A Review of Physical Activity Interventions in a Hispanic/Latino Population with Elevated Risk for Type 2 Diabetes Mellitus

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ABSTRACT:

Context: Hispanic/Latino adults are at a higher risk of developing type 2 diabetes mellitus compared to non-Hispanic white adults. Regular physical activity can help reduce the risk of developing chronic conditions such as diabetes mellitus and obesity. Standard prevention programs have not shown the same level of effectiveness in the Hispanic/Latino population.

Objective: The purpose of this systematized review was to evaluate the recent literature of physical activity interventions in the Hispanic/Latino population that may lead to an increase in physical activity and reduce long-term health risks.

Design: A systematized review of recent published articles utilizing physical activity interventions in the Hispanic/Latino community. This included seven articles that were published in the past five years.

Eligibility Criteria: Hispanic/Latino adults who have not been diagnosed with diabetes mellitus, but who may have certain risk factors such as pre-diabetes or obesity.

Study Selection: Sources searched were PUBMED and CINAHL. These sources were searched between December 2023 and February 2024. The search yielded 1,298 citations without duplicates. The inclusion criteria included studies in which the populations were entirely Hispanic or Latino adults, with an intervention that included the promotion of physical activity and was conducted in Spanish.

Main Outcome Measures: Increasing physical activity and decreasing risk factors, such as elevated hemoglobin A1c, body mass index (BMI), body fat percentage, and body weight.

Results: Most researchers reported an increased engagement in physical activity with their interventions. The approaches to engage participants and the end points varied in the individual studies. Researchers reported significant increases in “leisure walking” ($p=0.46$) or “brisk walking” ($p=0.011$), which also resulted in decreased sedentary time.

Researchers also reported an increased likelihood of achieving Centers for Disease Control and Prevention (CDC) physical activity guideline goals of ≥150 minutes of moderate- to vigorous- physical activity per week. After 12 months of a web-based physical activity tool, those meeting the CDC physical activity guidelines logged on significantly more than those who did not meet the guidelines (p=0.002). In addition, some researchers reported significant decreases in mean body weight with increased physical activity (p=0.004).

Conclusion: In those studies that were most effective in increasing physical activity, researchers implemented structured use of technology that were customized to the Hispanic/Latino community. Additional studies need to be conducted to evaluate the appropriate level of reach and engagement to increase physical activity in the Hispanic/Latino populations.

Key Words: Diabetes mellitus, Health, Hispanic, Latino, Physical activity

Section 1: Introduction

According to the 2020 United States (US) Census information, there are 62.1 million Hispanics/Latinos living in the United States. This group represents 18.9% of the total US Population and is the second largest racial/ethnic group after non-Hispanic whites. This ethnic group includes any individuals of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin. Among Hispanic/Latino subgroups in 2020, Mexicans ranked as the largest at 61.6%, followed by Puerto Ricans at 9.6%, Central Americans at 9.3% and South Americans at 6.4% (Office of Minority Health, 2024b).

The Centers for Disease Control and Prevention (CDC) states that US adults have a 40% chance of developing type 2 diabetes mellitus (T2DM) over their lifetime. However, Hispanic/Latino adults have more than a 50% chance of developing T2DM. Hispanics/Latinos are also more likely to develop T2DM at a younger age (CDC, 2021). The role of diet and exercise/physical activity are especially important to consider in this population. A prominent risk factor is a carbohydrate rich diet, which is notable in many Hispanic/Latino communities. Hispanic cuisine regularly includes tortillas, beans, and rice, especially among Mexican, Puerto Rican, and Dominican populations (Mora & Golden, 2017). These foods can cause an increase in blood glucose concentrations and can lead to obesity (Mora & Golden, 2017), which can lead to the development of T2DM

(Aguayo-Mazzucato et al., 2019). Physical inactivity is also a likely risk factor of T2DM in this population. Adams et al. (2011) stated that 45% of Latino individuals never engaged in physical activity in their leisure time. The higher rates of physical inactivity, even when adjusted for education levels, socioeconomic status, employment, marital status, family income and poverty, remain significant when compared to non-Hispanic whites (Crespo, 2000). The level of physical activity is inversely associated with an increased risk of developing some components of metabolic syndrome. These include hypertension, hypercholesterolemia, obesity, and cardiovascular disease (Mann et al., 2014). Because of this, accumulation of long-term complications from diabetes mellitus are more common in the Hispanic/Latino population. These complications include higher rates of kidney failure and diabetes-related vision loss and blindness (CDC, 2021).

Healthy People 2030, which identifies health priorities to help individuals, organizations, and communities across the United States improve health and well-being (Office of Disease Prevention and Health Promotion, 2024), emphasizes the role that social determinants of health (SDOH) may play in certain communities. A specific emphasis is placed on five categories under SDOH: 1) Economic Stability, 2) Education Access and Quality, 3) Healthcare Access and Quality, 4) Neighborhood and Built Environment, and 5) Social and Community Context. Social determinants of health, such as food insecurity or discrimination, may represent a lifelong risk that must be

effectively managed to improve health outcomes (Haire-Joshu & Hill-Briggs, 2019). Specific examples of these in the Hispanic/Latino community include physician-patient interactions that can be complicated by language barriers and can contribute to health inequities in Hispanic/Latino populations (Fernandez et al., 2011). Hispanic/Latino health also is shaped by several other factors including transportation issues, lack of access to preventative care, and lack of health insurance (Office of Minority Health, 2024b). Other factors such as higher levels of poverty, particularly among recent Hispanic/Latino immigrants, may further confound access to care. Hispanics/Latinos are much more likely to work in jobs with additional risks for health problems (Pew Research Center, 2022).

It is estimated that nearly 15 million Hispanics/Latinos have pre-diabetes, which is the second largest amount by any racial/ethnic group (CDC, 2021). The American Diabetes Association defines pre-diabetes as having a fasting plasma glucose concentration of 100 to 125 mg/dL, a 2-hour blood glucose concentration of 140 to 199 mg/dL, or a hemoglobin A1c (HbA1c) of 5.7% to 6.4% (Echouffo-Tcheugui & Selvin, 2021). Development of pre-diabetes increases the 10-year and lifetime risk of developing overt T2DM (Van Herpt et al., 2020). Lifestyle interventions can help prevent or delay T2DM (Knowler, 2002).

Evidence supports the use of physical activity in the prevention and/or management of numerous chronic conditions, including T2DM, obesity, cardiovascular disease, and certain cancers (Health.gov, 2018). Losing modest amounts of body weight (5% to 10%) can improve health and have a clinical influence on those diagnosed with pre-diabetes or T2DM (Heymsfield & Wadden, 2017; Magkos et al., 2016). Hispanics/Latinos have higher rates of obesity than non-Hispanic whites (Office of Minority Health, 2024b). Obesity is a significant health inequity among the Hispanic/Latino population.

The 2018 Physical Activity Guidelines for Americans support moving more and sitting less throughout the day; and that some physical activity is better than none. For substantial health benefits, adults should perform 150 minutes to 300 minutes of moderate intensity exercise or some combination of moderate- to vigorous- intensity exercise per week. Additional health benefits occur with more physical activity, including all-cause mortality, even at levels 3 to 5 times guideline recommended levels (Moore et al., 2012). Muscle strengthening activities should be performed two or more days per week for additional health benefits (Piercy et al., 2018). National data show that Hispanic/Latino male adults report significantly lower levels of guideline supported physical activity recommendations compared to the average population (National Center for Health Statistics, 2024). Hispanic/Latino females also report lower levels of physical activity compared to non-Hispanic white females (National Center for

Health Statistics, 2024). Barriers that have been self-reported in the past that limit physical activity include “lack of time,” “very tired,” or “lack of self-discipline” (Bautista et al., 2011).

The National Diabetes Prevention Program (DPP) was created in 2010 to address pre-diabetes and T2DM in the United States (CDC, 2024a). This national program created a partnership between public and private organizations. The program provides evidence-based interventions over a one-year period that can help prevent T2DM in the United States (Knowler, 2002). The key features of the National DPP focus on healthy eating and physical activity, and has been shown to be a cost effective intervention (Li et al., 2010). Participants met weekly (approximately) for the first six months, and then met one to two times per month for the last six months. The program was one year long that was facilitated by a trained lifestyle coach. The National DPP meeting topics are listed in Figure 2. The National DPP has been developed to be implemented and disseminated among communities. It can be offered in person, on-line, or a combination of both in-person and on-line (CDC, 2024b).

Since the inception of the National DPP in 2010, the program has been modified in some ways. The focus remains on lifestyle change based on the outcomes from the original study (Knowler, 2002), including nutritional and physical activity modifications that can reduce the risk of or delay the onset of T2DM. The CDC has approved these

modifications from the original DPP. Specific pre-approved curricula that meet the Diabetes Prevention Recognition Program (DPRP) standards is provided by the CDC to be used to implement a lifestyle change program at a community level (CDC, 2024b).

Lifestyle change programs have been shown to delay the onset of T2DM by 11.1 years, compared to 3.4 years of delay for those taking the medication metformin (Aroda & Ratner, 2008). Lifestyle change programs have shown that people who lost between 5% and 7% of their body weight decreased their risk of developing T2DM by more than 58% (Knowler, 2002). While the National DPP outcomes have shown to be effective, disparities in program reach and effectiveness among Hispanics/Latinos exist (Albright & Gregg, 2013; Cannon et al., 2022). Lower effectiveness among Hispanics/Latinos has been linked to lower attendance rates compared to other groups (Clennin et al., 2020; Ritchie et al., 2018). Barriers to attendance can include time off from work, transportation, and caregiving priorities (Mccurley et al., 2017; Saju et al., 2022; Zare, 2022).

Emphasizing lifestyle change is the primary method for preventing disease using the established approaches through the DPP. The American Heart Association also has key measures for improving and maintaining cardiovascular health through lifestyle modifications and measures. These measures are called Life's Essential 8 (American Heart Association, 2024). There are four behaviors and four factors listed in Life's

Essential 8. The four behaviors are: 1) Eat better, 2) Be more active, 3) Quit tobacco, and 4) Get healthy sleep. The four factors are: 1) Manage weight, 2) Control cholesterol, 3) Manage blood sugar, and 4) Manage blood pressure. Both the DPP and the American Heart Association's Essential 8 emphasize the importance of lifestyle modifications to improve health and reduce long-term risk factors for diabetes risk and cardiovascular health, respectively. These programs focus on the role that diet, physical activity, and weight management play in overall long-term health. Other similarities between the DPP and the American Heart Association's Life's Essential 8 include behavior support and self-management skills, risk factor reduction, and a preventative approach toward chronic diseases, specifically diabetes mellitus and cardiovascular disease.

Improving physical activity can reduce the risk of developing T2DM and can also improve cardiovascular health. The purpose of this systematized review is to uncover physical activity interventions that improve physical activity levels in a Hispanic/Latino population who is at-risk for type 2 diabetes mellitus.

Section 2: Methods

Search Strategy

The search strategy is depicted in Figure 1. This review followed the Preferred Reporting Items for Systematized Reviews and Meta-Analyses (PRISMA). Two different databases were searched for applicable articles. PUBMED was searched after using a

search strategy builder with three different concepts around activity, ethnicity, and risk factors. Keywords of the search concepts were: “physical activity”, “Hispanic”, “Latino”, and “pre-diabetes”. Other search variations of “physical activity” included: ”exercise” or “walking” or “cardio” or “workout”; other search variations of “Hispanic” included “Latino” or “Latin": other search variations of “pre-diabetes” included “insulin resistance” or “metabolic syndrome” or “obesity” or “at-risk”. CINAHL was searched with a similar search strategy. Article citations were downloaded to an online research management tool in Endnote (Version 20, 2023, Clarivate, Philadelphia, PA) and duplicates were removed. Remaining references were exported to systematic review software for screening in Covidence systematic review software (Veritas Health Innovation, 2024, Melbourne, Australia).

Inclusion and Exclusion Criteria

All studies included in this systematized review had to be human research with a specific physical activity intervention. The studies evaluated needed to include adults (³18 years of age) who self-identified as either Hispanic or Latino. Interventions were required to have an emphasis on the promotion of physical activity. Interventions could include additional elements other than physical activity, including diet and nutrition counseling. No time limit was placed on the length of the intervention or on the follow-up for participants. Only studies published in the last five years were included.

Exclusion criteria included studies not published in a peer reviewed journal and gray literature (information produced outside of traditional publishing and distribution channels) because of insufficient information provided. Studies that included individuals diagnosed with diabetes mellitus were excluded from this review.

Study Screening and Process for Data Extraction

Titles and abstracts were screened by one reviewer (JM) who identified potential articles for inclusion. The full text of relevant articles was obtained and screened by the same reviewer. The reference list of included articles was also back searched for other potentially relevant articles. Citation information, participant characteristics (age, sex, race/ethnicity, health status, etc.), type of intervention, length of intervention, and type of study were all reviewed in the decision-making process.

Section 3: Results

Study Characteristics

The search yielded 1,298 articles across two search engines: PUBMED (n=1,138) and CINAHL (n=160), with 72 duplicates identified. There were 1,226 studies that were screened (Figure 1). There were seven studies that met the inclusion criteria after full-text screening.

Study details and intervention characteristics are listed in Table 1. Of the seven studies included, the proposed interventions ranged from as few as 16 weeks to up to

two years. The populations studied in these interventions were predominantly female, although there was an intervention that exclusively enrolled males (Frediani et al., 2020). The lower percentage of men included in these studies is consistent with the low percentage of men enrolled in the National DPP (Jackson et al., 2020). The number of initial participants in the selected studies ranged from 26 to 656. All studies referenced took place in the United States. Three took place in California, two in Texas, one in Georgia, and one took place in the Midwest. Each intervention had a culturally tailored approach that was specifically focused on the Hispanic/Latino community.

Hispanic/Latino community groupings in the seven studies included a majority of Mexican Americans in each of the studies. Most of the studies specifically listed region of origin to provide more detail about the participants. Most studies had above 80% participants who were Mexican or Mexican American in the interventions. Individuals who were Puerto Rican and Central American were also common in these interventions; however, less common than those who were Mexican or Mexican American.

Educational interventions for three of the studies included a DPP educational component or DPP-based with a customized approach toward a physical activity intervention (Formagini et al., 2023; Frediani et al., 2020; Rosas et al., 2020). The remaining four studies were comprised more directly toward a focus on moderate- to

vigorous- physical activity changes in the study population (Brown et al., 2022; Linke et al., 2019; Marcus et al., 2022; Salinas & Parra-Medina, 2019). Some interventions were strongly centered around a technology component, such as text messaging, regular emailed communication, and website interactions/usage (Brown et al., 2022; Linke et al., 2019; Marcus et al., 2022; Salinas & Parra-Medina, 2019). The outcomes of these studies were assessed using various values including weight loss, body mass index (BMI), or change in hemoglobin A1c to evaluate the success of the intervention.

Physical Activity Design and Tracking

The physical activity interventions reviewed focused on a variety of endpoints. In one study the main intervention approach was to get participants to move more and reduce their sedentary time (Salinas & Parra-Medina, 2019). This has rarely been used as an endpoint for a physical activity intervention, although there is growing evidence that reducing sedentary time can have an effect on obesity and T2DM risk (Bazargan-Hejazi, 2017; Lof, 2012; Moy, 2014). Salinas & Parra-Medina (2019) reported significant increases from baseline in "leisure walking" ($p=0.046$), "brisk walking" ($p=0.011$), "dance" ($p=0.033$), and "aerobics class" ($p=0.001$). Each of these were associated with a decrease in sedentary time. Significant effect sizes were also seen for moderate- to vigorous- physical activity for "jogging" ($p=0.050$), "general exercise" ($p=0.024$), and "other exercise not specified" ($p=0.003$).

Other formats of the physical activity programs included a soccer-based intervention that consisted of an organized recreational soccer program and an associated fitness curriculum (Frediani et al., 2020). Frediani et al. (2020) reported significant increases in predicted maximal oxygen consumption (VO_2max) at 12 weeks (1.9%; p=0.007) and 24 weeks (1.0%; p=0.036). Participants also had a 22% increase in modified push-ups at 12 weeks (p<0.0001) and a 31% increase at 24 weeks (p<0.0001). A significant increase in vertical jump was reported at 24 weeks (2.8 cm; p=0.048).

Other tailored physical activity approaches included an internet intervention with exercise videos and mapping of walking routes (Rosas et al., 2020). Weight loss differed significantly between the intervention group versus the control group at 12 months (2.6 kg weight loss vs 0.03 kg weight loss, respectively; p=0.005). However, at 24 months there was no significant difference in weight loss between the two groups.

Physical activity was measured either objectively by a tracking device, subjectively by self-report via a questionnaire, or by a combination of both a tracking device and self-report survey/questionnaire. Four researchers used some form of objective measurement of activity tracking, but only one group of researchers used an objective measurement of physical activity (Frediani et al., 2020). Three groups of researchers used only a questionnaire to track physical activity (Brown et al., 2022; Formagini et al., 2023; Rosas et al., 2020). Three groups of researchers used both an

objective and a subjective form of physical activity tracking (Linke et al., 2019; Marcus et al., 2022; Salinas & Parra-Medina, 2019).

Educational Components and Behavioral Theory Approach

The Diabetes Prevention Program (DPP) was specifically noted as the educational framework in three of the studies (Figure 2 and Figure 3). This provided an established educational foundation and structure for behavior change. Frediani et al. (2020) utilized the DPP framework but implemented a six-month rather than one-year intervention. Components for each of the interventions were provided in Spanish. Implementation details of the DPP-based framework also differed within the interventions reviewed.

Motivational interviewing has been shown to be used as an approach to help change behaviors in adults (Frost et al., 2018). Brown et al. (2022) evaluated a base nutrition and exercise program (Healthy Fit) with the addition of motivational interviewing. Community Health Workers were able to address factors influencing participants' motivations and ability to make changes to their lifestyle. These included mental health issues and family dynamics. This was used to help guide participants and identify strategies to address barriers and help visualize behavior change (Brown et al., 2022). Participants in the motivational interviewing group had 2.13 higher odds of losing weight ($p=0.003$) and 2.59 times higher odds of reducing body fat percentage

($p=0.001$) relative to the control group. Participants who received motivational interviewing lost an average of 2.71 pounds and body fat percentage declined by 2% over 12 months.

In three of the interventions, Social Cognitive Theory (SCT) constructs were implemented (Bandura, 1986). Marcus et al. (2022) addressed the use of incorporating Social Cognitive Theory, which included increasing social support and self-efficacy for physical activity, and goal setting and monitoring of physical activity. Marcus et al. (2022) conducted a study in which 11% of their participants reported reaching national physical activity guidelines. They compared a culturally and linguistically adapted, print-based intervention to a variation of the intervention that included text message-based strategies for greater interactivity and accountability. Marcus et al. (2022) reported significant increases in physical activity in both groups at six months compared to baseline ($p<0.05$). Although there was no significant difference between the two groups for self-reported physical activity and objectively measured physical activity at six months, there were significant differences between the two groups in terms of individuals meeting recommended guidelines for moderate- to vigorous-physical activity per week; 57% of the participants in the enhanced intervention met the physical activity guidelines compared to 44% of participants in the original intervention.

Technology Use

Text messaging has been another form of intervention that can help to increase physical activity. For example, Formagini et al. (2023) incorported text messaging communications in their study. The text messages were culturally adapted and were based on the DPP messaging. The text messages emphasized five main topics: 1) Healthy eating, 2) Physical activity practices, 3) Problem solving skills and challenges, 4) Lifestyle change motivation, and 5) Reminders about keeping track of activity and meals and access to a coach if needed. Participants in the study would receive two or three text messages per day (Formagini et al., 2023). Mean body weight changed from 86.9 kg to 84.9 kg ($p=0.004$) during the six-month study. Waist circumference significantly decreased by 1.1 cm ($p=0.03$), while BMI significantly decreased by 0.9 kg/m^2 ($p=0.003$) over the six-month period. Physical activity results were collected using a Rapid Assessment of Physical Activity (RAPA). Scoring was interpreted on a 1- to 5-point scale as: 1) Sedentary, 2) Underactive, 3) Regular underactive (light activities), 4) Regular underactive, and 5) Regular active. At the end of the program self-reported physical activity increased from a mean score of 2.9 (Regular underactive / light activities) at the beginning of the program to a mean score of 4.3 (between Regular underactive and Regular active) at the end of the program ($p=0.003$).

Other researchers included email communication to help implement their intervention. Linke et al. (2019) involved access and associated utilization of a physical

activity intervention website designed for Latinas. The website features included: 1) Self-monitoring of physical activity and steps per day, 2) Goal setting, 3) A message board for social support, 4) "Ask an expert" section, and 5) Online resources such as exercise videos and walking routes. Participants would receive email prompts to access the website on a weekly basis, then bi-weekly, and then monthly in months four to six of the program. Those who were most engaged in logging onto the website were more likely to reach the moderate- to vigorous- physical activity goal of 150 minutes per week. The intervention group logged on significantly more than the control group (29 times vs 14.7 times, respectively; $p<0.001$). At study completion, participants in the intervention group were more likely to meet the CDC physical activity guidelines of [3]150 minutes of moderate- to vigorous- physical activity per week if they used the web-based physical activity tool. Those meeting the physical activity guidelines logged on significantly more than those who did not meet the physical activity guidelines (35 times vs 20 times, respectively; $p=0.002$).

Community Health Workers

Community Health Workers can play several roles in helping manage or prevent diabetes mellitus in a community and provide on-going support and advocacy (Egbujie et al., 2018). Community Health Workers are especially important with participants with social determinants of health risk factors who most need these services and who are unlikely to have the resources to pay for them (Zare, 2022). Community Health

Workers played a central role in two of the studies reviewed here. Brown et al. (2022) and Salinas and Parra-Medina (2019) both included Community Health Workers.

Brown et al. (2022) utilized Community Health Workers who served as local experts to bring education and services to the community. The Community Health Workers were trained to operate as community change agents and helped provide safety and credibility when helping others adopt new behaviors. The Community Health Workers were trained to implement motivational interviewing techniques. This was used to help address a potential lack of motivation toward change. These techniques were used by the Community Health Workers to help build a collaborative relationship and overcome barriers and improve lifestyle changes. Participants in the motivational interviewing arm had 2.13 higher odds of losing weight ($p=0.003$) and 2.59 higher odds of reduced body fat percentage ($p=0.001$) relative to those in the control group.

Salinas and Parra-Medina (2019) used Community Health Workers to lead educational classes and physical activity sessions. Educational classes were offered weekly and physical activity sessions were offered throughout the week. The Community Health Workers also coordinated walking groups and the exercise classes offered through the local community centers. Salinas and Parra-Medina (2019) reported significant increases in moderate- to vigorous- physical activity and decreased

sedentary time. Specifically, these researchers reported increases in leisure walking (p=0.046), brisk walking (p=0.011), dance (p=0.003), and aerobics class participation (p=0.001) from baseline. Each were associated with a decrease in sedentary time. Significant effect sizes were reported for moderate- to vigorous- physical activity for jogging (p=0.050), general exercise (p=0.024), and other exercise not specified (p=0.003).

Section 4: Discussion

This systematized review focused on the effect of physical activity interventions in the Hispanic/Latino community. Seven studies were included in this review, which included a total of 1,938 participants. Of the initial participants in these studies, 1,353 (69.8%) were included in the post-study analyses. Participants in these studies were diagnosed with pre-diabetes or were considered obese. No participants were diagnosed with type 2 diabetes mellitus at the time of study initiation. However, this population is considered at an above average risk for the development of T2DM. Even small changes in health status can correspond to meaningful changes in risk of disease. Each 1 point increase in hemoglobin A1c has been shown to be associated with a 20% to 30% increase in cardiovascular risk and mortality (Khaw, 2004).

Various obstacles exist in the Hispanic/Latino population to obtain appropriate care and support. Appropriate care and support are further complicated by higher rates of the development of T2DM and higher rates of obesity in the Hispanic/Latino

population. Physical activity interventions, like the studies reviewed here, often have other components to the intervention and are not exclusively physical activity specific interventions. Programs such as the DPP and its components have been successful in preventing T2DM; however, the benefits have not been implemented as often within the Hispanic/Latino community.

Of the seven interventions, five of them included 85% or more of female participants. One intervention only included male participants, which has previously been noted as a gap in the Hispanic/Latino culturally tailored interventions. Together, the results from these research studies suggest some initial evidence for improvement in physical activity in the Hispanic/Latino population; however, the long-term efficacy of these tailored interventions need to be evaluated. Rosas et al. (2020) conducted the longest intervention in this systematized review (24 months). They reported a significant difference in weight loss at 12 months in the intervention group compared to the control group ($p=0.003$). At 24 months, a greater percentage of individuals in the intervention group maintained a weight loss of 5% or greater; however, this did not reach statistical significance versus the control group (24.2% vs 15.2%; $p>0.05$). However, the intervention in the second year of the study was limited to monthly emails reminding participants of topics discussed in year one, and that they could reach out to the coach if they needed further support (Rosas et al., 2020).

Our systematized review is limited by a lack of meta-analyses and inconsistent measurement outcomes. This systematized review is also limited by other components included in the interventions that are not specific to physical activity (e.g., diet and nutrition), which were not specifically separated in this review.

The objective of this paper was to review physical activity interventions and to uncover factors that led to increases in physical activity levels in a Hispanic/Latino population at-risk for T2DM. Hispanic/Latino adults are 70% more likely than non-Hispanic white adults to be diagnosed with type 2 diabetes mellitus by a physician (Office of Minority Health, 2024a). Evidence has shown that regular bouts of physical activity and other lifestyle modifications can reduce the risk for developing T2DM (Colberg et al., 2010). The results of this systematized review suggest that the DPP framework is a successful lifestyle intervention for reducing the risk of T2DM, but more physical activity intervention options need to be specifically studied in the Hispanic/Latino community. The use of technology to reach the population has shown promise and should continue to evolve and help further engage the Hispanic/Latino community.

Section 5: Conclusions

The studies in this systematized review provide some pathways for further evaluation in future research. Combining aspects of several effective elements of these

interventions may be an option to explore further. First, the DPP lifestyle intervention provides a roadmap that should be used to provide the components of a successful intervention. Incorporating the use of technology, such as text messages, emails, or website interaction is an effective method to communicate with individuals seeking support. A community health worker can play an important on-going role in supporting those individuals seeking additional motivation toward lifestyle change. Combining these elements into a one-year clinical evaluation should be considered. In conclusion, implementing culturally tailored physical activity interventions, like those in this review, is important for effectively reducing diabetes risk and improving overall health within the Hispanic/Latino community. Investing in these targeted programs can improve individual well-being and contribute to the broader goal of reducing health inequities and building healthier communities.

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Table 1: Summary of the Seven Studies Included in the Systematized Review

Authors, Journal Name, Year	Intervention Study Population Site	Study Design and Length of Intervention	Outcomes
Frediani et al., Progress in Cardiovascular Diseases, 2020	Soccer-based 41 men Atlanta, GA	Preliminary effectiveness and feasibility 24 weeks	Broad ranging significant improvements in physical fitness markers were observed Vertical jump, lower extremity muscular power, predicted maximal oxygen consumption (VO_2max), modified push-ups, dynamic sit-ups Higher retention of participants Predicted VO_2max at 12 weeks improved 1.9% ($p=0.007$) Predicted VO_2max at 24 weeks improved 1.0% ($p=0.036$) Modified push-ups at 12 weeks increased 22% ($p<0.0001$) Modified push-ups at 24 weeks increased 31% ($p<0.0001$)
Linke et al., Journal of Medical Internet Research, 2019	Internet-based physical activity engagement and association with adoption of moderate- to vigorous-physical activity 205 Women San Diego, CA	Randomized Controlled Trial 12 months	Wellness website vs internet-based physical activity intervention website Increased engagement with website led to increased physical activity Certain features of the website that were most used were goal setting features, personal physical activity reports, and physical activity tips Intervention group logged on significantly more times than the control group (29 times vs 14.7 times; $p<0.001$) Participants in the intervention group were more likely to meet Centers for Disease Control and Prevention (CDC) physical activity guidelines of 150 minutes per week (at 12 months, the intervention group logged on 35 times vs the control group, who logged on 20 times; $p=0.002$)

Marcus et al., Journal of Behavioral Medicine, 2022	Refinements included Social Cognitive Theory constructs and incorporating text message-based strategies 199 Women San Diego, CA	Randomized Clinical Trial 6 months	Significant increases in moderate- to vigorous- physical activity over 6 months Significant loss to follow-up: 23% did not complete the trial (due to immigration issues) Significant increases in moderate- to vigorous- physical activity in both groups compared to baseline at 6 months ($p<0.05$) No significant differences in moderate- to vigorous-physical activity between the enhanced intervention and the original intervention at 6 months ($p=0.73$) The enhanced intervention group had a 66% higher odds of meeting the moderate- to vigorous- physical activity guidelines compared to the original intervention (57% vs 44%, respectively; $p<0.05$)
Rosas et al., JAMA Network Open, 2020	Family-based orientation 22 in-person group sessions in year one Monthly emails sent in year two 118 Women 73 Men 191 Total San Francisco, CA Area	Randomized Clinical Trial 24 months	Participants recruited from health system where many have employer-based health insurance and relatively high annual incomes The intervention group vs the usual care group was more likely to achieve a 5% weight loss at 12 months (25.9% vs 9.2%, respectively; $p=0.003$) There was no significant difference in percentage of participants in each group achieving at least a 5% weight loss at 24 months between the intervention group and the usual care group: 24.2% vs 15.2%, respectively ($p>0.05$) Weight loss was significantly greater in the intervention group versus the usual care group at 12 months (-2.6 kg vs 0.3 kg, respectively; $p=0.005$) Weight loss did not differ significantly at 24 months between the intervention group and the usual care group ($p=0.93$)
Salinas & Parra-Medina, BMC Public Health, 2019	Community health worker led physical activity change in Mexican American women	Randomized Clinical Trial 16 weeks	Multiple physical activity options led by Community Health Workers Significant increases in moderate- to vigorous- physical activity and decreased sedentary time

	620 Women South Texas		Increase in leisure walking (p=0.046), brisk walking (p=0.011), dance (p=0.003), and aerobics class participation (p=0.001) from baseline Each were associated with a decrease in sedentary time Significant effect sizes were seen for moderate- to vigorous-physical activity for jogging (p=0.050), general exercise (p=0.024), and other exercise not specified (p=0.003)
Brown et al., American Journal of Health Promotion, 2022	Community Health Workers and Enhanced Motivational Interviewing 327 Women 47 Men 374 Total El Paso, TX	Quasi - experimental evaluation 12 months	Motivational interviewing arm had higher odds of losing body weight and reducing body fat percentage Participants in the motivational interviewing group had 2.13 higher odds of losing weight (p=0.003) and 2.59 times higher odds of reduced body fat percentage (p=0.001) relative to the initial intervention group There was a significant weight loss of 1.23 kg (p=0.03) and a 2% body fat reduction (p=0.002) at the end of 12 months in those in the motivational interviewing group
Formagini et al., Translational Behavioral Medicine, 2023	Daily text messages about healthy eating, physical activity, and motivations to change lifestyle 22 Women 4 Men 26 Total Midwest	Preliminary effectiveness and evaluation 6 months	Significant self-reported increases in physical activity frequency (p=0.003) Statistically significant change in mean body weight, body mass index (BMI), and waist circumference Mean body weight significantly decreased from 86.9 kg to 84.9 kg (p=0.004) 45.8% of participants lost 3% or greater of body weight 29.2% of participants lost 5% or greater of body weight Significant decrease in BMI of 0.9 kg/m^2 (p=0.003) Significant decrease in waist circumference of 1.1 cm (p=0.03) No significant changes to diet quality were observed (p>0.05)

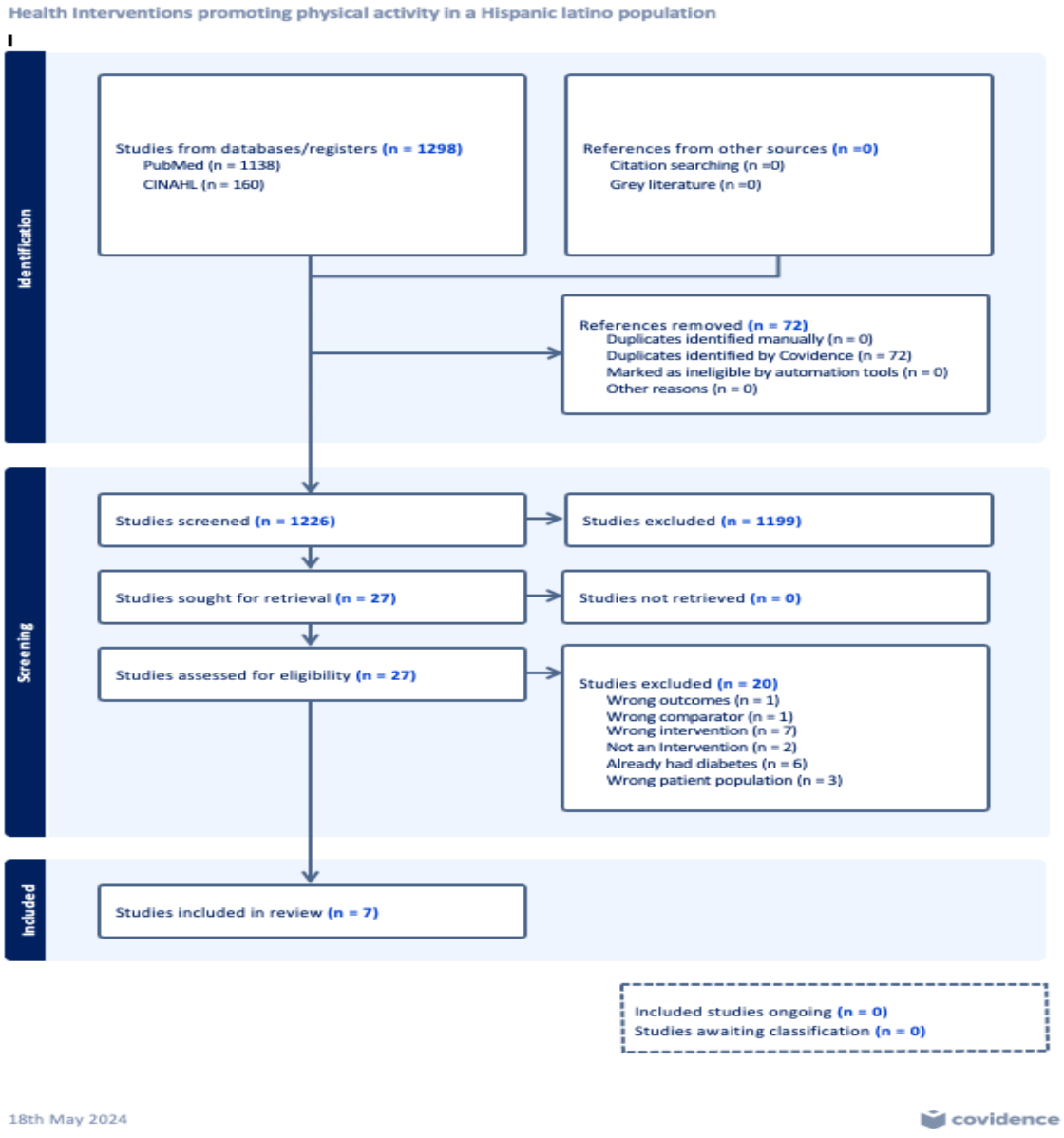

Figure 1. Preferred Reporting Items for Systematized Reviews and Meta-Analyses (PRISMA) diagram.

Diabetes Prevention Program / Lifestyle Change Topics

Curriculum for CDC-Recognized Diabetes Prevention Lifestyle Change Programs Topics Covered in First 6 Months

Welcome to the Program
Be a Fat and Calorie Detective
Three Ways to Eat Less Fat and Fewer Calories
Healthy Eating
Move Those Muscles
Being Active - A way of Life
Tip the Calorie Balance
Take Charge of What's Around You
Problem Solving
Four Keys to Healthy Eating Out
Talk Back to Negative Thoughts
The Slippery Slope of Lifestyle Change
Jump Start Your Activity Plan
Make Social Cues Work for You
You Can Manage Stress
Ways to Stay Motivated

Topics Covered in Second 6 Months

Fats - Saturated, Unsaturated, and Trans Fat
Food Preparation and Recipe Modification
Healthy Eating - Taking it One Meal at a Time
Healthy Eating with Variety and Balance
More Volume, Fewer Calories
Staying on Top of Physical Activity
Stepping up to Physical Activity
Balance Your Thoughts for Long-Term Maintenance
Handling Holidays, Vacations, and Special Events
Preventing Relapse
Stress and Time Management
Heart Health
A Closer Look at Type 2 Diabetes
Looking Back and Looking Forward

Figure 2. National Diabetes Prevention Program topics for year 1.

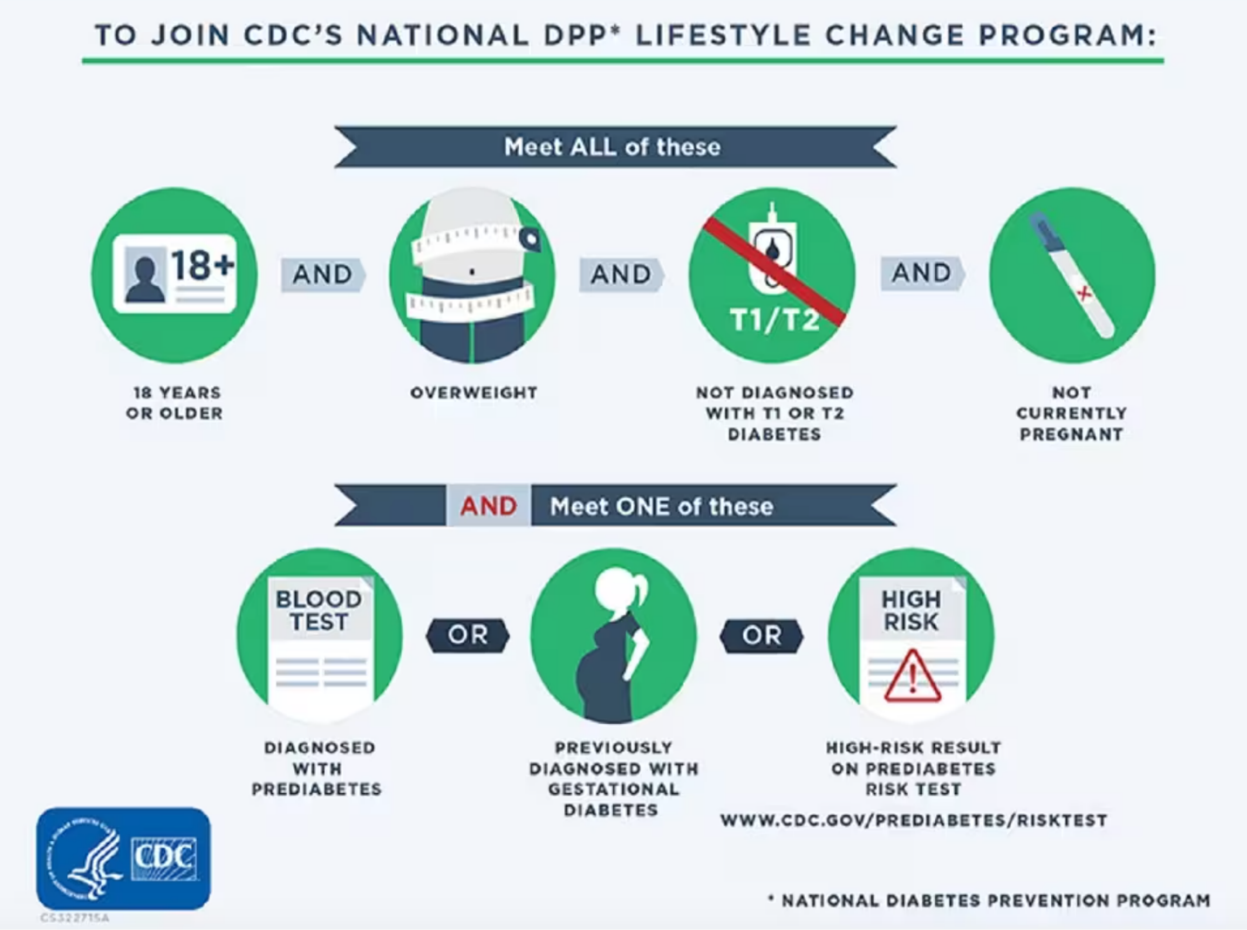

Figure 3. National Diabetes Prevention Program criteria.