Culturally adapting a physical activity intervention for Somali women: the need for theory and innovation to promote equity

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Abstract

There is pressing need for innovation in clinical research to more effectively recruit, engage, retain, and promote health among diverse populations overburdened by health disparities. The purpose of this study is to provide a detailed illustration of the cultural adaptation of an evidence-based intervention to bolster translational research with currently underserved communities. The cultural adaptation heuristic framework described by Barrera and colleagues is applied to the adaptation of a physical activity evidence-based intervention with adult Somali women. Widespread changes were required to ensure program feasibility and acceptability, including the reduction of assessment protocols and changes discordant with current trends in physical activity research. The cultural adaptation of evidence-based interventions offers an important mechanism for reducing health disparities. Improved reporting standards, assessment of features relevant to underserved communities, and greater funding requirements to ensure better representation are needed to promote more widespread access for all people.

Keywords

Cross-cultural research, Cultural adaptation, Health disparities, Translational research, Physical activity interventions, Refugee research

There is a pressing need for innovations in clinical research to more effectively recruit, engage, retain, and promote health among diverse populations overburdened by health disparities [1–3]. Disparities persist for many racial/ethnic minority groups in health outcomes [4], as well as representation in clinical research and interventions [2, 5]. Culturally, adapting current evidence-based interventions (EBIs) for use with more diverse target populations offers great potential for decreasing health disparities and increasing access to EBIs, yet there is a need to advance this science with broader applications within diverse populations [6–9].

There are several cultural adaptation theories and frameworks proposed in the literature, but few

Implications:

Research: Cultural adaptation models should guide translational research aimed at reaching diverse, underserved populations, with reporting standards raised for documenting the cultural adaptation processes implemented.

Practice: Physical activity programs for migrant and refugee communities benefit from community-engaged approaches to ensure cultural factors, such as unique barriers and opportunities to being active, are considered in programs to maximize effect.

Policy: Funding agencies should support broader efforts to ensure underrepresented groups in clinical trials and public health programs have access to and benefit from evidence-based programs.

comprehensive illustrations of program adaptations, which are needed to guide best practice. Herein, we detail the cultural adaptation of an efficacious physical activity (PA) program following the heuristic framework laid out by Barrera and Castro [10]. We selected this framework because it provides flexibility in the dimensions for adaptation (e.g., engagement strategies, outcomes) and clear steps for structuring the cultural adaptation process. The framework includes four steps that include a range of information gathering, adaptation processes, and adaptation tests. The goal of program adaptation is to identify and address challenges to ensuring program fidelity alongside the acceptability of the program for the new target population [11].

African immigrants represent one such underrepresented group in research and programming [12]. In particular, Somali women appear to have unique barriers to engaging in PA such as cultural practices related to modesty and limited exposure to intentional physical activity in Somalia [13], alongside risk for

chronic disease concerns for which PA is recommended, such as obesity, type II diabetes, and cardiovascular disease [14–16]. In an effort to develop a PA program for sedentary adult Somali women (entitled *Ladnaan*, meaning “wellbeing” in Somali), we culturally adapted an EBI. The STRIDE program [17, 18] is an EBI based on the Transtheoretical Model [19] and Social Cognitive Theory [20] that has been successfully applied to Caucasian, African-American, and Latino men and women to increase PA among sedentary populations, predominantly through print-based and online delivery of intervention materials [21–24]. It is important to test the feasibility of EBIs during the process of adapting programs from more tightly controlled efficacy trials to community-based settings and with new populations [25]. Herein, we provide an illustration of a comprehensive cross-cultural adaptation of STRIDE to ensure fit and efficacy with a new, culturally distinct population. In particular, this highlights some of the unique dimensions for adaptation when working with individuals from refugee, Muslim, and low literacy backgrounds. By outlining the lessons learned through the adaptation, we aim to bolster future research and the dissemination and implementation of EBIs to engage more effectively diverse, underserved communities.

METHODS

We outline the application of the four stages of the framework and provide examples of the steps taken in our population of Somali women. The four stages include: (1) information gathering to identify dimensions of cultural mismatch and strategies to address cultural differences, (2) preliminary adaptation design based on identified challenges and solutions, (3) preliminary adaptation tests, and (4) adaptation refinement [10]. Figure 1 provides an overview of the stages and components of adaptation, including PA research norms, challenges to applying these norms, potential solutions, and the source of information identifying misfit with our target population. For all stages of research, Institutional Review Boards approved the protocols and informed consent obtained from all participants.

Stage 1: information gathering

The goal of the information gathering stage is to identify strategies to address sources of intervention mismatch with a new population [10]. The first step of this process started in 2010 and continued throughout the project and included engagement of key stakeholders through the formation of a Community Advisory Board (CAB) and formative research approaches with the EBI program developers, community leaders, community members, and local agencies that could support or benefit from the adapted program. We gathered feedback from stakeholders informally and through formal group meetings consistently over the course of the adaptation.

Second, we conducted four focus groups between August and October 2010 with 40 community members who could potentially receive the intervention to identify the most pressing health concerns self-identified within the local communities. Participants were recruited through partnerships with community agencies and outreach by CAB members and bicultural staff. The focus groups highlighted rising rates of chronic disease concerns after moving to the USA (e.g., diabetes, hypertension) and a desire within the community to prevent chronic diseases before they begin, but that cultural and practical barriers made doing so difficult [14]. In particular, PA was identified as a priority for programming and intervention development both from a community and public health perspective. Key barriers (e.g., limited availability of free and low-cost physical activity resources that were safe and linguistically and culturally appropriate) and opportunities for intervention (e.g., key community partners and resources to support local intervention) were identified (see [14] and Table 1 for further detail and examples). This was a critical step in gauging community needs and prioritizing health issues for intervention.

Third, literature reviews starting in 2011 revealed minimal research on physical activity programs with Somali or other refugee women in resettlement. At that time, we identified only one study that evaluated PA interventions with Somali women in the context of resettlement [26]. This is despite research indicating rapid health transitions such as rising obesity rates and changing nutritional and physical activity habits [15, 16, 27–29] alongside unique barriers to PA and other health behaviors within Somali and other East African communities [16, 30–34].

Fourth, we conducted a qualitative study in 2011 to identify unique barriers and opportunities for PA when working with adult Somali women in order to best develop an effective and culturally appropriate program. In line with community-based participatory research methods [35], we conducted a Photovoice study with eight adult Somali women. Using Photovoice methodology [36], women were provided with cameras and asked to photograph and later discuss opportunities and barriers to PA within their communities and in daily life. Some of the identified barriers to PA were similar to those found in other low socioeconomic status communities (e.g., safety and financial barriers), whereas others were unique to the Somali community and represented cultural and religious barriers to engaging in PA in the local context (e.g., challenges of accommodating religious practices within US society; see [13] for further detail). Based on the findings across the four approaches, we discovered (a) PA as a community-identified topic for programming and (b) several key dimensions for cultural adaptation.

Stage 2: preliminary adaptation

Stage 2 includes making initial modifications to the intervention based on data gathered in Stage 1 [10]. We began with the STRIDE program [17, 18], which

Fig 1 | Overview of the four stages of cultural adaptation and dimensions

is delivered as an individual intervention that tailors program materials based on an individual's Stage of Change in the Transtheoretical Model [19]. The program has increasingly been implemented through print and online approaches, with the aims of reducing costs for delivery and increasing ease of access for participants. The program emphasizes cognitive and behavioral processes of change, such as the use of goal setting, self-monitoring, and increasing social support and problem solving skills to increase regular physical activity. The materials and framework of STRIDE were the starting point for culturally adapting the program.

Our collaboration with the community, as well as our culturally diverse research group, identified many features that were culturally inconsistent and led to tailoring aspects of the program that included peripheral (e.g., pictures, fonts, colors in materials), evidential (e.g., demonstrating data specific to the target group), constituent-involving (e.g., bicultural program staff), socio-cultural (e.g., incorporating cultural values, beliefs, and behaviors), and linguistic (e.g., translated documents) categories [9, 37]. A comprehensive list of points for adaptation and the data supporting these adaptations are provided in Table 1.

Table 1 | Points for cultural adaptation of physical activity interventions and assessments

PA standards	Challenges	Solutions	Deep structure categories (Resnicow et al., 1999)	Source
Accelerometry	Valid wear times, suspicion, trust; wrist accelerometer had to be removed 5 or more times daily in preparation for prayer time	Use of PA measures identified as acceptable (e.g. pedometers, waist instead of wrist-worn accelerometers, fitness tests)	Socio-cultural	Pilot Intervention
Limit enrollment based on defining characteristics	History of exclusion and/or scarcity of resources	Include organizational programming that emphasizes social inclusion	Socio-cultural	Community partners and bicultural staff
Academic or fitness facility location	Inconvenient locations, costs, unfamiliar or not trusted by the community	Community center location—safe trusted location and budget to support technology and infrastructure	Socio-cultural	Community partners and bicultural staff
Increasing emphasis on print- and technology-based dissemination of information	Limited access to technology and written forms of communication (e.g. availability in native language and/or literacy levels)	Emphasize culturally relevant methods for dissemination of information (e.g. group-based and promotora models) and oral or video channels for delivery to overcome literacy barriers	Socio-cultural	Community partners and bicultural staff, formative research
Avoid US holidays	Avoid prayer time and Ramadan	Proactive assessment of events pertinent to the target community	Socio-cultural	Community partners and bicultural staff, formative research
Community audits	Existing audits address safety and amenities but not other culture-specific factors	Modified audit tools to add information on women-only opportunities, dog-free areas, etc.	Socio-cultural	Community partners and bicultural staff
Increased utilization of existing resources—be active anywhere, anytime	Existing resources may not accommodate cultural practices or represent safety concerns	Create new resources that are culturally appropriate, safe, and affordable	Linguistic/Peripheral	Formative research
Self-monitoring through written logs	Low literacy/numeracy	Completing logs in session with 7-day recall pedometers	Linguistic	Pilot Intervention
Healthcare management/oversight	Lack of primary care provider	Recruit through trusted community organizations and provide information on resources to participants	Constituent-involving	Pilot Intervention
Comprehensive assessment of primary and secondary outcomes and mediators/moderators of change	Time, trust, concern of assessment of secondary outcomes (e.g. mental health)	Abbreviated assessments that ensure comprehensive coverage with fewest items	Evidential	Pilot Intervention

Most studies readily identify linguistic barriers when working with non-native English speakers, with an emphasis on translation and back-translation standards [38]. In this instance, health literacy was identified as an important issue beyond the translation process and has been identified by others when working with vulnerable or refugee populations [39, 40]. Members of the research team reviewed all of the STRIDE intervention materials to identify, prioritize, and break down into lists the key messages in the materials. The lists were then reduced; the number of words per sentence and the number of syllables per word were lowered. For example, bullet points were used in place of complete sentences and paragraphs and more complex terms or phrases were replaced with simpler language (e.g. “Beware of saboteurs: These are the people who discourage your efforts to become more physically active” changed to “Some people may not be supportive.”) while retaining the meaning of the materials. Table 2 provides a comparison of the original and adapted materials (see [41] for a list of free readability calculators). We then modified documents to be more visually appealing and less intimidating to read, with attention to blank space, font size, and use of colors and images [42]. Further, despite the reduction of literacy level for materials, we modified the delivery to utilize English/Somali written materials with group-based facilitation of the intervention. The in-person group format was identified as more culturally appropriate and increased assurances that the intervention materials would be consistently received. A *promotora* (trained peer leader) approach was selected as optimal for this cultural group as a typical and accepted format for receiving health information.

Increasing readability includes ensuring cultural equivalence. The goal of the modification was to reduce ways in which the original program may not be culturally comparable or compatible [43]. In order for participants to be able to identify with the reading material, examples and images used needed to be culturally relevant. For example, images of East African women, fully covered and wearing a hijab, were substituted for

Caucasian women wearing more revealing attire. Additionally, activities such as stretching, walking, and yoga were substituted for activities that were uncommon or unavailable in Somalia, such as bicycling or skiing, and therefore less likely to be initiated in the USA.

In this study, gender, race/ethnicity, religion, and socio-economic status were critical factors that affected the adaptation. Pilot participants as well as the CAB, which included Somali women representing diverse demographic backgrounds within the community, raised these issues. These groups expressed a preference for engaging in women-only and/or family-oriented PA programs. We addressed this consideration in several ways, including having only female study staff directly engaging with participants. We conducted audits of local exercise facilities and identified a lack of women only and/or safe PA opportunities. We supported ongoing efforts and expanded offerings through agreements with community-based agencies. To encourage moderate intensity PA, African dance exercise videos were designed and developed, which featured local women who were from African nations or who have dance experience pertaining to the particular culture. While the video was not suitable to all participants due to beliefs about the appropriateness of dance, it was an important component of outreach to the broader African and refugee communities.

Additional changes made based on recommendations by the CAB included the utilization of a community center for intervention programs and issues related to messaging in the program due to cultural norms around PA. Furthermore, the CAB and pilot participants did not support the original trial design (random assignment to one of two interventions), so a waitlist control design was adopted to allow all participants to receive the PA intervention. Intervention logistics such as appointment scheduling were adapted to ensure they did not interfere with prayer times or religious holidays such as Ramadan. Survey questions were also tailored to Somali Muslim women as to obtain accurate information pertaining to hypothesized cultural factors (e.g., acculturation, body image preferences).

Table 2 | Adaptation components and comparison between original EBI and adapted program

STRIDE	Ladnaan
Print-based program	Group-based program
Health literacy	Health literacy
5.5 grade reading level of tip sheets	2.9 grade reading level of tip sheets
0.62 of images per page	4.2 of images per page
Individual intervention	Individual intervention plus organizational intervention
University-based location	Community-based location
Pre-existing resources (gym membership, get new shoes)	Creation of new resources
Potential costs associated with program recommendations (e.g., joining a gym, personal rewards for increasing PA)	Emphasis on free or low-cost options (e.g., spend time with a friend, walk at local parks)
Religion irrelevant to programming	Acknowledging the role of religion in health promotion
Weight loss	Healthy living
Individual health	Overall family and community health
Rewards for self (e.g., vacation, new clothes)	Social rewards (e.g., spending time with others)
Separate intentional activity	Incorporate into daily living
Randomized intervention	Randomized waitlist control

Modifications were required to support PA for women of low socio-economic status. Community audits of free- or low-cost recreation centers were conducted to develop a resource list in places frequented by the community. The lists also included labeled maps for ease of identification. Maps displayed a lack of available low-cost resources for study participants and community members, which highlighted the need for environmental interventions. The audits included a range of common and unique barriers to engaging community resources, including facilities for children, women-only facilities, safety of neighborhoods (crime), availability of sidewalks, the presence of unleashed dogs, and proximity of resources to home, work, schools, and mosques frequented by participants.

Stage 3: preliminary adaptation tests

In stage 3, initial case studies or small pilot studies are conducted to test the initial modifications. Two stages of preliminary adaptation tests were completed. First, we conducted focus groups and individual interviews with 25 women representing the target population: sedentary adult Somali women. Purposeful sampling maximized variability across age (18 to 65 years), time spent living in the USA, and health literacy. Over the course of 6 months in 2013, individual interviews and focus groups were conducted to test the entirety of the adapted PA program. To reduce participant burden, smaller segments of the program were tested using cognitive interview approaches [44], with multiple parts of the program and assessment batteries conducted multiple times to the point of data saturation [45]. We modified materials and retranslated as needed to accommodate issues related to the clarity and cultural fit of the program.

Second, a pilot of the PA intervention and assessment procedures was conducted with an additional 10 participants in 2014. Assessments were done individually, and the intervention was facilitated in a group format at a community center. Bicultural research team members facilitated all components in Somali or English, depending on participant preference. Slight modifications were made to the program for this pilot, including a reduction from a 12-week to a 6-week program for the preliminary adaptation test. Key findings are presented to highlight discrepancies between the original PA research and the current sample with discussion on the implications for cultural adaptation to the new target population.

Based on the eligibility criteria detailed in the EBI, participants were screened to ensure eligibility, including: (1) age 18 or older, (2) self-identify as Somali, (3) currently exercising less than 90 min per week, and (4) no physical limitations or health conditions that could limit uptake of moderate intensity PA (e.g., heart conditions, musculoskeletal concerns). Health literacy was assessed at screening using a 3-item measure [46] to identify literacy levels. After determining eligibility and enrollment in the program, participants then completed three sets of assessments, conducted at the start,

end, and 6 weeks after completing the program. Table 3 provides a comparison between the current sample with the original study sample and data for the cultural adaptation for Latina women.

The individual measurement visits assessed basic demographic characteristics (e.g., age, education, income) and a range of measures related to PA (see Table 3). Participants received wrist-based accelerometers (wActiSleep-BT Monitor) to wear for a period of 7 days and nights on a subset of participants. Several measures were included to address specific concerns among refugee populations, including US and Somali acculturation (adapted from [47]), cultural attitudes and beliefs related to religious practices [48], years lived in the USA, and body image [49]. Additional items included the Hopkins Symptoms Checklist [50], a 25-item scale assessing mental health symptoms, and 16-items from the Harvard Trauma Questionnaire, which assessed exposure to different types of torture and trauma. Both measures have been widely used with refugee populations and were considered potential moderators of exercise uptake and maintenance.

Ten participants signed consent forms and completed baseline assessments. Of those, one participant was deemed ineligible, one was unable to initiate participation due to scheduling conflicts with the group, and another had a change in work schedule arise 2 weeks into the program. During the 6-week program, one participant became pregnant, which was an exclusion criterion for the study. The remaining 6 participants completed baseline, post-program, and 6-week follow-up assessments. Participants were an average age of 46.14 (SD = 12.22) and had lived in the USA for 15 years (SD = 4.76). Comparisons of available demographic data are provided in Table 3 and indicate that the current sample had lower levels of education and household income, yet were similar in baseline averages for age and BMI compared to the original STRIDE participants.

Overall, participants reported low levels of baseline PA-related measures as compared to the original and Latina samples (see Table 3). Participants reported very low levels of access to PA resources, indicating organizational and community interventions are essential for creating more opportunities to be physically active. The culturally linked items revealed differences in body image preferences between Somalia and the USA and varying levels of acculturation, suggesting these should be considered in the messaging of programs.

Despite the need for further adaptation, the trial indicated some improvements in weekly physical activity and related measures for participants in the brief trial. Participants reported increases in self-reported physical activity from no activity at baseline to approximately 50 min per week after the 6-week program. There were also increases in behavioral processes and stages of change. Given the small sample size, lack of control group, and limited scope of the intervention, the results are considered preliminary yet provide some initial support for the efficacy of the program.

Table 3 | Demographic and PA data comparisons between the original sample, adapted Latino sample, and current Somali sample at baseline

	STRIDE (<i>n</i> = 239)	STRIDE-Latino (<i>n</i> = 93)	Ladnaan (<i>n</i> = 7)
Age	44.50	41.37 (11.18)	46.14 (12.22)
Education			
HS graduate or less		45 (48 %)	5 (71 %)
Some college/technical or vocational school		26 (28 %)	1 (14 %)
College education or above	70.6 %	22 (24 %)	
Household Income (\$)			
<\$10,000		22 (24 %)	2 (29 %)
\$10,00–19,999		32 (34 %)	4 (57 %)
\$20,000–29,999		21 (23 %)	0 (0 %)
\$30,000–39,999		7 (8 %)	0 (0 %)
≥\$40,000		10 (11 %)	0 (0 %)
≥\$50,000	60.8 %	0 (0 %)	0 (0 %)
Body mass index (BMI; kg/m ²)			
≥30	80 (33.6 %)	44 (47 %)	3 (43 %)
25–29.9	91 (38.2 %)	30 (32 %)	2 (29 %)
18.5–24.9	67 (28.2 %)	19 (20 %)	2 (29 %)
7-day Physical Activity Recall (PAR) ^a	19.64 (25.02)	14.14 (23.87)	0.00 (0)
PA Stage of Change ^b			
1. Precontemplation	8 (3 %)	5 (5 %)	2 (29 %)
2. Contemplation	154 (64 %)	55 (59 %)	4 (57 %)
3. Preparation	76 (32 %)	32 (34 %)	1 (14 %)
4. Action	1 (0.4 %)	1 (1 %)	0 (0 %)
PA self-efficacy ^b	2.63 (0.76)	2.65 (0.91)	1.77 (1.04)
PA processes ^c			
Cognitive	2.90 (0.71)	3.02 (0.88)	–
Behavioral	2.39 (0.58)	2.45 (0.75)	2.18 (0.93)

^a Sallis, J. F., Haskell, W. L., Wood, P. D., Formann, S. P., Rogers, T., Blair, S. N., & Paffenbarger, R. S. (1985). Physical activity assessment methodology in the Five-City Project. *American Journal of Epidemiology*, 121(1), 91–106

^b Marcus, B. H., Selby, V. C., Niaura, R. S., & Rossi, J. S. (1992). Self-efficacy and the stages of exercise behavior change. *Research Quarterly for Exercise and Sport*, 63(1), 60–66

^c Marcus, B. H., Rossi, J. S., Selby, V. C., Niaura, R. S., & Abrams, D. B. (1992). The stages and processes of exercise adoption and maintenance in a worksite sample. *Health Psychology*, 11(6), 386–395

Process evaluation and a focus group with participants at the final session (*n* = 6) of the pilot study revealed several strengths and limitations of the program. Overall, focus group participants reported high levels of satisfaction with the group-based program. They reported increased awareness of the importance of PA and strategies for increasing PA in their daily life due to the program—these data aligned with the quantitative data. In particular, participants highlighted the importance of social support as a motivating factor for PA. Related to evaluation, participants indicated the heavy assessment burden of the measures and concerns as to why items perceived as unrelated to PA were included in the assessment battery. In particular, focus group participants identified the 25-item mental health measure as invasive and potentially harmful, and they perceived to be irrelevant to the PA program. Participants had low compliance rates in wearing the accelerometers. Participants indicated challenges related to the wrist-mounted accelerometer due to their need to wash up to their elbows five times each day prior to prayer. They reported that family members and other acquaintances inquired about the data captured by the device (e.g., audio- or video-recordings).

This appeared to influence participant wear time despite their receiving information about the devices as used in previous PA studies by investigators on the project. In contrast, they highlighted the value of the pedometers in providing real-time feedback and as a motivator for increasing PA on a daily basis.

Process evaluation by research staff identified challenges related to the implementation of the program. This included extensive research staff time spent in scheduling and facilitating participant visits. While other research frequently relies on self-administration for some portion of assessment, this was not appropriate in the current study. The length of time to administer surveys was burdensome to staff and participants and thus has implications for the feasibility of extensive data collection.

Stage 4: adaptation refinement

Stage 4 includes the reflection on initial tests in Stage 3 and making additional adaptations as needed. Two primary areas for change occurred following the pilot program in Stage 4: (1) further reductions in assessment and (2) changes in the availability of PA for the

broader community. While significant reductions were made at the onset to reduce respondent burden, further reductions were required decrease assessment times and to address content concerns, such as questions related to past trauma and mental health. Additional changes were needed in the assessment of PA, with participants showing significantly lower levels of PA than participants in other trials, although not different from the STRIDE Latina sample [21]. This may reflect the low socio-economic backgrounds of the participants as well as a lack of currently available language appropriate resources. This floor effect has implications for a short trial where the goal is to increase the duration of activity before increasing intensity. Some measures only assess moderate to vigorous PA and may miss increases in activity appropriate for individuals with such low PA at baseline.

We found significantly low compliance rates with the wrist accelerometer, despite other studies finding increases when moving from a waist to wrist device and are an issue that deserves further exploration. There was some feedback from trial participants that waist-worn accelerometers or other movement capturing devices (e.g., Fitbits or masked pedometers) may be more acceptable, though those approaches were not directly tested with the current sample. PA programs may consider tests of cardiorespiratory fitness or other health assessments that could be performed onsite to observe potential program benefits. These diverse forms of assessment should be tested for feasibility and acceptability with the current sample and with other groups who may report similar barriers to engagement with wrist accelerometers. In our research, we opted to proceed with masked pedometers for assessment of weekly activity given their tested acceptability with our sample population. The variety of challenges related to PA assessment in the current study indicates many current gold standards for PA trials may not be appropriate for all populations and need to be adequately evaluated with diverse demographic groups.

The move from a print-based to in-person group-based intervention poses challenges to retention and attrition, as witnessed with only 60 % of the sample completing the short 6-week trial. Based on our piloting, we were confident that retaining a print-based approach would limit the amount of treatment received by participants due to limited uptake of written material. The more general trend to move to print and online programs comes with increasing pressures to enhance cost-effectiveness that is a challenge of face-to-face programs. This trial witnessed those challenges firsthand with issues of attrition due to scheduling conflicts, as well as not meeting eligibility criteria (i.e., pregnancy). Some attrition could have been mitigated by selecting the day/time for the program ahead of recruitment, which was not done for the pilot. However, the challenges to retention are consistent with other trials conducted in community settings and with low-income and minority populations [e.g., [51]]. Race/ethnicity and income are important factors

predicting attendance and retention in interventions, and further research is needed to develop and test strategies for promoting retention among groups at risk for attrition [52]. We maintain that in-person and *promotora* approaches were the optimal adaptation in this instance, and further research is needed to examine overall cost-effectiveness of different delivery channels and features that support trial retention for diverse populations.

Changes were made to ensure more widespread PA offerings to the broader community. The feedback received from participants and advisory members was that randomized controlled trial (RCT) approaches were not acceptable. While further descriptions of the rationale for the screening and enrollment process for the project was added to the program orientation, additional programs were developed and made available to individuals who are unable to enroll in the trial (e.g., not available or interested in committing to a 12-week program or an RCT, do not speak either English or Somali). The program was modified from a wellness intervention control to a waitlist control group, who were offered wellness programming during the wait period and subsequently offered the PA program. This was deemed important by research staff, the study CAB, and pilot participants who indicated this approach was acceptable from their perspective. Innovative research designs are essential if EBIs are to more effectively reach and engage currently underserved communities.

GENERAL DISCUSSION

The heuristic framework for cultural adaptation provided a useful structure for guiding intervention change. Adapting EBIs is very involved and laborious, with each stage revealing new issues. Adapting programs requires resources from the investigator and community that are often not supported within traditional research funding mechanisms. The formative research described herein spanned 4 years and was only feasible through career development funding for the lead investigator. Current standard practice has not reduced disparities, and furthering science and the cost-effectiveness of cultural adaptation efforts is critical.

The challenges to using more standard PA research designs with Somali women were significant and widespread. This suggests greater attention needs to be paid to the ways in which current research and intervention standards can more effectively reach and support currently underserved communities. In communities with a history of scarce or unequally distributed resources, withholding treatment may be a sizeable barrier to enrollment. Further, there are multiple barriers to retention of low-income populations in clinical trials such as greater work and family responsibilities, which requires further attention and resources within clinical research. Adaptations in design and the demands placed on participants (e.g., modifications in assessment method and amount) may be required to

increase current disparities in trial enrollment and retention. The assessment of factors relevant to diverse populations (i.e., immigration status, years in the US, preferred language and, health literacy) across all stages of research (i.e., from recruitment to program completion and outcomes) must be assessed in all studies, not only those specifically targeting diverse populations. Enhanced assessment, reporting, and standards will help to ensure that programs are able to engage, retain, and improve health outcomes for the entirety of the US population.

To expand EBI access to diverse cultural groups, researchers should draw from cultural adaptation models and principles to enhance research and practice. This review provides a detailed illustration of the adaptation process to ensure that programs go beyond linguistic and surface-level changes to accommodate aspects of culture and context essential to sound, ethical, and effective research and practice. The examples provided could be used by other intervention developers, in particular for programs targeting individuals with low literacy and/or predominantly Muslim communities. These represent two underserved populations in current research and outreach.

The heuristic model laid forth by Barrera and Castro [10] provides a template for the steps for adaptation, yet the current evidence base around adapting health interventions provides limited descriptions of the extent to which this occurs in translational research today. There is a need to elevate practice standards to ensure the rigor of adaptations as pressures mount to ensure current biomedical and public health programs are effectively engaging the diverse populations they intend to serve. Issues of fidelity and fit are profound [11] and have implications for promoting health equity in research and practice. Enhanced standards of reporting cultural adaptations, widespread assessment of factors relevant to diverse and underserved communities, and funding requirements to demand greater representation provide important steps toward ensuring better practice and health for all people.

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Compliance with ethical standards

Conflicts of interest: None to report.

Originality: The findings reported have not been previously published and are not under review at any other publication. There are no prior publications from this dataset. The authors have full control of all primary data and the data will be made available for review if requested by the journal.

Human and animal rights and informed consent: All aspects of the research were approved by the Institutional Review Board of the sponsoring institution prior to the initiation of research. All participants provided informed consent, and the research followed ethical principles outlined by international research ethics standards (e.g., Declaration of Helsinki, Belmont Report) that maintain the human rights of participants and their autonomy, wellbeing, and

benefit from participating in research. Animals were not involved in the current research; therefore animal welfare standards do not apply.

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