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A mixed-methods, theory-driven assessment of the sustainability of a multi-sectoral preventive intervention for South Asian Americans at risk for cardiovascular disease

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Abstract

Background South Asian Americans bear a high burden of atherosclerotic cardiovascular disease (ASCVD), but little is known about the sustainability of evidence-based interventions (EBI) to prevent ASCVD in this population. Using community-based participatory research, we previously developed and implemented the South Asian Healthy Lifestyle Intervention (SAHELI), a culturally-adapted EBI targeting diet, physical activity, and stress management. In this study, we use the Integrated Sustainability Framework to investigate multisectoral partners' perceptions of organizational factors influencing SAHELI sustainability and strategies for ensuring sustainability.

Methods From 2022 to 2023, we conducted a mixed-methods study (quant- > QUAL) with 17 SAHELI partners in the Chicago area. Partners' settings included: community organization, school district, public health department, and healthcare system. Descriptive statistics summarized quantitative results. Two coders used a hybrid thematic analysis approach to identify qualitative themes. Qualitative and quantitative data were integrated and analyzed using mixed methods.

Results Surveys (score range 1–5: higher scores indicate facilitators; lower scores indicate barriers) indicated SAHELI sustainability facilitators to be its "responsiveness to community values and needs" (mean = 4.9). Barriers were "financial support" (mean = 3.5), "infrastructure/capacity to support sustainment" (mean = 4.2), and "implementation leadership" (mean = 4.3). Qualitative findings confirmed quantitative findings that SAHELI provided culturally-tailored cardiovascular health education responsive to the needs of the South Asian American community, increased attention to health issues, and transformed perceptions of research among community members. Qualitative findings expanded upon quantitative findings, showing that the organizational fit of SAHELI was a facilitator to sustainability while competing priorities were barriers for partners from the public health department and health system. Partners from the public health department and health system discussed challenges in offering culturally-tailored programming exclusively for one targeted population. Sustainability strategies envisioned by partners included: transitioning SAHELI to a program delivered by community members; integrating components of SAHELI into other programs; and expanding SAHELI to other populations. Modifications made to SAHELI (i.e., virtual instead of in-person delivery) had both positive and negative implications for sustainability.

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Discussion This study identifies common sustainability barriers and facilitators across different sectors, as well as those specific to certain settings. Aligning health equity interventions with community needs and values, organizational activities, and local context and resources is critical for sustainability. Challenges also arise from balancing the needs of specific populations against providing programming for broader audiences.

Keywords Sustainability, Health equity, Lifestyle evidence-based interventions, South Asian Americans, Cardiovascular health, Cultural adaptation, Populations experiencing health disparities

Contributions to the literature

- We contribute to the emerging literature on sustainability and health equity by exploring multisectoral factors influencing the sustainability of a culturally-adapted lifestyle intervention for South Asian Americans at risk for cardiovascular disease.
- We identified barriers and facilitators that were commonly observed across different sectors, as well as those specific to certain settings.
- Results underscore the need to align health equity interventions with community needs and organizational activities, adapt to local context, and plan for funding diversification and program modification.
- Resolving the tension between specific population needs and broader population programming is central to supporting health equity.

Background

People of South Asian background (i.e., those with historical or ancestral connections to Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka, and the Maldives) represent a fast-growing population in the U.S., numbering more than 5.7 million as of 2020 [1]. South Asian Americans also carry an elevated burden of atherosclerotic cardiovascular disease (ASCVD), evidenced by higher ASCVD hospitalization and mortality rates as well as higher burden of ASCVD risk factors (e.g., type 2 diabetes mellitus, hypertension, hyperlipidemia, and truncal obesity) when compared to non-Hispanic White and/or other Asian American populations [2–7]. The U.S. Preventive Services Task Force recommends intensive lifestyle (e.g., diet and physical activity) evidence-based interventions (EBIs) for ASCVD prevention in at-risk populations [8]. However, our prior research shows that existing EBIs fail to reach South Asian Americans due to a lack of alignment with their sociocultural patterns and values [9–12]. Growing evidence continues to demonstrate the pressing need for culturally-adapted diet and/or physical activity interventions for South Asian Americans that are rooted in community engagement and incorporate migration context, cultural norms, beliefs, and language [13–18]. While emerging literature has focused on developing, implementing, and testing such culturally-adapted EBIs [15–18], important gaps remain regarding the determinants of or strategies to sustain the EBIs beyond their original implementation.

Sustainability of EBIs for populations experiencing health disparities is a critical issue. Unsustainable or discontinued EBIs can further widen disparities in health outcomes across settings and subgroups, bring disillusionment and reinforce mistrust in underserved communities, and threaten the mission of health equity [19]. We acknowledge that there is no unanimous agreement on a single definition of EBI sustainability [20]. Rather, evolving literature provides conceptual guidance on this multidimensional concept [21]. Scheirer and Dearing outlined six aspects of EBI sustainability: 1) continuing benefits for clients; 2) continuing original program activities; 3) maintaining community-level partnerships developed during implementation; 4) maintaining new organizational practices started during implementation; 5) sustaining attention to the issue; and 6) diffusing the EBI to other sites [22]. Some researchers differentiate between sustainability and sustainment [23–25], though their definitions also vary. Chambers and colleagues described sustainability as the extent to which an EBI can deliver its intended benefits over an extended period of time after external support is terminated, while sustainment is continued use of an EBI within practice [24]. In contrast, Birken and colleagues conceptualized sustainment as continuous use of EBIs as intended, over time, in ongoing operations with dynamic adaptation, while sustainability centers characteristics that enhance sustainment [25]. Following Shelton and colleagues, in this study, we use the term sustainability to refer to both several desired aspects identified by Scheirer and Dearing [22] (e.g., continuation of benefits and activities, maintenance of partnerships and organizational practices, sustained attention, and EBI diffusion) as well as the characteristics that increase the likelihood of maintaining these aspects [26].

Sustaining EBIs requires meaningful engagement of key partners with a direct interest or involvement in EBI implementation [19, 27, 28]. Furthermore, key partner engagement should not be confined to a single sector but instead extended to multiple different sectors [29, 30].

This recognition aligns with recent research agendas in implementation science that call for investigating determinants of sustainability with a focus on different settings and contexts [31, 32]. For example, the Integrated Sustainability Framework outlines the emerging multilevel factors that may influence sustainability depending on the setting (e.g., community, school, clinical, or public health sectors) [31, 33]. These understandings are important because what constitutes barriers and facilitators in one setting may not necessarily apply in other settings.

Our study, the South Asian Healthy Lifestyle Intervention (SAHELI), provides an ideal opportunity to contribute to the emerging literature on EBI sustainability in multisectoral settings to promote health equity. SAHELI was a culturally-adapted EBI targeting diet, physical activity, and stress management for South Asian Americans at risk for ASCVD. SAHELI was conducted with a community-based participatory research framework, where the study partners used a collaborative structure to plan and implement SAHELI, engage and retain South Asian American research participants, increase awareness about ASCVD disparities in South Asian Americans, and disseminate results to partners and community members. Partnering organizations included a community organization, a school district, a public health department, and a health system. The purpose of this study is to explore multisectoral partners' perceptions of organizational factors influencing SAHELI sustainability and strategies for ensuring SAHELI sustainability.

Methods

Study design and setting

Details about the design of the SAHELI intervention have been published elsewhere [13]. A manuscript with primary outcome results has been recently published [34]. To briefly summarize, the study was a type 1 effectiveness-implementation hybrid randomized control trial [35] aimed at reducing ASCVD risk in South Asian Americans. In the trial, 549 participants in the Chicago metropolitan area were randomized to receive either printed healthy lifestyle education materials or SAHELI, a group-based lifestyle change program that includes weekly classes for 16 weeks and 4 booster classes through month 11. The trial adapted content and materials from the U.S. Diabetes Prevention Program (DPP) [36], the National Heart, Lung, and Blood Institute [37], and the PREMIER trial [38]. The core curriculum (months 1–4) included 16 intervention contacts (1 individual counseling session and 15 weekly group meetings). The trial began in March 2018 and the last follow-up assessment was completed in February 2023. Weekly classes were delivered at community partner sites prior to the COVID-19 pandemic. With the onset of the pandemic, treatment and assessment procedures were modified for telephone and video administration. Remote intervention delivery began on March 14, 2020.

Our present study is an explanatory sequential mixed-methods study (quant- > QUAL; capitalization depicts the primary component that is dominant) [39, 40] conducted with a sample of 17 survey participants and 9 interview participants who were key organizational partners, study implementers, and university research team members of the SAHELI intervention. In January 2022, 17 participants (29% from the community organization, 18% school district, 6% public health department, 12% health system, 18% project implementers, and 18% university research team members) completed a web-based survey, hosted by REDCap [41, 42] to quantitatively assess domains related to SAHELI sustainability. Between August 2022 and March 2023, 9 participants (purposively selected as a subset of the 17 survey participants) who were deeply involved in project implementation and/or were organizational leaders further completed semi-structured interviews to elaborate on their perspectives on SAHELI sustainability. Appendices A and B provide 1) a description of partner organizations and 2) the experience and involvement in SAHELI of survey and interview participants. The Northwestern University Institutional Review Board approved this study (STU00204939).

Data collection and measures

Quantitative survey

We adapted two previously-developed instruments: the Sustainment Measurement System Scale (SMSS) [23] and the Program Assessment Sustainability Tool (PSAT) [20]. The original SMSS [23] has a total of 35 items and 8 subscales; it focuses on the determinants and outcomes of sustainment of prevention programs. In a previous study, the measure demonstrated good reliability and convergent and discriminant validity in assessing likelihood of program sustainment [23]. In addition to the 8 subscales from the SMSS, our survey included 2 subscales (Program Adaptation and Communications) from the PSAT [20]. The original PSAT has 40 items and 8 subscales; it was designed to measure capacity for program sustainability of various public health and other programs. The PSAT has demonstrated high reliability when tested with a large and diverse sample over time [43]. The two domains (Program Adaptation and Communications) were added because the SMSS did not capture these constructs. Based on our review of existing literature, we believe these two domains have important implications for sustainability.

Our final survey included 36 items and 10 domains (Appendix C). Examples of items include: "The SAHELI project has sustained funding"; "The SAHELI project is

well integrated into the operations of your organization"; "Your organization has a process in place to sustain the project in the event the champion at your organization leaves"; and "The SAHELI project provides strong evidence to the public that the healthy lifestyle program works." For each statement, participants were instructed to respond using a scale ranging from 1 = little to no extent to 5 = a great extent. Responses of "Not applicable" or "I do not know" were recoded as missing data.

Interview guide

Interview questions (Appendix D) explored organizational barriers to and facilitators of SAHELI sustainability, what sustainability means in the context of routinely-delivered programs, and planning and strategies for sustainability. The interview guide was developed based on past qualitative research on program sustainability [44] as well as the Integrated Sustainability Framework [31]. Examples of questions included: "For your organization, what are the barriers to sustaining the SAHELI programs once the funding ends?"; "What would your organization need to be able to sustain SAHELI?"; and "What organizational and community assets can be leveraged to keep SAHELI going into the future?".

Data analysis

All statistical analyses were conducted in R version 4.1 [45]. For each domain, a summed score for all statements was calculated and then divided by the number of non-missing statements to obtain a domain score. Means, standard deviations, medians, and ranges of scores were reported.

All interviews were recorded and transcribed verbatim. MAXQDA 2022 was used for all data analysis and management. We used a hybrid approach of qualitative thematic analysis, which incorporated both 1) a deductive *a priori* template of codes and themes from the survey items and the Integrated Sustainability Framework [31] and 2) a data-driven inductive approach [46]. We established qualitative data trustworthiness by: 1) familiarizing ourselves with the data; 2) generating initial inductive codes; 3) searching for themes; 4) reviewing themes; 5) defining and naming themes; and 6) producing the report [47]. First, two analysts (MV and SN) independently reviewed three transcripts [48], generated qualitative codes [49–51], and created a codebook [49]. Then, using the codebook, one analyst (MV) coded all nine transcripts. The second analyst (SN) reviewed MV's coding of all nine transcripts. The two analysts held several meetings to discuss results and resolve any discrepancies. The study team then organized codes into larger thematic categories based on conceptual similarities and *a priori* research questions. We summarized findings and identified illustrative quotes for each theme.

Mixed methods integration occurred through the design [52] that connected the survey and interview samples. We analyzed the quantitative and qualitative data to identify areas of confirmation (i.e., findings from both types of data reinforced the results of each other) or expansion (i.e., findings from each dataset expanded insights or addressed complementary aspects) [40]. While we also analyzed data for areas of discordance (i.e., findings from each dataset contradicted each other) [40], we did not identify such instances. Further integration occurred through a weaving narrative (e.g., explaining both qualitative and quantitative findings together on a concept-by-concept basis) and the use of a joint display [40]. In particular, qualitative and quantitative findings are presented together in a joint display with meta-inferences [40, 53] guided by the Integrated Sustainability Framework [31].

Results

Quantitative findings

Table 1 displays the description and summary score for each of the 10 survey domains, with a higher mean score indicating greater perceived positive impact of this domain on SAHELI sustainability. The domains with the highest mean scores are global sustainment indicators, responsiveness to community needs, and responsiveness to community values (M = 4.9 for all 3). Following these, in order of mean scores, are program adaptation (M = 4.8), monitoring, evaluation, and program outcomes (M = 4.7), coalitions, partnerships, and networks (M = 4.6), and communications with partners and the publics (M = 4.6). The domains with the lowest mean scores are funding and financial support (M = 3.6), infrastructure and capacity to support sustainment (M = 4.3), and implementation leadership (M = 4.3). There was also greater variability in responses in these 3 domains (evidenced by higher SD).

Qualitative findings

Figure 1 summarizes SAHELI sustainability facilitators and barriers by setting. Emergent themes are also described below.

Program characteristics

Facilitators: Perceived benefit, need, and fit with the South Asian American population Participants underscored how SAHELI responded to a critical gap by offering culturally-adapted ASCVD education in the South Asian American community and, relatedly, was a strong fit with target populations. These factors were highlighted

Table 1 Description of subscale constructs and summary of subscale scores of program sustainability

Domain	n	Mean (SD)	Median (Range)
Global sustainment indicators (3 items) Adapted from the SMSS to assess the continued operation of the program, including delivering prevention services to intended population that are evidence-based as described in the original application for funding and periodically measuring service fidelity	17	4.9 (0.3)	5.0 (4.0, 5.0)
Responsiveness to community values (3 items) Adapted from the SMSS to assess adaptability to meet the needs of the populations being served, consistency and fit with norms and values of participating organizations, fit with values of sustaining organizations and communities, and shared perception of project importance by participating organizations	17	4.9 (0.2)	5.0 (4.3, 5.0)
Responsiveness to community needs (2 items) Adapted from the SMSS to assess the degree to which the program meets the needs of communities/populations being served	16	4.9 (0.3)	5.0 (4.0, 5.0)
Program adaptation (2 items) Adapted from the PSAT to assess taking actions that adapt the program to ensure its ongoing effectiveness	16	4.8 (0.4)	5.0 (3.5, 5.0)
Monitoring, evaluation, and program outcomes (4 items) Adapted from the SMSS to assess ongoing evaluation of progress made toward sustainment, timeliness of feedback about project delivery and quality improvement, and evidence of positive outcomes	16	4.7 (0.5)	5.0 (3.8, 5.0)
Coalitions, partnerships, and networks (8 items) Adapted from the SMSS to assess networking of grantee organization with other organizations committed to program sustainability, community engagement and access to project information, and level of networking among the coalition/partnership/network of organizations supporting the project	17	4.6 (0.4)	4.7 (3.7, 5.0)
Communications with partners and the public (3 items) Adapted from the PSAT to assess strategic communications with partners and the public about the program	16	4.6 (0.5)	5.0 (3.7, 5.0)
Implementation leadership (3 items) Adapted from the SMSS to assess active engagement of leaders in project implementation and sustainment, involvement of community leaders in the project, appointment of someone responsible for coordinating project implementation and sustainment, support from a program champion, and process in place for sustainment in the event the champion leaves	17	4.3 (1.1)	5.0 (1.3, 5.0)
Infrastructure and capacity to support sustainment (7 items) Adapted from the SMSS to assess available resources for project implementation and sustainment, integration into operations of the organization and partners, advanced development of plans for implementing and sustaining the project, execution of the project according to these plans, adequacy of staff to sustain program goals and activities, sufficiency of training available to staff and community members, and staff knowledge, self-efficacy, and beliefs to implement the project	17	4.3 (1.1)	4.8 (1.0, 5.0)
Funding and financial support (1 item) Adapted from the SMSS to assess sustained funding and financial support for the program	12	3.6 (1.5)	4.0 (1.0, 5.0)

Abbreviations: *SMSS* Sustainment Measurement System Scale, *PSAT* Program Sustainability Assessment Tool

as sustainability facilitators. A participant spoke about their motivation to adopt SAHELI because of the high burden of ASCVD among their South Asian American clients and the perceived benefits of SAHELI to promote healthy lifestyle changes and reduce diseases: "[SAHELI provides] really powerful data around medical research and South Asian representation… The higher incidence of heart disease in South Asians that, with proper and early intervention, could be changed also resonated with us… We have a significant South Asian [client] population. Thinking about their wellbeing was compelling to partner with SAHELI" (#08, school district).

Participants highlighted how SAHELI aligned with the South Asian American community's sociocultural and language needs and preferences (e.g., relevant cooking techniques and physical activity). One participant said: "The South Asian cultural way… we fry food and eat foods with high saturated and trans fats… SAHELI offered cooking techniques, including steam and pressure cooking, with minimal oil that helped with diet. We also had an education session on eating heart-healthy diets… This curriculum was just perfect… All components of SAHELI were culturally tailored" (#05, project implementer). Another described: "[SAHELI] exercises were conducted by South Asian fitness instructors, and the music that was used was Bollywood songs so that people could relate to the music… I feel SAHELI was a very integrated and tailored South Asian program" (#12, project implementer).

Participants described how SAHELI increased attention to ASCVD and enhanced positive perceptions of research in the South Asian community, which were integral to its sustainability. A participant said: "SAHELI has become a movement… it's brought about an empowerment where you take ownership of your health, and you realize that this is important for me… It has brought

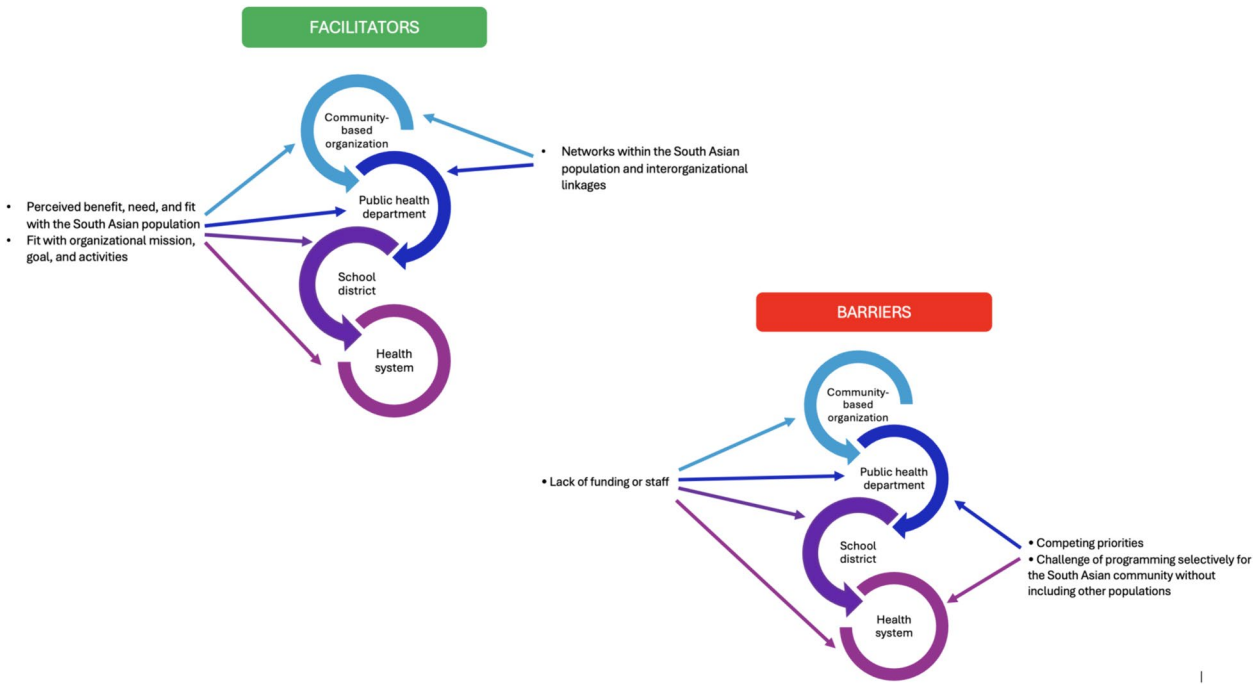

Fig. 1 Qualitative themes on facilitators of and barriers to SAHELI sustainability by setting

about understanding of research. In our community, research used to be very intimidating. People wouldn't understand research. They would think it's something that's done with numbers in your ivory tower where intellectual people sit and do research. But community-based research where you can be a part of it, this sort of understanding… I think is a big achievement" (#04, CBO). Another participant shared a similar perspective: "[The value of SAHELI was] to raise awareness, to also teach that community the value of a study because they did not understand that" (#14, public health department).

Inner contextual factors

Facilitator: Fit with organizational mission, goal, and activities Across settings, participants discussed the fact that SAHELI was well-aligned with their organizational missions, goals, or current activities and structure. This alignment was a sustainability facilitator as it increased the motivation of partners, made it easier to incorporate SAHELI into the operation of the organization, or facilitated resource mobilization. For example, a participant commented on the fit between SAHELI and the mission and goals of their CBO: "[As] one of the oldest South Asian organizations which has a wide network of clients with health issues, [our organization] was the right fit to become a partner and do the whole project on a great scale… Apart from improving the health of the community, the SAHELI program has also brought awareness about community research in our population, and that is a goal of [our organization]: to educate our people on different aspects of health and research. So that way it was also a good fit" (#04, CBO). Another participant echoed similar sentiments: "[SAHELI] was similar to our overall mission within our health and wellness in empowering our community… There was natural alignment to the work that we are doing related to health, with the specific focus of the South Asian community" (#07, school district).

Moreover, a participant highlighted how SAHELI supplemented their organizational activities by bridging a gap in behavioral change promotion in the health system: "We want to be the most trusted health partner for our communities… One-on-one patient-physician interaction is limited. It is hard for a patient to pick up on all the things they need to do, and it's not the ideal setting for behavioral change… SAHELI is the right type of program for that type of behavioral change that allows for nutrition, exercise, and activity" (#10, health system).

Another participant described how SAHELI fit with the program activities and structure of their school district as well as the district's emphasis on family and community engagement: "With SAHELI, the capacity of the organization to support and devote resources to it came

from [our] community schools' structure. We already had a neighborhood network. We had a South Asian lead and liaison, and this project matched our goals, which is extremely important. If you just approach any schools that are traditionally staffed, and they don't have the community structure like we do, it would not have worked. The key is to have a very strong commitment to family and community engagement" (#08, school district).

Barriers: Lack of funding or staff and competing priorities Across settings, participants acknowledged potential existing resources at their organizations to sustain SAHELI. However, a need for funding and dedicated staff members was identified as a sustainability barrier. Given that partnering organizations provide different programs and services, participants found it difficult to redirect funding and personnel to SAHELI. For example, a participant reported: "We have the physical space, and we have the clients. But what about the equipment?… We need to hire at least one or two specifically for this purpose as well. Funding definitely, is one of the barriers as well" (#04, CBO). Another participant said: "As far as the SAHELI intervention components… there may be some sources to support certain components, but the question always becomes if there is enough funding" (#08, school district). Further emphasizing the issue with staffing, a participant discussed: "There would have to be a dedicated staff member to [SAHELI]. There is no room within our existing staff for someone to take that on to be doing weekly sessions" (#14, public health department).

In addition, participants from the public health department and health system also talked about competing organizational priorities as a sustainability barrier. A participant mentioned: "With workforce shortages in health care, it gets even more tricky… [SAHELI sustainability] may not bubble up to the top" (#10, health system). Another participant said: "We're not out of pandemic mode yet… Going back to the staff that would be involved that we have pre-pandemic, while still operating in pandemic mode, and adding on additional programs is difficult" (#14, public health department).

Outer contextual factors

Facilitator: Networks within the South Asian American population and interorganizational linkages Participants from the CBO and public health department identified their networks within the South Asian American community as well as interorganizational linkages as sustainability facilitators. A participant discussed their extensive reach with South Asian American community members: "We are very strong in marketing and our networking. We have a huge network of clients. We have adult daycare and home care programs, and we have about 3,000 clients in both programs. We also have 2,500 homecare workers… We also have a strong network of about 10,000 donors in the community, and we reached out in an exhaustive way to all of them with the SAHELI program over the five years" (#04, CBO).

Interorganizational linkages allowed program partners to broaden the resources that could support SAHELI sustainability. A participant described how partnerships were an effective platform to further amplify SAHELI and reach a larger population: "We partnered with [the village] family services, public libraries, and parks to organize and promote SAHELI. We partnered with some restaurants and grocery stores. We also partnered with [the public health department] and [the health system]. We also worked with [another organization] and promoted SAHELI at the huge picnic they had. In the summer, we promoted it at festivals" (#05, project implementer). A participant from the public health department discussed the value of their interorganizational linkages for SAHELI sustainability: "We helped partner with our local legislator… to promote [SAHELI]… That's because of… the Health Department name, and being an integral part of the community… Our name helped open doors where they may not have been able to get in as easily" (#14, health department).

Barrier: Challenge of programming selectively for the South Asian American community without including other populations Participants from the public health department and health system acknowledged that a sustainability barrier would be to continue offering SAHELI exclusively for the South Asian American community. A participant mentioned the challenge of balancing programs for a specific population that experiences health disparities and demonstrating generalizability of the program to broader populations: "If you offer this for the South Asian American population, people are going to ask why not offer that to other populations that also have high degrees of cardiovascular disease. When setting up a program specific to one high-risk patient population… In terms of sustainability, does the finding generalize to all populations or just to one population? The cultural tailoring is really good if you're trying to target specific audiences. But it's harder to maintain funding for something like that because it's focused on a super narrow population… I understand the need to tailor it, and it's focused to produce better outcomes. But the lack of generalizability makes it tricky" (#10, health system). Another participant echoed similar challenges: "The health department

serves the entire community… we can't single out one group over another" (#14, public health department).

Planning and strategies for program sustainability

SAHELI as a program delivered by community members To sustain SAHELI once NIH funding ends, some participants envisioned transitioning the intervention from being a research-centric, researcher-delivered program to a program managed and delivered by community members. Such a transition would require training community members in implementing SAHELI. A participant shared: "Right now the SAHELI intervention is delivered with the research team. But if it is to be sustainable, it has to be taken over by the community members. One way can be it can be done is by training the community members, so that they can take it forward and keep it sustainable… The research team's work is done after the study ends. The best way to continue would be to train community members and train interested participants…There are many participants, [for whom SAHELI] was very empowering… They were very empowered to take up more responsibility and become better individuals. They were also interested in learning [to teach SAHELI]… That would be a better way of sustaining the program" (#12, project implementer). Another project implementer was enthusiastic about their role in this transition, saying: "I can help train the members and supervise them. For me, it would be even more meaningful to have a multigenerational impact for the community and I think that would eventually sustain the health education we are providing for them" (#05, project implementer).

Integrating SAHELI within the operations of partner organizations Some participants from the school district and CBO proposed integrating components of SAHELI into other programs offered by their organizations. A participant from the school district described: "We have a structure of neighborhood networks and affinity groups, there are ways to [integrate SAHELI in] some of the activities of those affinity groups… There is a need to connect and maybe have experts at times [for these activities] … having some of those experts come in who are also aware of the [South Asian] cultural connections… It could be a few classes focused on activities to initiate at home and modeling those activities. Community members can collaborate and provide ideas on how to make it sustainable and fun" (#08, school district). A participant from the CBO proposed leveraging their networks of professionals to sustain health education sessions using SAHELI curriculum: "We have access to a good network of professionals and doctors who work or partner with us on a regular basis… We can get the professional speakers on board even without [the research team's] help to keep SAHELI going. Regular educational sessions about diabetes and cardiovascular through these resources is not a problem… we can do on our own" (#04, CBO).

Expanding SAHELI to other populations Some participants discussed expanding SAHELI to include other populations and communities as a sustainability strategy. A participant said: "A SAHELI 2.0… To grow your own and empowering our South Asian community, but then also be able to expand the SAHELI model to other communities within our school district, while culturally tailoring the curriculum and the prevention initiatives. We definitely have sought additional grants to continue funding the program itself, the materials, and the people needed to do it" (#07, school district). A project implementer affiliated with the school district said: "To continue SAHELI… we would want to include more families generally and to the community, with health education or exercise classes" (#09, project implementer).

Impacts of the COVID-19 pandemic Project implementers reported the adaptation made to SAHELI delivery due to the COVID-19 pandemic and its implications for sustainability. One participant mentioned how virtual delivery increased access for intervention recipients: "Most of the time, participants didn't want to come because of transportation and time constraints. With Zoom classes, they can save time, stay at home, and continue the group sessions virtually" (#05, project implementer). Meanwhile, another participant acknowledged that virtual delivery did not impact the motivation from the study team but did negatively affect the social connectedness of intervention recipients: "From the team members… everyone seemed highly motivated the entire time. However, patient motivation goes down. If you're just doing it over Zoom and you're not connecting with people, it is the same thing with meetings over Zoom: it's focused on the actual meeting, the small side conversations never occur prior to or after the meeting, so those types of connections were not happening" (#12, project implementers).

Mixed-methods integration of quantitative and qualitative data

Through Table 2, we provide a joint display that integrates mixed-methods results, identifies meta-inferences, and examines implications of findings. Domains are organized based on the Integrated Sustainability Framework [31]. Qualitative findings confirmed quantitative

Table 2 Joint display for mixed methods integration of quantitative and qualitative findings

Construct	Quantitative survey results	Qualitative interview results	Meta-inferences
Program characteristics	***Responsiveness to community values***: M = 4.9, SD = 0.2 ***Responsiveness to community needs***: M = 4.9, SD = 0.3	Across settings, SAHELI responded to a critical need in the South Asian community and, relatedly, was a strong fit with the population served by the organizations. Participants also described how SAHELI increased attention to cardiovascular health and created positive perceptions of research in the South Asian community	**Mixed-methods findings were confirmatory**: Quantitative findings showed that SAHELI was highly responsive to community needs and values. Qualitative findings confirmed quantitative findings that SAHELI provided culturally-tailored cardiovascular health education that responds to the needs of the South Asian community. Besides cardiovascular health benefits, SAHELI also increased attention to health issues and transformed perceptions of research among community members **Implications**: Evidence-based interventions that confer benefits and are culturally-tailored to the needs and preferences of a specific population experiencing health disparities are likely to be perceived as valuable and have buy-in and support from partners in different settings, which can enhance program sustainability
Inner contextual factors	***Responsiveness to community values***: M = 4.9, SD = 0.2 ***Implementation leadership***: M = 4.3, SD = 1.1 ***Infrastructure and capacity for sustainment***: M = 4.2, SD = 1.1 ***Funding and financial support*** M = 3.5, SD = 1.5	Across settings, participants discussed the fact that SAHELI was well-aligned with their organizational missions, goals, or current activities and structure. Participants identified this factor as a facilitator to intervention sustainability. Across settings, participants also identified a need for funding and dedicated staff members as a barrier to intervention sustainability after the formal funding period concluded. In addition, participants from the public health department and health system also talked about competing organizational priorities as a barrier to sustainability	**Mixed-methods findings provided expansion of understanding**: Quantitative findings indicated funding, infrastructure and capacity to support sustainment, and implementation leadership could be considered barriers to SAHELI sustainability. Qualitative findings also indicated that a lack of funding and staff are barriers across settings. In addition, qualitative findings expanded upon quantitative findings to show that the fit of SAHELI with specific organizational mission, goal, and current activities and structure was a sustainability facilitator across settings, while competing priorities were additional sustainability barriers for partners from the public health department and health system **Implications**: Findings highlight the importance of aligning the design and implementation of health equity interventions with organizational activities and goals. Stable and adequate funding and capable infrastructure and staff are critical to successful long-term operation, which can be a challenge for NIH-funded interventions and indicate the need to diversify funding sources and human capital. In settings such as the public health department or health system, there may be competing priorities (e.g., health issues or programs that are perceived as more urgent) that create challenges for the sustainability of culturally adapted programs

Table 2 (continued)

Construct	Quantitative survey results	Qualitative interview results	Meta-inferences
Outer contextual factors	***Coalitions, partnerships, networks***	Participants from the community-based organization and public health department identified their networks within the South Asian community as well as interorganizational linkages as sustainability facilitators. Participants from the public health department and health system acknowledged that a barrier to sustainability would be to continue offering SAHELI exclusively for the South Asian community	**Mixed-methods findings provided expansion of understanding**: Quantitative findings showed that the coalitions, partnerships, and networks of SAHELI were rated moderately. Qualitative findings expanded upon quantitative findings to demonstrate that the networks in the South Asian population as well as interorganizational linkages were notable sustainability facilitators reported by partners affiliated with the community-based organization and public health department. In addition, qualitative findings also highlighted the challenges that partners affiliated with the public health department and health system encounter with offering a health program exclusively for one targeted population **Implications**: Working with organizations who have strong ties and extensive networks in the services area can contribute to program sustainability. In certain settings such as the public health department or health system, partners may recognize the benefits of cultural tailoring to create meaningful impacts and reach a specific population. However, they may also face pressures to ensure their programs appeal to a broader, general audience. Resolving this tension is central to meaningful health equity

Table 2 (continued)

Construct	Quantitative survey results	Qualitative interview results	Meta-inferences
Planning and strategies for sustainability	***Global sustainment indicators***: M = 4.9, SD = 0.3 ***Program adaptation***: M = 4.8, SD = 0.4 ***Monitoring, evaluation, and program outcomes***: M = 4.7, SD = 0.5 ***Communications with partners and the public***: M = 4.6, SD = 0.5	When asked about sustainability strategies, participants discussed transitioning the intervention from being a research-centric, researcher-delivered program to a program managed and delivered by community members. Participants from the school district and community-based organizations proposed integrating components of SAHELI into pre-existing programs offered by their organizations. Participants also described the possibility of expanding SAHELI to include other populations and communities. In addition, project implementers said that the shift to virtual delivery of SAHELI has increased access but also decreased the social connectedness of intervention recipients	**Mixed-methods findings provided expansion of understanding**: Quantitative findings showed that partners highly rated: global sustainment indicators and outcomes, program adaptation, monitoring, evaluation, and program outcomes, and communications with partners and the public about SAHELI. Qualitative findings expanded understandings by exploring sustainability strategies envisioned by partners: transitioning SAHELI to a program managed and delivered by community members; integrating components of SAHELI into pre-existing organizational programs; and expanding SAHELI to other populations and communities. The modification made to SAHELI (i.e., virtual instead of in-person delivery) had both positive and negative implications for sustainability **Implications**: Program sustainability is dynamic and will inherently entail modification, either due to external events (e.g., the COVID-19 pandemic), or due to the intervention transitioning from being a NIH-funded research program to a community or partner organization-implemented program. Partners can leverage the experience of implementing SAHELI to design programs for other populations. To facilitate program modification, planning for sustainability early in the process can be helpful, such as through monitoring and evaluation and providing positive outcomes, or communications with partners and the public

findings regarding program characteristics. In addition, qualitative findings provided expansion of understanding for quantitative results regarding outer factors, inner factors, and planning and strategies for sustainability.

Discussion

Our study queries multisectoral partners' perspectives on the sustainability of a culturally-adapted lifestyle EBI for South Asian American adults at risk for ASCVD. Using a mixed-methods research design, we identified sustainability barriers and facilitators that were similar across different sectors, as well as those specific to certain settings. Results have important implications for research and practice on sustaining EBIs adapted for populations experiencing health disparities.

Across multisectoral settings and in both qualitative and quantitative findings, SAHELI was seen as highly responsive to the social and cultural factors that impact the South Asian American community's access to EBIs for ASCVD prevention. Not only did SAHELI focus on health outcomes and behaviors relevant to the community, but it also increased community members' attention to health issues and positive perceptions of health research. As seen by partners, the sustainability of SAHELI is closely linked with its strong fit and delivery of benefits for South Asians. These results can be attributed to the long history of community engagement embedded in the trial design and implementation. SAHELI was developed based on extensive formative research on South Asian Americans' explanatory models of coronary heart disease and was adapted from evidence-based cardiovascular and diabetes prevention curricula [54, 55] to incorporate the sociocultural context that influences health behaviors [13, 56, 57]. Moreover, it was implemented through longstanding relationships between the research team and multisectoral partners. Community members actively shaped its curriculum and format [11]. Our findings contribute to the literature on implementation research for populations experiencing health disparities. Implementation science is increasingly prioritizing equity dimensions by calling for designing with implementation in mind, particularly through intervention development *with, for,* and *among* underserved communities [26, 58]. Culturally-adapted EBIs that confer benefits are likely to be perceived as valuable and have buy-ins, which can enhance program sustainability [59].

Across sectors, SAHELI was seen as well-aligned with organizational goals or current programs, particularly those with a focus on immigrants, community, family, and health equity. The fit of an innovation within existing organizational mission or procedures, or the ease of the innovation to be embedded within existing services and policies, has been noted as key sustainability facilitators [60, 61]. Organizations are more likely to support continued use and allocate time, staff, and internal resources to projects that they deem suitable and significant [60, 62]. Alignment is also central to integrating program components into established tasks, thereby maintaining program activities to a certain extent even after the original funding period ends [60]. For example, in our study, partners from the school district and CBO described their planned incorporation of SAHELI components into their pre-existing health education programs when research funding ended.

Reported key barriers included a lack of funding and staff and low infrastructure and capacity to support sustainment. This finding likely stems from the complex nature of SAHELI as an NIH-funded research study to evaluate intervention effects on clinical and behavioral outcomes. SAHELI protocols required the use of clinical screening equipment and accelerometers to track physical activity [13], which is resource-intensive and neither feasible nor necessary for all partner organizations to sustain. Furthermore, the current healthcare reimbursement policy landscape does not prioritize prevention programs, and thus the cost of community implementation of lifestyle EBIs for cardiovascular health is often not sustainably covered [63, 64].

Funding and resources have been well-studied as important factors impacting intervention sustainability and scalability [65–67]. Long-term program operations can be enhanced by diversifying funding sources [68, 69], including funding from philanthropic foundations, county and state governments, revenue generations, Medicare reimbursement, and individual donors [70, 71]. Early strategic planning is critical as it takes considerable time to identify appropriate funding sources and apply for them [71].

Partners proposed several strategies to enhance SAHELI sustainability, including transitioning SAHELI from being an intensive, researcher-delivered program to a program managed and delivered by community members [64] or integrating elements of SAHELI (e.g., health education classes) into pre-existing programs offered by their organizations [72]. Drawing on the experience of implementing SAHELI, partners also discussed offering lifestyle or cardiovascular health programs for other populations. Moreover, partners described adaptations made due to COVID-19 and their impacts on program delivery. Recent literature has advocated for a dynamic conceptualization of sustainability, suggesting that changes are inevitable and can lead to better EBI fit and impact, instead of the traditional "static" view that resists EBI modifications [24]. Our findings resonate with this perspective. Studies on real-world implementation of DPP have also noted that while the DPP itself is labor- and

time-intensive, making changes to the implementation protocol to cater to local context and resources can help bolster its sustainability [73–75].

To facilitate adapting complex, resource-intensive interventions to a specific community and context (as opposed to attempting to keep the EBI "as is"), it may be useful to separate the core functions of an EBI (i.e., the basic purposes of the EBI) from the forms (i.e., what may be the strategies to achieve each function) [76, 77]. Additionally, Movsisyan and colleagues have published literature reviews on guidance and practices for adapting population health EBIs to new contexts [78, 79]. Emergent literature also provides tools such as the Framework for Reporting Adaptations and Modifications-Expanded (FRAME), which can be useful in documenting how, when, and why EBIs may be modified [80].

Similar to funding acquisition, program modification can benefit from planning at an early stage [24, 58, 81]. Strategic planning for modification can be done through ongoing monitoring of context and outcomes and fostering effective dialogues with partners [20, 23]. These strategies are also key to program sustainability [20, 23, 61]. In this study, partners gave high quantitative scores for the domains of monitoring, evaluation, and program outcomes, and communications with partners and the public [20, 23]. Throughout project implementation, the research team actively presented interim progress, identified challenges (e.g., during the COVID-19 pandemic), and sought partners' feedback through regular meetings, which likely contributed to observed outcomes.

Partners from the public health department and health system discussed the challenges associated with offering SAHELI exclusively for South Asian Americans. These partners recognized the benefits of culturally-adapted EBIs to create meaningful impacts and reach a specific population. However, they also faced pressures to ensure their programs appeal to a broader constituency. Partners from these two settings also discussed competing priorities (e.g., health issues or programs that are perceived as more urgent) that are sustainability barriers. These obstacles can undermine culturally-adapted programs to address health disparities in populations from minoritized racial and ethnic backgrounds. Resolving the tension between meeting the needs and experiences of a specific population with health disparities while also offering programming for broader populations [82] is central to advancing health equity. It is critical to recognize that certain populations experience specific challenges or obstacles to participation or uptake of EBIs, and thus culture-specific or adapted programs are warranted [58].

Strengths and limitations

Strengths of our study include the use of theory-driven framework (Integrated Sustainability Framework) [31] and survey measurements (PSAT [20] and SMSS [23]) to assess sustainability. We included partners from diverse settings: CBO, health system, public health department, and school district. We also integrated mixed-methods data at multiple levels [40] by using an explanatory sequential mixed-methods design, merging quantitative and qualitative data for analysis, weaving narrative, and providing a joint display to explain how one data source confirmed or expanded the other [40], which enriches the interpretation and validity of findings. Nevertheless, given the small sample size of organizations and partners, our study may have limitations in terms of the transferability of results to different contexts. While we assessed sustainability perspectives at one point in time, future studies could consider multiple assessments at different points in the implementation process.

Conclusion

Through a mixed-methods design, we analyzed multisectoral barriers and facilitators to the sustainability of a culturally-adapted lifestyle EBI for South Asian American adults at risk for ASCVD. Findings highlight the importance of aligning the design and implementation of health equity interventions with community needs and values as well as organizational activities and goals to ensure sustainability. Successful long-term operation necessitates sufficient funding, capable infrastructure, and adequate staff, which can be challenging for grant-funded prevention interventions. Context-specific program modification through communication across sectors can also ensure sustainability.

Supplementary Information

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Supplementary Material 1

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Authors' contributions

MV was responsible for study conception, design of the work, acquisition, analysis and interpretation of data, and drafting and revision of the manuscript. SN and NL were responsible for the acquisition, analysis, and interpretation of data as well as the revision of the manuscript. BS and CHB were responsible for the interpretation of data and revision of the manuscript. NK was responsible for study conception, design of the work, interpretation of data, and revision of the manuscript.

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Availability of data and materials
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request and with the approval of the Northwestern University Institutional Review Board.

Declarations

Ethics approval and consent to participate
Research reported in this study was performed in accordance with the Declaration of Helsinki. The Northwestern University Institutional Review Board approved this study (STU00204939).

Consent for publication
Not applicable.

Competing interests
Not applicable.

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References

1. United States Census Bureau. Total population: 2020 detailed demographic and housing characteristics file A. 2020.
2. Ardeshna DR, Bob-Manuel T, Nanda A, Sharma A, Skelton WP IV, Skelton M, et al. Asian-Indians: a review of coronary artery disease in this understudied cohort in the United States. Ann Transl Med. 2018;6(1):12–12.
3. Shah NS, Xi K, Kapphahn KI, Srinivasan M, Au T, Sathye V, et al. Cardiovascular and cerebrovascular disease mortality in Asian American subgroups. Circ Cardiovasc Qual Outcomes. 2022;15(5):e008651.
4. Ajjan R, Carter AM, Somani R, Kain K, Grant PJ. Ethnic differences in cardiovascular risk factors in healthy Caucasian and South Asian individuals with the metabolic syndrome. J Thromb Haemost. 2007;5(4):754–60.
5. Volgman AS, Palaniappan LS, Aggarwal NT, Gupta M, Khandelwal A, Krishnan AV, et al. Atherosclerotic cardiovascular disease in South Asians in the United States: epidemiology, risk factors, and treatments: a scientific statement from the American Heart Association. Circulation. 2018;138(1):e1–34.
6. Virani SS, Alonso A, Aparicio HJ, Benjamin EJ, Bittencourt MS, Callaway CW, et al. Heart disease and stroke statistics—2021 update. Circulation. 2021;143(8):e254–743.
7. Unnikrishnan R, Gupta PK, Mohan V. Diabetes in South Asians: phenotype, clinical presentation, and natural history. Curr Diab Rep. 2018;18(6):30.
8. Stephenson J. USPSTF: lifestyle counseling advised for overweight, obese adults with other cardiovascular risk Factors. JAMA. 2014;312(11):1085.
9. Tirodkar MA, Baker DW, Makoul GT, Khurana N, Paracha MW, Kandula NR. Explanatory models of health and disease among South Asian immigrants in Chicago. J Immigr Minor Heal. 2011;13(2):385–94.
10. Tang J, Mason M, Kushner R, Tirodkar M, Khurana N, Kandula N. South Asian American perspectives on overweight, obesity, and the relationship between weight and health. Prev Chronic Dis. 2012;9:E107.
11. Kandula NR, Khurana NR, Makoul G, Glass S, Baker DW. A community and culture-centered approach to developing effective cardiovascular health messages. J Gen Intern Med. 2012;27(10):1308–16.
12. Koenig CJ, Dutta MJ, Kandula N, Palaniappan L. "All of Those Things We Don't Eat": a culture-centered approach to dietary health meanings for Asian Indians living in the United States. Health Commun. 2012;27(8):818–28.
13. Kandula NR, Bernard V, Dave S, Ehrlich-Jones L, Counard C, Shah N, et al. The South Asian Healthy Lifestyle Intervention (SAHELI) trial: protocol for a mixed-methods, hybrid effectiveness implementation trial for reducing cardiovascular risk in South Asians in the United States. Contemp Clin Trials. 2020;92:105995.
14. Kandula NR, Patel KM, Lancki N, Welch S, Bouris A, Marquez DX, et al. South Asians Active Together (SAATH): protocol for a multilevel physical activity intervention trial for South Asian American mother and daughter dyads. Contemp Clin Trials. 2022;120:106892.
15. Lim S, Wyatt L, Chauhan H, Zanowiak JM, Kavathe R, Singh H, et al. A culturally adapted diabetes prevention intervention in the New York City Sikh Asian Indian community leads to improvements in health behaviors and outcomes. Health Behav Res. 2019;2(1):4.
16. Beune E, Muilwijk M, Jelsma JGM, van Valkengoed I, Teitsma-Jansen AM, Kumar B, et al. The acceptability and effect of a culturally-tailored dance intervention to promote physical activity in women of South Asian origin at risk of diabetes in the Netherlands—a mixed-methods feasibility study. Carels V, editor. PLoS One. 2022;17(2):e0264191.
17. Kousar R, Burns C, Lewandowski P. A culturally appropriate diet and lifestyle intervention can successfully treat the components of metabolic syndrome in female Pakistani immigrants residing in Melbourne. Australia Metabolism. 2008;57(11):1502–8.
18. Patel RM, Misra R, Raj S, Balasubramanyam A. Effectiveness of a group-based culturally tailored lifestyle intervention program on changes in risk factors for type 2 diabetes among Asian Indians in the United States. J Diabetes Res. 2017;2017:1–13.
19. Shelton RC, Hailemariam M, Iwelunmor J. Making the connection between health equity and sustainability. Front Public Heal. 2023;26:11.
20. Luke DA, Calhoun A, Robichaux CB, Elliott MB, Moreland-Russell S. The program sustainability assessment tool: a new instrument for public health programs. Prev Chronic Dis. 2014;23(11):130184.
21. Iwelunmor J, Blackstone S, Veira D, Nwaozuru U, Airhihenbuwa C, Munodawafa D, et al. Toward the sustainability of health interventions implemented in sub-Saharan Africa: a systematic review and conceptual framework. Implement Sci. 2015;11(1):43.
22. Scheirer MA, Dearing JW. An agenda for research on the sustainability of public health programs. Am J Public Health. 2011;101(11):2059–67.
23. Palinkas LA, Chou CP, Spear SE, Mendon SJ, Villamar J, Brown CH. Measurement of sustainment of prevention programs and initiatives: the sustainment measurement system scale. Implement Sci. 2020;15(1):71.
24. Chambers DA, Glasgow RE, Stange KC. The dynamic sustainability framework: addressing the paradox of sustainment amid ongoing change. Implement Sci. 2013;8(1):117.
25. Birken SA, Haines ER, Hwang S, Chambers DA, Bunger AC, Nilsen P. Advancing understanding and identifying strategies for sustaining evidence-based practices: a review of reviews. Implement Sci. 2020;15(1):88.
26. Shelton RC, Chambers DA, Glasgow RE. An extension of RE-AIM to enhance sustainability: addressing dynamic context and promoting health equity over time. Front Public Heal. 2020;12:8.
27. Ramanadhan S, Davis MM, Armstrong R, Baquero B, Ko LK, Leng JC, et al. Participatory implementation science to increase the impact of evidence-based cancer prevention and control. Cancer Causes Control. 2018;29(3):363–9.
28. Aji B, Anandari D, Soetikno H, Sumawan H. Sustaining maternal and child health programs when donor funding ends: a case study of stakeholder involvement in Indonesia. Int J Health Plann Manage. 2022;37(4):2049–62.
29. Biermann O, Nordenstam A, Muwonge T, Kabiri L, Ndeezi G, Alfvén T. Sustainable preventive integrated child health care: reflections on the importance of multidisciplinary and multisectoral stakeholder engagement. Glob Health Action. 2023;16(1):2173853.
30. Warren AM, Constantinides SV, Blake CE, Frongillo EA. Advancing knowledge about stakeholder engagement in multisectoral nutrition research. Glob Food Sec. 2021;29:100521.

31. Shelton RC, Cooper BR, Stirman SW. The sustainability of evidence-based interventions and practices in public health and Health care. Annu Rev Public Health. 2018;39(1):55–76.
32. Proctor E, Luke D, Calhoun A, McMillen C, Brownson R, McCrary S, et al. Sustainability of evidence-based healthcare: research agenda, methodological advances, and infrastructure support. Implement Sci. 2015;10(1):88.
33. Cruden G, Kelleher K, Kellam S, Brown CH. Increasing the delivery of preventive health services in public education. Am J Prev Med. 2016;51(4):S158–67.
34. Kandula NR, Shah NS, Kumar S, Charley M, Clauson M, Lancki N, Finch EA, Ehrlich-Jones L, Rao G, Spring B, Shah NS, Siddique J. A culturally adapted lifestyle intervention for South Asian adults with cardiovascular risk factors: The SAHELI community-based randomized clinical trial. JAMA Cardiol. https://doi.org/10.1001/jamacardio.2024.2526.
35. Curran GM, Bauer M, Mittman B, Pyne JM, Stetler C. Effectiveness-implementation hybrid designs. Med Care. 2012;50(3):217–26.
36. Diabetes Prevention Program (DPP) research group. The Diabetes Prevention Program (DPP). Diabetes Care. 2002;25(12):2165–71.
37. National Heart Lung and Blood Institute. Description of the DASH Eating Plan. 2021. Available from: https://www.nhlbi.nih.gov/education/dash-eating-plan. Cited 2023 Nov 29
38. Svetkey LP, Harsha DW, Vollmer WM, Stevens VJ, Obarzanek E, Elmer PJ, et al. Premier: a clinical trial of comprehensive lifestyle modification for blood pressure control: rationale, design and baseline characteristics. Ann Epidemiol. 2003;13(6):462–71.
39. Guest G, Namey EE. Public Health Research Methods. 1 Oliver's Yard, 55 City Road London EC1Y 1SP: SAGE Publications, Inc; 2015.
40. Fetters MD, Curry LA, Creswell JW. Achieving integration in mixed methods designs-principles and practices. Health Serv Res. 2013;48(6pt2):2134–56.
41. Harris PA, Taylor R, Minor BL, Elliott V, Fernandez M, O'Neal L, et al. The REDCap consortium: building an international community of software platform partners. J Biomed Inform. 2019;95:103208.
42. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42(2):377–81.
43. Bacon C, Malone S, Prewitt K, Hackett R, Hastings M, Dexter S, et al. Assessing the sustainability capacity of evidence-based programs in community and health settings. Front Heal Serv. 2022;30:2.
44. Palinkas LA, Spear SE, Mendon SJ, Villamar J, Reynolds C, Green CD, et al. Conceptualizing and measuring sustainability of prevention programs, policies, and practices. Transl Behav Med. 2020;10(1):136–45.
45. R Core Team. R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; 2021.
46. Fereday J, Muir-Cochrane E. Demonstrating rigor using thematic analysis: a hybrid approach of inductive and deductive coding and theme development. Int J Qual Methods. 2006;5(1):80–92.
47. Nowell LS, Norris JM, White DE, Moules NJ. Thematic analysis. Int J Qual. Methods. 2017;16(1):160940691773384.
48. Charmaz K. Teaching theory construction with initial grounded theory tools: a reflection on lessons and learning. Qual Health Res. 2015;25(12):1610–22.
49. Hennink M, Hutter I, Bailey A. Qualitative Research Methods. Sage Publications; 2010.
50. Glaser BG, Strauss AL. The discovery of grounded theory. Routledge; 2000. p. 1–282.
51. Starks H, Trinidad SB. Choose your method: A comparison of phenomenology, discourse analysis, and grounded theory. Qual Health Res. 2007;17(10):1372–80.
52. Ivankova NV, Creswell JW, Stick SL. Using mixed-methods sequential explanatory design: from theory to practice. Field Methods. 2006;18(1):3–20.
53. Guetterman TC, Fetters MD, Creswell JW. Integrating quantitative and qualitative results in health science mixed methods research through joint displays. Ann Fam Med. 2015;13(6):554–61.
54. Funk KL, Elmer PJ, Stevens VJ, Harsha DW, Craddick SR, Lin PH, et al. PREMIER—a trial of lifestyle interventions for blood pressure control: intervention design and rationale. Health Promot Pract. 2008;9(3):271–80.
55. Centers for Disease Control and Prevention. National Diabetes Prevention Program - Curriculum and Handouts. 2023. Available from: https://www.cdc.gov/diabetes/prevention/resources/curriculum.html. Cited 2023 Aug 22
56. Kandula NR, Patel Y, Dave S, Seguil P, Kumar S, Baker DW, et al. The South Asian Heart Lifestyle Intervention (SAHELI) study to improve cardiovascular risk factors in a community setting: design and methods. Contemp Clin Trials. 2013;36(2):479–87.
57. Kandula NR, Dave S, De Chavez PJ, Bharucha H, Patel Y, Seguil P, et al. Translating a heart disease lifestyle intervention into the community: the South Asian Heart Lifestyle Intervention (SAHELI) study; a randomized control trial. BMC Public Health. 2015;15(1):1064.
58. Aschbrenner KA, Mueller NM, Banerjee S, Bartels SJ. Applying an equity lens to characterizing the process and reasons for an adaptation to an evidenced-based practice. Implement Res Pract. 2021;26(2):26334895211017172.
59. Baumann AA, Cabassa LJ. Reframing implementation science to address inequities in healthcare delivery. BMC Health Serv Res. 2020;20(1):190.
60. Scheirer MA. Is sustainability possible? A review and commentary on empirical studies of program sustainability. Am J Eval. 2005;26(3):320–47.
61. Cowie J, Nicoll A, Dimova ED, Campbell P, Duncan EA. The barriers and facilitators influencing the sustainability of hospital-based interventions: a systematic review. BMC Health Serv Res. 2020;20(1):588.
62. Herkama S, Kontio M, Sainio M, Turunen T, Poskiparta E, Salmivalli C. Facilitators and barriers to the sustainability of a school-based bullying prevention program. Prev Sci. 2022;23(6):954–68.
63. Konchak JN, Moran MR, O'Brien MJ, Kandula NR, Ackermann RT. The state of diabetes prevention policy in the USA following the affordable care act. Curr Diab Rep. 2016;16(6):55.
64. Steinman LE, Gasca A, Hoeft TJ, Raue PJ, Henderson S, Perez R, et al. "We are the sun for our community:" Partnering with community health workers/promotores to adapt, deliver and evaluate a home-based collaborative care model to improve equity in access to quality depression care for older U.S. Latino adults who are unders. Front Public Heal. 2023;11:1079319.
65. Beidas RS, Stewart RE, Adams DR, Fernandez T, Lustbader S, Powell BJ, et al. A multi-level examination of stakeholder perspectives of implementation of evidence-based practices in a large urban publicly-funded mental health system. Adm Policy Ment Heal Ment Heal Serv Res. 2016;43(6):893–908.
66. Hailemariam M, Bustos T, Montgomery B, Barajas R, Evans LB, Drahota A. Evidence-based intervention sustainability strategies: a systematic review. Implement Sci. 2019;14(1):57.
67. Cavero V, Toyama M, Castro H, Couto MT, Brandt L, Quayle J, et al. Implementation and scalability of a digital intervention to reduce depressive symptoms in people with diabetes, hypertension or both in Brazil and Peru: a qualitative study of health system's stakeholders' perspectives. Discov Ment Heal. 2022;2(1):12.
68. Xiang X, Robinson-Lane SG, Rosenberg W, Alvarez R. Implementing and sustaining evidence-based practice in health care: The bridge model experience. J Gerontol Soc Work. 2018;61(3):280–94.
69. Zakumumpa H, Bennett S, Ssengooba F. Alternative financing mechanisms for ART programs in health facilities in Uganda: a mixed-methods approach. BMC Health Serv Res. 2017;17(1):65.
70. LaPelle NR, Zapka J, Ockene JK. Sustainability of public health programs: the example of tobacco treatment services in Massachusetts. Am J Public Health. 2006;96(8):1363–9.
71. Stevens B, Peikes D. When the funding stops: do grantees of the local initiative funding partners program sustain themselves? Eval Program Plann. 2006;29(2):153–61.
72. West DS, Bursac Z, Cornell CE, Felix HC, Fausett JK, Krukowski RA, et al. Lay health educators translate a weight-loss intervention in senior centers. Am J Prev Med. 2011;41(4):385–91.
73. Neamah HH, Kuhlmann AKS, Tabak RG. Effectiveness of program modification strategies of the diabetes prevention program. Diabetes Educ. 2016;42(2):153–65.
74. Azar KMJ, Nasrallah C, Szwerinski NK, Petersen JJ, Halley MC, Greenwood D, et al. Implementation of a group-based diabetes prevention program within a healthcare delivery system. BMC Health Serv Res. 2019;19(1):694.

75. Dineen TE, Bean C, Jung ME. Implementation of a diabetes prevention program within two community sites: a qualitative assessment. Implement Sci Commun. 2022;3(1):11.
76. Perez Jolles M, Lengnick-Hall R, Mittman BS. Core functions and forms of complex health interventions: a patient-centered medical home illustration. J Gen Intern Med. 2019;34(6):1032–8.
77. Kirk MA, Haines ER, Rokoske FS, Powell BJ, Weinberger M, Hanson LC, et al. A case study of a theory-based method for identifying and reporting core functions and forms of evidence-based interventions. Transl Behav Med. 2021;11(1):21–33.
78. Movsisyan A, Arnold L, Evans R, Hallingberg B, Moore G, O'Cathain A, et al. Adapting evidence-informed complex population health interventions for new contexts: a systematic review of guidance. Implement Sci. 2019;14(1):105.
79. Movsisyan A, Arnold L, Copeland L, Evans R, Littlecott H, Moore G, et al. Adapting evidence-informed population health interventions for new contexts: a scoping review of current practice. Heal Res Policy Syst. 2021;19(1):13.
80. WiltseyStirman S, Baumann AA, Miller CJ. The FRAME: an expanded framework for reporting adaptations and modifications to evidence-based interventions. Implement Sci. 2019;14(1):58.
81. Moise N, Cené CW, Tabak RG, Young DR, Mills KT, Essien UR, et al. Leveraging implementation science for cardiovascular health equity: a scientific statement from the American Heart Association. Circulation. 2022;146(19):e260–78.
82. Fichtenberg C, Delva J, Minyard K, Gottlieb LM. Health and human services integration: generating sustained health and equity improvements. Health Aff. 2020;39(4):567–73.

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