2=C for HDL *(d* = -0.09) and LDL *(d* = 0.20) cholesterol;	$\square_{T2}$	8

	levels, blood pressure and lipid levels among uninsured Mexican Americans.	**Population:** uninsured Mexican American men and women diagnosed with type 2 diabetes	previous sessions and teaching troubleshooting strategies. **C:** Usual medical care. **Duration**: 52 weeks **Timing of measurements:** Baseline, 3-, 6-, 9-, and 12-months	diastolic BP *(d* = 0.22), systolic BP *(d* = 0), and BMI *(d* = -0.31).		
Ratanawongsa et al., (2014) [77] **USA**	To evaluate the impact of an automated telephone self-management support and health coaching intervention in improving health-related QoL, diabetes self-management, patient centered processes of care, and cardio metabolic outcomes among patients with type 1 or 2 diabetes from an urban safety net clinic.	**N** = 362 (T = 182; Waitlist = 180) **Mean age** (years): T: 56.5 (SD = 7.9); C: 55.0 (SD = 8.6) **%female:** T: 77.2%; C: 62.4% **Population**: English-, Cantonese-, or Spanish-speaking adults with type 1 or 2 diabetes	**T:** 27 x weekly Automated Telephone Self-Management (ATSM) calls (8-12 minutes each) in Cantonese, Spanish or English and delivered health messages and inquired about self-care behavior, psychosocial challenges, and access to preventative services + educational messages + health coaching with a lay person as needed (involving collaborative goal setting and action planning). A second intervention arm received T_{ATSM} + medication adherence coaching, initiated by non-adherence. **C:** Participants received usual care +reminders and could then join one of the two intervention groups after 6 months. **Duration**: 27 weeks **Timing of measurements:** Baseline and 6-months	**P:** T1=C for health related QoL (physical) *(d* = 0.20) and health related QoL (mental) *(d* = 0.09). **S:** T1>C for diabetes self-care (*d*= 0.30) and LDL cholesterol (*d*= 0.52) T1=C for self-efficacy *(d* = 0.17), diastolic BP *(d* = 0.11), systolic BP *(d* = 0.06), HbA1C *(d* = -0.17), interpersonal processes of care (IPC) *(d* = 0.18), patient assessment of care for chronic conditions *(d* = 0.03), self-reported days in bed in prior month *(d* = -0.14) and medication adherence *(d* = 0.22).	$\square_{T1}$	6
Riegel et al., (2002) [78]	To evaluate the effectiveness of a telephonic disease management intervention in	**N** = 358 (T = 130; C = 228) **Mean age** (years): Hispanic: 72.25 (SD =	**T:** Average of 17 nurse-led telephone calls standardized through a computer software program entitled *At Home with Heart Failure* addressing education on various topics including: signs and	**O:** T1>C: Rehospitalization for HF (◆)	$\square_{T1}$	4

USA	decreasing hospitalizations among heart failure patients.	10.93); non-Hispanic: 71.68 (SD = 13.06) **%female**: Hispanic: 58.1%; Non-Hispanic: 48.6% **Population:** Hispanic and non-Hispanic patients with HF.	symptoms of HF, when to seek medical attention, physical activity, and alcohol consumption. **C:** Usual care. **Duration**: 24 weeks **Timing of measurements:** Baseline, 3- and 6-months	T1 = C for all-cause hospitalization rates, HF and all-cause readmission rate, average number of days in the hospital, multiple readmissions, acute care costs, out patient resource use and satisfaction with care (◆)		
Riegel et al., (2006) [79] **USA**	To evaluate the effectiveness of telephone case management in reducing hospitalizations, improving health-related QoL and depression among Hispanics with heart failure.	**N** =135 (T = 70; C = 65) **Mean age** (years): T: 71.6 (SD = 10.8); C: 72.7 (SD = 11.2) **% female**: T: 58.0%; C: 49.2% **Population**: Hispanics of Mexican origin with heart failure.	**T:** Standardized telephone calls ($\bar{x}$ = 13.5 contacts with patients) led by nurses addressing, diet, self-care skills, and medication adherence, while integrating cultural aspects such as personalized caring, trust, and family inclusion ($\bar{x}$ = 8.4 contacts with family) + consultation with other professionals as needed ($\bar{x}$ = 4.6 telephone contacts) + monthly mailed educational materials. **C**: Usual care. **Duration**: 24 weeks **Timing of measurements:** Baseline, 1-, 3-, and 6-months	**P:** T1=C for HF re-hospitalizations (◆) **S**: T1 = C for all-cause hospitalizations, HF days in hospital, readmissions (>1), HF cost of care, all-cause cost of care, and all cause mortality rate (◆) **O:** T1=C for emotional QoL *(d* = -0.16), physical QoL *(d* = -0.09), overall QoL *(d* = -0.07), and depression *(d* = -0.24)	$\square_{T1}$	8
Rosal et al., (2005) [81] **USA**	To evaluate the feasibility and effectiveness of a self-management intervention in improving metabolic control among Spanish-speaking adults with low income and	**N** = 25 (T = 15; C = 10) **Mean age** (years): T: 62.7 (SD = 8.1); C: 62.4 (SD = 9.7) **% female:** T: 80%, C:80% **Population:** Low-income Spanish speaking adults with type 2 diabetes	**T:** Initial individual session (1-hr) + 10 x weekly groups sessions (2.5-3-hr) and 2 x individual sessions (15 minutes) delivered by diabetes nurse, nutritionist, and an assistant. Sessions addressed diabetes knowledge and attitudes, physical activity, diet, glucose self monitoring, and medication adherence using strategies such as: a soap opera viewing with guided group discussion, group cooking, family support, self-monitoring demonstrations, etc. **C:** Usual care.	**O:** T1>C for HbA1C (*d*= -1.60) T1=C for self efficacy for: diet (◆), exercise *(d* = 0.29), self-monitoring *(d* = , 0.05), oral glycemic agents, and insulin *(d* = 0.44); overall QoL *(d* = -0.35), global QoL *(d* = -0.13), specific QoL *(d* = -0.29), physical activity *(d* = 0.34), total kcal *(d* = 0.15), total fat	$\square_{T1}$	6

	diagnosed with type 2 diabetes.		**Duration**: 10 weeks **Timing of measurements:** Baseline, 3- and 6-months	intake (%, d =0.38), saturated fat intake (%, d = 0.23), total carb intake (g, d = -0.01), fiber intake *(d* = 0.07), blood glucose self-monitoring *(d* = 0.84), HDL *(d* = -0.41), LDL *(d* = -0.29), and total cholesterol *(d* = -0.22), diastolic BP *(d* = 0.15), systolic BP *(d* = 0.57), BMI *(d* = -0.11), diabetes knowledge *(d* = -0.08), triglycerides *(d* = -0.05), depression *(d* = 0.08), and waist circumference *(d* = 0.17).		
Rosal et al., (2011) [80] **USA**	To evaluate the effectiveness of a culturally tailored self-management intervention on glycemic control among Latinos with low income and diagnosed with type-2 diabetes.	**N** = 252 (T = 124; C = 128) **Mean age** (years): not specified **% female**: T: 78.2%; C: 75% **Population:** Adults of Latino ethnicity diagnosed with type 2 diabetes and with low income.	**T:** Initial individual session (1-hr) + 12 x weekly group sessions then 8 x monthly sessions (2.5-hrs) delivered by either a nutritionist or health educator and trained lay individuals. Sessions addressed diabetes knowledge and attitudes, and self-management behaviors through the use of culturally appropriate activities such as soap operas and bingo. **C:** Usual care. **Duration**: 52 weeks **Timing of measurements:** Baseline, 4- and 12-months	**P:** T1>C for HbA1C *(d* = -0.43) T2>C for HbA1C *(d* = -0.28) **S:** T1>C for daily blood glucose self-monitoring (◆) and self-efficacy (d= 0.128) T1=C for diabetes knowledge *(d* = 0.17), improvement in dietary quality *(d* = 0.13), % fat intake *(d* = 0.13), % saturated fat intake *(d* = 0.13), BP, weight, and waist circumference (◆). T2>C for improvement in dietary quality *(d* = 0.17), daily blood glucose self-monitoring (◆) and diabetes knowledge *(d* = 0.25)	$\square_{T1}$ $\square_{T2}$	8

				T2=C for % fat intake (*d* = 0.127), % saturated fat intake (*d* = 0.126), BP, weight, waist circumference, and self-efficacy (*d* = 0.126)		
Rothschild et al., (2014) [82] **USA**	To evaluate the effectiveness of an intervention delivered by CHWs on self-management behaviors for Mexican Americans with type 2 diabetes.	N = 144 (T= 73; C = 71) **Mean age** (years): T: 53.7 (SD = 11.7); C: 53.6 (SD = 12.7) **% female:** T: 64.4%, C: 70.4% **Population:** Mexican American adults with type 2 diabetes.	**T:** 36 home visits ($\bar{x}$ = 99 minutes) led by a bilingual, trained, Mexican-American CHW addressing seven core diabetes self-management behaviors recommended by the American Academy of Diabetes Educators, emphasizing use of brainstorming, social support, problem-solving, journal writing, and managing stress. **C:** Attention control. Received 36 bilingual diabetes newsletters addressing the same topics as covered in the intervention. **Duration**: 104 weeks **Timing of measurements:** Baseline, 12- and 24-months	**P:** T2>C for HbA1C (*d*= -0.45) T2=C for BP control (OR = 1.39) T3 = C for BP control (OR = 0.54) **S:** T2>C physical activity, weight (◆) T2=C for daily glucose self-monitoring, medication adherence, self-efficacy, and fruits and vegetables consumption (◆)	$\square_{T2}$ $\square_{T3}$	9
Ruggiero et al., (2014) [83] **USA**	To evaluate the effectiveness of a medical assistant self-care coaching (MAC) intervention in improving diabetes self-care and HbA1C among low-income racial/ethnic minority populations with type 2 diabetes.	**N** = 266 (T = 134; C = 132) **Mean age** (years): T: 53.2 (SD = 11.7); C: 53.1 (SD = 13.0) **% female**: T: 67.9%, C: 69.7% **Population:** Adults with Type 2 diabetes, either Hispanic/Latino (47.4%)	**T**: Quarterly face-to face coaching sessions (30-minutes) with a medical assistant guided by a computer program to follow the 5 A's: assess, agree, advise, assist, and arrange. Session content was tailored to patients' choice and included: medication adherence, physical activity, diet, etc. + 8 x monthly follow-up phone calls (in months when no face-to-face contact) to provide additional self-care coaching, answer patient questions, and remind patient of upcoming medical visits and tests.	**O:** T1=C for HbA1C (*d* = 0.03) and diabetes self care behaviors of: physical activity (*d* = 0.34), general diet (*d* = -0.14), specific diet (*d* = 0.16), blood glucose testing (*d* = -0.10), and foot care (*d* = 0.05). T2=C for HbA1C (*d* = 0.02), and diabetes self care behaviors of: physical activity	$\square_{T1}$ $\square_{T2}$	8

		or African American (52.6%)	**C:** Enhanced care treatment as usual which included regular visits with the HCP, foot and eye exams, and basic diabetes education provided by physician or other HCP. Patients also received "Diabetes: You're in Control" educational booklet at baseline assessment. **Duration**: 52 weeks **Timing of measurements:** Baseline, 6- and 12-months	*(d* = 0.09), general diet *(d* = -0.12), specific diet *(d* = 0.03), blood glucose testing *(d* = -0.003), and foot care *(d* = 0.24).		
Ryabov et al., (2010) [84] **USA**	To evaluate the effectiveness of a lay educator (promotora) facilitated diabetes self-management intervention on HbA1C, BMI, diabetes knowledge, self-efficacy, and self-management among of Mexican American adults diagnosed with type 2 diabetes.	**N** = 30 (T = 15; C = 15) **Mean age** (years): T: 54.4 (SD = 8.0); C: 54.7(SD = 6.8) **% female:** T: 80%, C: 80% **Population:** Mexican American adults (30+ year old) diagnosed with type 2 diabetes	**T:** Monthly home visits (1-hr) by a promotora to provide diabetes self-management education. Individual self-management plans were established in the first visit, and subsequent visits focused on diabetes education including: pathophysiology, complications, treatment options, diet, exercise, and daily self-management strategies such as blood glucose monitoring, stress management, and problem solving. **C:** Usual care. **Duration**: 104 weeks **Timing of measurements:** Baseline and 24-months	**O:** T3>C for self-management (*d*= 4.86), self-efficacy (*d*= 2.63), HbA1C (*d*= -1.84), and diabetes knowledge (*d*=1.45) T3=C for BMI *(d* = -0.6)	$\square_{T3}$	3
Shah et al., (2004) [85] **USA**	To evaluate the effectiveness of culturally sensitive dietary program to lower cholesterol, improve nutrient intake, diet quality and HbA1C levels among patients with systemic lupus erythematosus	**N** = 17 (T = 8; C = 7) **Mean age** (years): T: 44.1 (SD = 9.3); C: 45.1 (SD = 12.7) **% female:** 100% **Population**: Adult women with a diagnosis of SLE for at least 6 months and a low literacy level (below 5th grade)	**T:** 6 x weekly group sessions followed by 3 x telephone consultation every 2 weeks. Sessions were conducted by one of the authors, a nutritionist, and bilingual RAs. Content addressed diet guidelines, diet maintenance, reading of food labels and feedback on food journals. **C:** Usual care (no diet advice) **Duration**: 12 weeks	**O:** T1=C for Kcal intake *(d* = -0.50), fiber intake (grams, *d* = 0.81), iron intake (mg, *d* = -0.51), sodium intake (mg, *d* = -0.30), calcium intake (mg, *d* = -0.72), B12 intake (mcg, *d* = -1.07), folate intake (mcg, *d* = 0.56) and HbA1C *(d* = 0.78).	$\square_{T1}$	7

			Timing of measurements: Baseline, 1.5-, and 3-months			
Sixta et al., (2008) [86] **USA**	To evaluate the effectiveness of a lay educator (promotora) facilitated diabetes self-management education and support intervention on knowledge, beliefs, and HbA1C among Mexican American adults diagnosed with type 2 diabetes.	**N** = 131 (T = 63; C = 68) **Mean age** (years): T: 54.5 (range, 30-77 years); C: 52.8 (range, 26-81 years) **% female**: T: 71%; C:71% **Population**: Mexican American adults (18+ years) diagnosed with type 2 diabetes	**T:** 10 x weekly group education sessions (1.5-hrs) delivered by promotoras. The sessions were curriculum-based including education/coaching on blood glucose management, psychosocial coping, nutrition and exercise, healthcare team management and problem-solving/goal revision. **C:** Wait-list control with usual care. **Duration**: 10 weeks **Timing of measurements**: Baseline, 3- and 6-months	**O:** T1>C for diabetes knowledge (*d*=0.59) T1=C for HbA1C (◆)	$\square_{T1}$	5
Spencer et al., (2011) [87] **USA**	To evaluate the effectiveness of a culturally tailored behavioral intervention in improving the glycemic control among patients diagnosed with type 2 diabetes.	**N** = 164 (T = 84; C = 99) **Mean age** (years): T: 50 ; C: 55 **% female:** T: 75%, C: 67% **Population**: African American and Latino/Hispanic adults diagnosed with type 2 diabetes	**T:** 11 x diabetes education classes (2-hrs) held every 2 weeks + 2 x home visits (1-hr) per month to address participants' specific self-management goals led by CHWs + 1 x clinic visit with the participant and his or her primary care provider + follow-up phone calls every 2 weeks with a family health advocate with the aim of improving patient-provider communication skills and referrals to other services as needed. **C:** Wait list control (involved monthly phone call to update contact information). **Duration**: 24 weeks **Timing of measurements**: Baseline, and 6-months	**P:** T1=C for HbA1C (*d* = -0.33). **S:** T1>C for consumption of fatty/fried food (*d*=-0.47), consumption of soda pop or fruit drinks (*d*=-0.49), self-management knowledge (as assessed with 3 questions: 'How well do you understand how to manage your diabetes?' (*d*=0.54); % who 'Strongly agree' that what you eat will make a big difference in your ability to control affect blood sugar levels (*d*=0.68), and % who agree that 'exercise helps control blood sugar' (*d*=0.87), and self-care behaviors of: foot	$\square_{T1}$	6

				checks (*d*=-0.54), and inspecting shoes (*d*=0.69) T1=C for diabetes distress *(d* = -0.23), self-efficacy *(d* = 0.35), physical activity *(d* = 0.002), daily fruit and vegetable servings *(d* = 0.34), LDL cholesterol *(d* = -0.37), diastolic BP *(d* =0.25), systolic BP *(d* = 0.15), BMI *(d* = -0.09) and diabetes self-care behaviors of: following healthful eating plan every day *(d* = 0.29) and testing blood sugar *(d* = 0.27). **O**: T1>C for medication adherence *(d* = -0.42)		
Swerissen et al., (2006) [88] **Australia**	To evaluate the effectiveness of the Chronic Disease Self-Management Program (CDSMP) for improving health outcomes and individual satisfaction, as well as reducing use of health services among individuals with chronic illness(es) originating from a CALD background.	N= 474 (T = 320; C = 154) **Mean age** (years): T: 66.4 (SD = 8.35), C: 65.4 (SD = 11.71) **% female:** T: 72.8%, C: 79.2%. **Population:** Patients from CALD backgrounds (Greek, Italian, Vietnamese, and Chinese) diagnosed with chronic illness(es) including arthritis, hypertension, diabetes, heart disease, and asthma.	**T:** Six weekly group sessions (2.5-hrs) delivered in participants' first language, which addressed topics such as symptom management, problem solving, coping with emotions, communications skills, and skills mastery. Materials given included an audiocassette and program booklet in each individual participant's first language. **C:** Usual care, then received the CDSMP 6 months after the intervention group. **Duration**: 6 weeks **Timing of measurements**: Baseline and 6-months	**O:** Overall: T1>C for self-rated health, energy, health distress, fatigue, pain, exercise, cognitive symptom management and self-efficacy (◆) T1=C: shortness of breath, disability, intrusiveness of illness, depression, and role function (◆)	$\square_{T1}$	3

Toobert et al., (2011) [89] **&** **Toobert et al., (2011)** [2] [90] **USA**	To evaluate the effectiveness of a culturally-adapted multiple health behavior change program for improving biological and QoL outcomes among Latina females with type 2 diabetes	N = 280 (T = 142; C = 138 **Mean age** (years): T: 55.6 (SD = 9.7); C: 58.6 (SD = 9.7) **% female:** 100% **Population:** Latina females with type 2 diabetes.	**T:** A 2.5 day retreat + follow-up meetings (4-hrs) weekly x 6 months then twice monthly x 6 months. Program content focused on encouraging participants to: follow a Mediterranean diet adapted for Latin American subcultures, partake in daily stress management techniques, smoking cessation, adhere to 30 minutes of exercise daily and take part in a problem-solving support group. **C:** Usual care with optional educational enhancement (1x booklet based on some educational material from intervention). **Duration**: 96 weeks **Timing of measurements**: Baseline, 6- and 12-months	**O:** T1>C for social support *(d* = 1.00), quality of problem solving strategies *(d* = 0.44), behavior-specific disease management (*d* = 0.61), self-efficacy *(d* = 0.57), physical activity *(d* = 0.35), % calories saturated fat (*d*=-1.00), stress management daily (*d*=0.38), and HbA1C (*d*=-0.24) T1=C for physical QoL *(d* = 0.04), mental QoL *(d* = -0.11), smoking *(d* = -0.17), and CHD risk *(d* = -0.18) T2>C for social support *(d* = 1.00), quality of problem solving strategies (*d*=1.13), behavior specific disease management (*d*=0.31), self-efficacy (*d*=0.40), physical QoL *(d* = -0.25), and % calories saturated fats (*d*=-0.78) T2=C for smoking *(d* = -0.07), CHD risk *(d* = 0.08), mental QoL *(d* = -0.17), physical activity *(d* = 0.18), HbA1C *(d* = 0.12) and stress management *(d* = 0.18). T3>C for HbA1C *(d* = -0.39), social support *(d* = 0.44), % calories saturated fats *(d* = -19.92), stress management practices *(d* = 4.09) and quality	$\square_{T1}$ $\square_{T2}$ $\square_{T3}$	7

				of problem solving strategies *(d* = 0.43). T3=C for self-efficacy *(d* = 0), exercise *(d* = -0.02), CHD risk *(d* = 0.20), and behavior-specific disease management *(d* = 0.09)		
Trief et al., (2013) [91] **USA**	To evaluate the change in adherence over time and in response to a telemedicine diabetes self-care intervention for improving glycemic control among elderly Hispanic or African American patients with type 2 diabetes	**N =** 1665 (T = 844; C = 821) **Mean age** (years): T: 70.79 (SD = 6.48), C: 70.86 (SD = 6.78) **% female:** 62.82 % (T: 63.5%; C: 62.12%) **Population**: Non-Hispanic white, Hispanic, and African American adults (55+ years) diagnosed with type 2 diabetes	**T:** Telemedicine case management intervention involving regular meetings (tele-visits) every 4-6 weeks with an educator to review blood glucose and blood pressure readings, set behavioral goals, and assess their progress in achieving control, to identify any patterns of difficulty, and to discuss good diabetes self care. **C:** Usual care **Duration**: 260 weeks **Time of measurements:** Baseline, 12-, 24-, 36-, 48-, and 60-months	**P:** T2>C diabetes self-care (◆) T3>C diabetes self-care (over 60 months) (◆) *Data not presented for HbA1C (◆)	□T2 □T3	7
Vincent et al., (2007) [92] **USA**	To evaluate the feasibility and effectiveness of a culturally tailored behavioral diabetes self-management intervention for Mexican Americans diagnosed with type 2 diabetes.	**N** = 20 (T = 10; C = 10) **Mean age** (years): T: 56.7 (SD = 10.6); C: 55.3 (SD = 8.2) **% female**: T: 89%; C: 50% **Population:** Mexican American adults diagnosed with type 2 diabetes	**T:** 8 weekly group sessions (2-hrs) consisting of culturally tailored didactic education on stress management and self-efficacy, cooking demonstrations, and group support **C:** Usual care (2-4 annual visits with physician). **Duration**: 8 weeks **Timing of measurements:** Baseline, 2- and 3-months	**O:** T1=C: diabetes self-knowledge *(d* = 0.02), HbA1C *(d* = -0.73), self-efficacy *(d* = 0.03), weight *(d* = 0), BMI *(d* = -0.07) and blood glucose *(d* = -0.33). T1 = C for overall self-management activities *(d* = 0.43) and subscales of blood glucose self-management *(d* =	□T1	8

				0), diet *(d* = -0.23), exercise *(d* = 0.25), foot care *(d* = -0.11) and medication adherence *(d* = 0.10).		
Vyas et al., (2003) [93] **UK**	To evaluate the effectiveness of a secondary-primary care education package utilizing HCP specialists improves diabetes self-care knowledge among South Asian patients diagnosed with type 2 diabetes	N = 211 (T = 108; C = 103); **Mean age** (years): 55.4 (SD = unavailable) **% female**: T: 59.2%; C: 48.5% **Population**: South Asians diagnosed with type 2 diabetes.	**T:** Four x targeted individual clinic sessions with a practice nurse, which were tailored (according to participants' questionnaire response) to meet the educational needs of the participant. A diabetes specialist nurse, a podiatrist, and dietician saw participants at least once during these sessions. Urdu or Punjabi speaking HCPs or interpreters at each session. **C:** Usual care (routine diabetes care) **Duration**: 52 weeks **Timing of measurements:** Baseline and 12- months	**O:** T2=C for diabetes knowledge and awareness and diabetes self-management (◆)	$\square_{T2}$	4
Welch et al., (2011) [94] **USA**	To evaluate the clinical effectiveness of a nurse-led diabetes care program (Comprehensive Diabetes Management Program, CDMP) for improving diabetes self-management among Hispanic patients with poorly controlled Hispanic type 2 diabetes.	**N =** 46 (T = 25; C = 21); **Mean age** (years): T: 54.4 (SD = 10.4); C: 57.5 (SD = 9.5); **% female:** T: 68%, C: 61.9% **Population:** Hispanic patients with poorly controlled diagnosed type 2 diabetes	**T:** Seven (1-hr) x individual diabetes care visits with a bicultural/bilingual diabetes nurse and team including diabetes education on lifestyle changes + care planning tailored according to Diabetes Self-Care Profile, which if filled out generates a set of diabetes behavioral alerts, as well as clinical status evaluative tools; risk profiles; and telemedicine retinopathy assessment. **C:** Attention control: 7 x 1-hr visits to review diabetes education books & encourage contact with HCPs **Duration**: 52 weeks **Timing of measurements**: Baseline and 12-months	**O:** T2> C: Change in HbA1C, change in diabetes distress (◆) and treatment satisfaction *(d* =0.66), T2=C: BMI *(d* = -0.07), HbA1C *(d* = -0.36), depression (◆) diastolic BP *(d* = -0.46), systolic BP *(d* = -0.54), diabetes distress *(d* = -0.58), change in depression status (◆)	$\square_{T2}$	8

Welch et al., (2015) [95] **USA**	To evaluate the clinical effectiveness of an internet-based diabetes management platform as a clinical-decision support (CDS) tool for providing care to patients with type 2 diabetes at urban poor safety net clinics	**N** = 399 (T = 199; C = 200) **Mean age** (years): T: 54.8 (SD = 10.3), C: 55.2 (SD = 11.9) **% female:** T: 60.8%, C: 59% **Population:** Hispanic adults with type 2 diabetes and HbA1C > 7.5%.	**T:** Five one-on-one diabetes educational sessions (1 x 1-hr + 4 x 30 minutes) delivered by a bicultural/ bilingual diabetes nurse and dietician scheduled at baseline, 2 weeks, 1 month, 3 months, and 6 months. An internet tool guided the intervention, which included: clinical alerts and reminders, a diabetes complications risk profile that supports the delivery of evidence-based treatment protocols, diabetes education teaching resources, and clinical reports. **C:** Usual diabetes care (in-house diabetes program involving patient visits with educational content). **Duration**: 24 weeks **Timing of measurements**: Baseline and 6-months	**P:** T1>C: Percentage of patients achieving good blood glucose control as evidenced by HbA1C *(d* = -0.57) **S:** T1=C: Diastolic BP *(d* = 0.06) and systolic BP *(d* = 0.01), BMI *(d* = -0.07), changes in self-reported hypoglycemia symptoms (◆), and depression (◆) T1>C: improvements in diabetes distress *(d* = -0.27), and social distress *(d* = -0.26).	$\square_{T1}$	7

T = Treatment; C = Control; P = primary outcomes; S = secondary outcomes; O = unspecified P and S outcomes (as specified by study authors)
*E = effectiveness of the intervention was defined as those interventions in which >50% of P outcomes were significant. For those interventions without specified P outcomes, they were said to be overall effective if >50% of all outcomes were significant
Time points: T1 = Treatment group at Time 1 (0 to ≤6 months); T2 = Treatment group at Time 2 (>6 to 12 months); T3: outcomes only reported at >12 months
(◆) Data unavailable for extraction (clustered) or insufficient data for ES calculation

Table 2. *SMDs at T1 and T2 by outcomes.*

Outcomes	**Time points**					
	T1			**T2**		
	# studies	**Pooled ES (95% CI)**	**I^2 (%)**	**# studies**	**Pooled ES (95% CI)**	**I^2 (%)**
Physical Outcomes						
Systolic BP	14	-0.07 (-0.15, 0.02)	0	10	-0.04 (-0.16, 0.09)^{R}	39
Diastolic BP	13	-0.05 (-0.13, 0.04)	22	9	-0.05 (-0.25, 0.15)^{R}	72
BMI	13	**-0.13 (-0.23, -0.04)**	0	7	**-0.19 (-0.36, -0.01)^{R}**	45
Cholesterol (Total)	10	**-0.18 (-0.36, -0.01)^{R}**	57	7	-0.12 (-0.29, 0.03)^{R}	41
Cholesterol (LDL)	10	-0.17 (-0.44, 0.09)^{R}	78	7	-0.03 (-0.23, 0.17)^{R}	62
Cholesterol (HDL)	8	-0.13 (-0.30, 0.05)^{R}	30	6	-0.06 (-0.24, 0.12)^{R}	39
Blood Glucose	6	**-0.35 (-0.49, -0.20)**	1	4	**-0.31 (-0.46, -0.16)**	0
HbA1C	19	**-0.29 (-0.40, -0.18)^{R}**	52	12	**-0.25 (-0.38, -0.13)^{R}**	51
Triglycerides	9	**-0.12 (-0.24, -0.00)**	0	6	**-0.13 (-0.25, -0.01)**	0
Waist Circumference	4	-0.20 (-0.48, 0.09)	0	--	--	--
Weight	6	-0.12 (-0.30, 0.06)	0	3	-0.26 (-0.70, 0.18)^{R}	76
Psychosocial Outcomes						
Depression	8	-0.07 (-0.25, 0.12)^{R}	61	3	**-0.27 (-0.44, -0.09)**	0
Knowledge	12	**0.35 (0.22, 0.48)^{R}**	39	5	**0.45 (0.28, 0.62)^{R}**	47

ES: Effect Size; 95% CI: Confidence Interval. Significant ES at alpha 0.05 are in bolt font. T1: Short term (median: 6-month), T2: Long term (median: 12-month). I^2: describes the percentage of variation across studies that is due to heterogeneity rather than chance. Fixed effect model was used to compute the pooled effect size and 95% CI, except when the I^2>25%, the random effect model labeled as "^{R}" was used. ^{R} = Random effect model.

Declarations

Ethics approval and consent to participate. Not applicable

Consent for publication. Not applicable.

Availability of data and materials. Most of the data generated or analyzed during this study are included in this published article (and its supplementary information files). For any additional datasets used and/or analyzed during the current study, they are available from the corresponding author on reasonable request.

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Authors' contributions. SL, AML, NF, CM, ER, LC, SD, EGP, SD, and AC conceptualized the literature search and obtained funding. SL, KL, ST and KC performed the selection of studies included in the present review by screening titles, abstracts and full texts. Further, they contributed to data collection by extracting raw data from the 58 included studies. JLS, ST and SL extracted all the raw data for outcomes included in the meta-analysis and descriptive review. JLS, LH, and LOB coded the health education interventions to allow for a comprehensive description of the properties of the included interventions. JLS, EB, AC and LOB analyzed and interpreted all extracted data for meta-analysis and descriptive review (including analysis of intervention modifiers). LH, EB and LOB contributed to writing the manuscript sections pertaining to their area of

expertise. SL and JLS drafted the manuscript. All authors critically reviewed the manuscript and approved the final version.

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