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Targeted health behavior interventions promoting physical activity: A conceptual model

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Short title: Targeted physical activity interventions

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ABSTRACT

This paper presents a conceptual model illustrating a targeted approach to the design and delivery of health behavior interventions that focus on physical activity promotion. We hypothesize that researchers who i) enhance the socio-cultural relevance of their core intervention components, and ii) recognize the unique contributions of both intervention design *and* delivery, will experience greater intervention engagement and improved outcomes.

Summary

This paper presents a conceptual model of key factors that characterize a socio-culturally targeted approach to physical activity intervention design and delivery.

Keywords: Exercise, cultural targeting, program, lifestyle, health education, health behavior, pedagogy

INTRODUCTION

Regular physical activity is associated with a decreased risk of many chronic health conditions including obesity, type 2 diabetes, heart disease and mental illness (23). However, the majority of adults and young people worldwide are not sufficiently active (16). Consequently, physical inactivity is a leading cause of morbidity and mortality worldwide (21), highlighting the need for effective interventions.

As physical inactivity results from multiple individual, interpersonal, societal and environmental factors, it requires a systems-based solution that acknowledges the complex interactions between these determinants and targets physical activity participation at multiple levels (e.g., individual, environment, policy) (21). Behavioral physical activity interventions are an important component of this broader solution, but reviews suggest previous behavioral interventions have only been modestly effective for both young people and adults (6, 7, 28). The tendency for previous interventions to predominantly target individual-level factors may have contributed to this limited impact, given this approach does not consider other socio-cultural and environmental influences that could also affect program engagement and efficacy in different population subgroups (21).

Cultural targeting may be a key strategy to improve the efficacy of behavioral physical activity interventions, especially in ‘at-risk’ groups (6). As defined by Kreuter and Skinner (22), cultural targeting involves the development of an intervention *‘for a defined population subgroup that takes into account characteristics shared by the subgroups’ members*. In social science research, the term ‘culture’ is often used interchangeably with ‘ethnicity’ and many culturally-targeted physical activity interventions have focused on specific ethnic subgroups (6). However, in a broader sense, culture has been described as *‘the norms, values, beliefs and behaviors that are common in a population’* (39). Using this ‘socio-cultural’ perspective, it is clear that interventions may also be targeted towards a

diverse number of groups based on combinations of variables including sex, age, marital status, parenting status and socio-economic position.

Conceptual Model

This paper presents a conceptual model that illustrates our socio-culturally targeted approach to the design and delivery of health promotion interventions that promote physical activity (Figure 1). Although this model is relevant for many health behaviors, it has been shaped through reflections on our programs that have targeted physical activity as a means of improving overall health (10, 24, 26, 32-36, 41). We hypothesize that physical activity researchers and practitioners who: i) adapt the core intervention components to recognize the unique attributes and preferences of their sample, and ii) recognize the important contributions of both intervention design *and* delivery, will experience greater intervention engagement and improved outcomes.

It is important to acknowledge that this model is not a formal protocol for intervention planning. Rather, the model answers the recent call for researchers to provide more experiential insights into intervention components that may be linked to intervention efficacy and acceptability (11). Thus, the model should be viewed as a complement to existing intervention planning approaches, such as the *Intervention Mapping Approach* (2), which provide more formal, structured, and iterative processes to guide intervention design, implementation and evaluation. The model also builds on Resnicow and colleagues' model of cultural sensitivity (38), which proposes that interventions will be most effective if they are matched to both the observable characteristics of the subgroup (i.e., the surface structure) and to their core cultural values (i.e., the deep structure). Examples of how the surface and deep-structure components of our programs have been targeted for each subgroup can be located in Supplementary Table S1.

As presented in Figure 1, to develop an effective intervention it is important to gain an

in-depth understanding of the unique sample characteristics (i.e., values, preferences, motivators, challenges) of the specific subgroup to be targeted. Throughout this paper we will provide examples of such insights as they relate to our various target populations. These insights were obtained through pilot work, focus groups, interviews, process evaluations, observations, personal researcher reflections, examination of existing literature and extensive experience personally delivering interventions in school and community settings.

With a greater understanding of the target population, these insights can then be used as a ‘socio-cultural lens’ to: i) increase the salience of recruitment strategies for the target group and ii) inform the selection and implementation of core intervention components, which we have grouped into four broad categories: i) *content* (e.g., targeted behaviors, program messages, behavior change techniques), ii) *format* (i.e., the setting, mode of delivery, duration and dose of the program), iii) *facilitator* (e.g., qualifications, experience and personal attributes of the person delivering the intervention), and iv) *pedagogy* (i.e., teaching strategies employed by the facilitator to effectively deliver the intervention content). We believe all of these components are integral to any behavioral intervention and can be socio-culturally adapted to match the needs of specific population subgroups.

In addition, the model recognizes that both intervention design and intervention delivery characteristics exhibit unique and important influences on participant engagement and intervention outcomes. Importantly, each can serve to heighten or undermine the impact of the other. For example, the impact of a well-designed, theoretically-sound, targeted intervention can be hampered by a poor facilitator. Similarly, the influence of an excellent facilitator may be restricted if the intervention content and format are poor. While both components may provide substantial contributions to intervention effectiveness, it appears that physical activity researchers have predominantly focused and reported on the science and application of the intervention design elements (e.g., behavior change techniques,

operationalization of theory) with less attention paid to the critical role of intervention delivery (30). Indeed, the CONSORT extension for non-pharmacologic treatments (4) appears to consider intervention delivery as an external source of bias, rather than an important intervention component that can be optimized.

Our conceptual model was developed upon reflection on the strengths and lessons learned from our program of work, in which we have developed, tested and published a series of health behavior interventions focused on physical activity that have targeted under-represented and ‘at-risk’ subgroups. In this paper, we will present examples of how our previous studies have informed the conceptual model and how the model continues to inform our intervention work. It is important to interpret all of our studies as ‘works in progress’ that have not been without their limitations. However, as these programs have advanced from pilot and efficacy trials to translation trials and broader program dissemination, they have been adapted and improved in response to extensive feedback from participants, facilitators and key stake holders. Importantly, these revisions have also allowed us to optimize the socio-cultural relevance of the programs after considering feedback from participants in addition to the study outcomes and measures of participant engagement.

Overview of programs

The following section summarizes the intervention components and study results of four of health promotion interventions that have targeting physical activity in different subgroups. Following this general overview, to contextualize our model we will describe how recruitment, design, and delivery components for the four programs were adapted for increased socio-cultural relevance in each subgroup.

Our interventions include: (i) the *Self-Help, Exercise and Diet using Information Technology (SHED-IT) Weight Loss Program* for overweight and obese men (32, 35, 36), (ii) the *Healthy Dads, Healthy Kids (HDHK) Program* for overweight fathers and their primary-

school aged children (33, 34), (iii) the *Nutrition and Enjoyable Activity for Teen Girls (NEAT) Program* for low-income and low-active adolescent girls (10, 26) and (iv) the *Active Teen Leaders Avoiding Screen-time (ATLAS) Program* for low-income adolescents boys ‘at risk’ of obesity (24, 41). A summary of study results for these trials is located in Table 1. Further, Supplementary Table S1 provides extended details on the participant characteristics, study interventions and supporting references for strategies used to increase the socio-cultural relevance in each program.

SHED-IT Weight Loss Program

The SHED-IT Weight Loss Program is a gender-targeted, self-administered weight loss program for men. Initially, the program included one group face-to-face information session plus a program handbook. In a pilot study at the University of Newcastle (35, 36), 65 overweight/obese staff and students were randomized to a SHED-IT *Resources-only* group or a SHED-IT *Online* group. While there were no significant between-group differences at post-test, both groups demonstrated significant within-group effects for weight and a host of secondary outcomes including physical activity, which were maintained at 6- and 12 months. As seen in Table 1, participant satisfaction and retention rates were very high. This study was followed by a community effectiveness trial with 159 men, where the *Online* and *Resources-only* versions of the program were compared to a control group (32). In addition to refining the program based on participant feedback, an additional log book was created for participants to complete Social Cognitive Theory-based tasks and the information session was replaced with a DVD to increase scalability. Notably, despite including no face-to-face contact, the men in both intervention groups demonstrated significant and sustained improvements in weight, physical activity and most other outcomes, over the control group (32).

The Healthy Dads, Healthy Kids Program

HDHK was first tested in a pilot randomized controlled trial (RCT) at the University of Newcastle with 51 overweight and obese men and their 71 primary-school aged children (34). The 3-month program was designed to help the men lose weight and role model healthy behaviors to their children. After 6 months, significant intervention effects were identified for the primary outcome (fathers' weight) and other outcomes including physical activity (for fathers and children). This trial was followed by an effectiveness RCT with 93 fathers and 132 children, where trained local facilitators delivered the program in two regional areas with high rates of mining and shift work-based employment (33). Despite the challenges often associated with such real world delivery models, significant and clinically meaningful improvements were again observed for adiposity and physical activity in both fathers and children. Program satisfaction was very high in both trials and retention levels exceeded 80% at all assessments (Table 1). Based on participant feedback, process questionnaires and focus groups, the HDHK program was further improved to include more 'dads and kids' sessions, greater involvement of mothers and integrating more engaging learning experiences for both fathers and children. This version of HDHK is currently being evaluated in a translation trial.

NEAT Girls Program

The NEAT Girls intervention (10, 26) was developed to address the precipitous decline in physical activity levels among teenage girls (16). The program was socio-culturally adapted from an existing intervention called Program X (25), which was originally delivered to both male and female students concurrently. During this pilot trial, girls appeared particularly receptive to messages about health eating, and unlike the boys, significantly improved their consumption of fruit by post-intervention (25). In light of this, the revised NEAT Girls intervention incorporated nutrition education and cooking workshops as one a major intervention component. Reflections on Program X also led to the conclusion that girls would benefit more from a single-sex environment, in which they could participate in activities that

aligned with their preferences (e.g., Pilates and Zumba) without having to feel anxious about performing in front of male classmates. Following these updates, the NEAT Girls program was evaluated in a cluster RCT with 357 adolescent girls attending schools in low-income communities (10, 26). At post-test (12-months), there were no significant intervention effects for body composition or physical activity, but significant reductions in screen-time were noted. Two years from baseline, there was a significant group-by-time effect for body fat in favor of the intervention group.

ATLAS Program

The Physical Activity Leaders (PALs) program was a successful pilot study (24) which informed the ATLAS obesity prevention intervention for adolescent boys (24, 41). The program was evaluated over a 6-month period in a sample of 100 adolescent boys attending four schools in low-income communities (24). After 6 months, there were significant intervention effects for weight, BMI, body fat and physical self-esteem, but not for muscular fitness (push-ups, sit-ups) or physical activity. Based on a detailed process evaluation and feedback from teachers, the intervention was extensively refined, including: additional professional development for teachers, greater autonomy for students and variety in sessions and the inclusion of a smartphone app and website for self-monitoring and goal setting. The ATLAS cluster RCT was conducted in 14 schools with 361 boys (24, 41). There were no significant intervention effects for body composition or physical activity, though significant intervention effects were found for screen-time, muscular fitness (push-ups) and resistance training skill competency. After taking participant and teacher feedback into consideration, we are currently evaluating modified and improved versions of NEAT and ATLAS in an effectiveness trial in 16 secondary schools, which will further inform a translational study.

MODEL COMPONENTS

Recruitment

Recruitment for physical activity interventions can be very challenging, particularly for the ‘at-risk’ groups we have targeted including men, fathers and low-active adolescents (20, 43). However, we believe a critical factor influencing our recruitment success has been the targeting of unique motivators for each subgroup via socio-culturally-relevant ‘hooks’ embedded within the recruitment approaches.

Our recruitment efforts for the SHED-IT and HDHK studies focused on content and outcomes that would be meaningful for, and valued by, men and fathers. For example, the ‘male-only’ nature and scientific legitimacy of the programs were highlighted in the recruitment materials, as these factors have been shown to be important for men’s participation in health research (43). Sensitive use of humor in the SHED-IT materials emphasized the opportunity for men to improve their health without major lifestyle disruption (e.g., ‘we will show you how to lose weight without giving up beer’). The recruitment materials for the HDHK program focused on the ‘father-only’ nature of the study, but also targeted unique paternal motivators such as fathers’ important influence on child development and the opportunity to spend quality time with their children while engaging in appealing physical activities such as rough-and-tumble play. Of note, the recruitment materials did not describe all intervention goals. For example, while a central focus of HDHK was to provide fathers with parenting strategies to improve their children’s physical activity and dietary behaviors, this was not highlighted in the recruitment drive as research suggests many parents do not perceive their children’s physical activity or dietary behaviors to be in need of change, or even as important (8).

The challenges of recruiting adolescents into school-based research have been reported in the literature (20). As seen in Supplementary Table S1, the NEAT and ATLAS studies employed a range of socio-culturally appropriate strategies to assist with participant recruitment, including presentations to students by same-sex role models, information leaflets

promoting enjoyable activity in single-sex classes and demonstrations of non-competitive lifelong physical activities (e.g., skipping, dance, yoga, Pilates, resistance training). These strategies may have particular utility for recruiting adolescent girls, as this group often have poor physical self-perceptions and may therefore feel less threatened in a female-only environment where competition and individual ability are not emphasized (27). Indeed, evidence suggests that recruitment campaigns focusing on enjoyment, social aspects and personal mastery may be effective strategies for recruiting adolescent girls in physical activity programs (19). Although the recruitment strategies for ATLAS and PALs (24) were similar to those used in the NEAT Girls study, the materials were socio-culturally adapted to focus on strength and fitness outcomes (e.g., Would you like to get fitter and stronger?), which are particularly salient among young western males (15).

This socio-culturally targeted approach to recruitment has assisted us to successfully recruit participants which are typically considered ‘hard-to-reach’ in physical activity research (13, 20, 43). For example, although men are notoriously hard-to-engage in weight loss research (43), the recruitment drive for the SHED-IT community weight loss trial generated over 600 expressions of interest from men in the local community within a week. In addition, 357 girls from schools in low-income areas provided written consent to participate in the NEAT girls RCT within a 4-week period. Finally, this approach has been successful in recruiting fathers into the HDHK program, even though fathers are consistently underrepresented in parent-based interventions (40).

Content

The content of an intervention includes all information and recommendations designed to improve behavior as well as the health behavior theory selected to inform the program and the behavior change techniques (BCTs) employed. Although many health recommendations are applicable to the general population, we contend participants’ attention to, and retention

of, these messages will increase if the messages are adapted to be relevant, memorable, persuasive and meaningful to the experience of the target group.

Researchers are faced with a considerable challenge to comprehensively describe the content of behavioral interventions in research papers. However, the field has taken notable strides in recent years with the advent of the BCT taxonomy (31). By providing researchers with a set of explicitly-defined techniques, this taxonomy has reduced the ambiguity in intervention description and interpretation. However, it is important to acknowledge that many BCTs are ‘socio-culturally-neutral’ and researchers have significant scope to make them more engaging and effective. Indeed, Michie and colleagues suggest that the way BCTs are presented to participants “*may have as great or larger impact on outcomes as the techniques themselves*” (31). Further, BCTs have distinct parameters for effectiveness, and contextual factors (e.g., sample characteristics) may moderate whether these parameters are met (37). For example, two of the parameters in the ‘modelling of behavior’ BCT are: (i) that participants attend to the communication, and (ii) that participants identify with the model (37). Notably, both of these parameters can be made addressed by improving the socio-cultural relevance of the BCT.

In addition to informing how specific behavior change techniques are presented, the ‘socio-cultural lens’ can inform the way physical activity messages are ‘pitched’ to participants in ways that target valued and socio-culturally relevant outcomes. For example, in our experience with the HDHK program, we have observed that it is often more effective to frame physical activity advice as a means to improve children’s social-emotional wellbeing rather than for the purposes of obesity prevention or improving physical fitness. In recognition of this, we have gradually increased the emphasis placed on the important mental health benefits for children that are linked to father-child ‘co-physical activity’. Similarly, rather than focusing on the metabolic health consequences of excessive screen-time, the

intervention content now emphasizes how screen-time reduces opportunities for social interaction, bonding and meaningful conversations (particularly at meal times), and decreases the likelihood of optimal cognitive and social-emotional development in children. Another novel aspect of the HDHK program is its focus on ‘reciprocal reinforcement’, where fathers and children are independently encouraged to role model healthy behaviors at home for the benefit of the other. We have noticed that engagement with health behavior messages, particularly among the children, has been considerably stronger when study participants feel responsible for the health and well-being of a loved one.

Format

In addition to informing intervention content, physical activity researchers and practitioners should also consider the preferences of their target sample when selecting the format of their intervention. These attributes include the setting (e.g., community, school), mode of delivery (e.g., face-to-face, group, online, combination), duration (i.e., program length), and dose (i.e., contact frequency). Although these considerations are often constrained by external factors (e.g. funding, capacity), it is important to acknowledge that the format of an intervention can play a critical role in both the recruitment and engagement of participants. This concept is well-illustrated by the recent Football Fans in Training project in the United Kingdom, where the male participants reported that the program setting (professional football stadiums) was the biggest drawcard for participation (18).

We have attempted to increase the socio-cultural relevance of our interventions by considering how the program format characteristics can best reflect the needs, preferences and characteristics of the target sample. For example, in the NEAT and ATLAS programs we ensured the programs were delivered on the school campus, in single-sex groups and at no cost to the students. In Australia, many school sport activities are delivered off campus and students are required to pay for transport and/or participation. Such costs may serve as a

barrier to participation among young people, especially those from low-income communities. In addition, effort and ability are generally on public display in physical education and both mixed-sex and mixed-ability classes can be source of anxiety for students (3). The SHED-IT Program has evolved to become a self-guided program requiring no commitments from the male participants to attend ongoing behavioral counselling sessions. This format aligns with a traditional hegemonic view of masculinity, where men are expected to be self-reliant, strong, tough and independent (9). Of note, despite including no face-to-face sessions, results in the community trial were comparable to more intensive male-only physical activity (13) and weight loss (43) interventions in the literature and 89% of men reported that the program provided them with adequate support for weight loss (32).

Facilitator

Although notable improvements have been observed in the reporting of intervention design characteristics, the field remains limited by a dearth of information regarding mechanisms of intervention delivery. As Michie and Johnston (30) summarize, complex behavioral interventions are often delivered by “*individuals of unreported competence*”. It is reasonable to expect that the characteristics and qualifications of an intervention facilitator may have a considerable impact on program efficacy. Indeed, meta-analyses in the psychology literature have determined that the personal and professional characteristics of therapists are important determinants of treatment effectiveness (17). Through our process evaluation data, observations of facilitators and examination of the broader literature, we have identified the following facilitator characteristics as important for participant engagement in behavior change interventions targeting physical activity: (i) the dispositions (i.e., character or mentality) of the facilitator; (ii) perceptions of the facilitator as credible, relatable and likeable; and (iii) facilitator motivation.

Drawn from research in the fields of education, intelligence, talent and creativity, the

Dispositional Cluster Model (12) outlines the five clusters of dispositions that epitomize highly effective teachers (or facilitators). As suggested by the model, an effective facilitator is: (i) committed (i.e., purposeful, organized and motivated); (ii) creative (i.e., curious, original and a problem solver); (iii) communicative (i.e., knowledgeable, a good listener and uses humor to engage); (iv) authentic (i.e., caring, empathetic and open); and (v) passionate (i.e., enthusiastic, positive and energetic). The presence (and absence) of these dispositions, and the subsequent effects on participants' engagement, has been clear during researcher observations of facilitators delivering our programs. Although it may not be possible to find a facilitator who embodies all of these characteristics, it is important to keep in mind that these traits that should be sought after and fostered in facilitators to enhance the quality of the program.

In addition to these dispositions, we suggest that perceptions of the facilitator as *credible*, *relatable* and *likeable* are implicit drivers of participant engagement and receptiveness to intervention messages. According to the *authority* heuristic, individuals presented with novel or unfamiliar information will determine the legitimacy of the information by firstly deferring to the credibility of the source (29). Within our programs, we have attempted to establish credibility with multiple strategies including the use of university badging on program materials, the inclusion of facilitator and research team titles and qualifications on introduction slides and citations of our published research articles. However, as the *confidence* heuristic (i.e., a rule-of-thumb that someone speaking confidently is likely to be correct), also has an important influence on credibility judgements (42), facilitators in our programs are trained to present confidently and to respond with authority to spontaneous questions from participants. Another consideration is that the facilitator characteristics which contribute to credibility may vary between different socio-cultural groups. For example, in men's weight loss trials a facilitator's credibility may be undermined

if they are overweight or obese (1). However, in our experience the weight status of the facilitator has not been of consequence in programs with adolescent girls, where enthusiasm and active participation in the program activities appears to have a greater bearing on credibility judgments. Establishing credibility has been particularly important in our work with teachers, who may see university academics as disconnected with the real-world challenges of working with adolescents. To build teacher perceptions of our credibility, members of our research team delivered the first ATLAS session in each of the study schools and PE teachers were encouraged to evaluate our teaching using a structured observation checklist.

Another key driver of participant engagement is *relatability*. The similarity-attraction hypothesis suggests that individuals express an implicit bias in favor of those who are similar to themselves. Indeed, the use of physical activity facilitators who share the same beliefs and values of the participants has been recommended in the literature (6). In our research, we have aimed to enhance perceptions of relatability by providing subgroups with facilitators of the same sex (e.g., males were selected to deliver the HDHK program, same-sex teachers delivered the ATLAS and NEAT programs). However, other examples may also be effective (e.g., a male with their own weight-loss success delivering a men's weight-loss program), bearing in mind feasibility constraints which may limit the selection of suitable facilitators.

We also propose that positive attitudes towards intervention facilitators (i.e., *likeability*) contribute to engagement. The *liking/agreement* heuristic is a simple decision rule based on the reasoning that “*people I like usually have correct opinions on issues*” (5). Importantly, likeability can be enhanced by training facilitators on how to enhance the quality and quantity of positive social interactions with participants and by embedding learning experiences in the program that bring out likeable characteristics of the facilitator. For example, in our programs targeting men we plan for the deliberate use of humor to engage

participants. Additionally, HDHK facilitators are trained and encouraged to be ready for sessions early and to stay late so they have time to meet and greet families and initiate conversations around program successes and challenges. In addition to optimizing social interactions, the delivery of enjoyable learning activities may also enhance likability, as positive associations with the program activities may generalize to positive feelings toward the individual delivering them. Notably, our study participants have reported highly positive evaluations of the facilitators in both our pilot and community-based ‘train-the-trainer’ research (Table 1). It is important to note, participants’ perceptions of the facilitator as credible, relatable and likable are dynamic and may continue to be enhanced or undermined during the delivery of intervention content and interaction with study participants. For example, citing relevant experience and qualifications at the start of a physical activity program may enhance perceptions of credibility in the short term. However, these positive perceptions may not be sustained if a facilitator cannot confidently answer pertinent questions asked by study participants. In acknowledgement of this, strategies for enhancing credibility, relatability and likeability are now explicitly addressed during the facilitator training workshops within the HDHK community trial.

Finally, we view the *motivation* of facilitators as another key characteristic central to the successful delivery of physical activity programs. Ensuring that intervention facilitators are wholeheartedly engaged with the program may improve fidelity, and we have utilized a number of strategies to enhance facilitator motivation to both enroll in and optimally deliver our programs. For example, we organized for the ATLAS facilitator workshops to be accredited with the state authority responsible for managing teacher professional learning. The provision of accredited professional learning hours was a tangible and salient incentive for teachers. In addition, we have embedded autonomy supportive strategies within the professional learning component of our current ATLAS and NEAT effectiveness trial, with

the aim of enhancing autonomous motivation among participating teachers.

Pedagogy

Considering the majority of physical activity interventions incorporate an educational component of some kind, it is surprising that the extensive literature on pedagogy (i.e., the science of teaching) appears to have been largely overlooked in behavioral physical activity intervention research. In addition to the personal characteristics and qualifications of the program facilitator, researchers and practitioners should consider the way in which information is delivered or ‘taught’ to be a core component for all physical activity interventions. Principles of effective pedagogy, such as those outlined in the Productive Pedagogy and Quality Teaching frameworks (14) identify important elements of teacher practice which enhance motivation and learning.

For example, an important pedagogical technique used in our interventions is the use of *narrative* or ‘story telling’, which is an engaging and effective way to transfer knowledge. For example, the HDHK program has many ‘built-in’ opportunities for facilitators to share their own stories (or those of previous participants) about occasions where implementing the program recommendations has led to improvements in their family life or physical activity habits. This technique was also particularly important in the SHED-IT program, where participants received a DVD depicting a ‘day in the life’ of a middle aged, overweight man who was chosen as a relatable model for the target sample. In this DVD, the narrative of the protagonist was interspersed with strategies for avoiding common weight-loss pitfalls during a typical day and was delivered by a credible expert (a men’s weight-loss researcher).

Another technique is *substantive communication*, where participants are meaningfully engaged in sustained conversations about concepts and ideas. Rather than using a didactic lecture-style approach in our presentations and facilitator training workshops, we aim to make the sessions highly interactive with numerous opportunities for input and discussion

from participants that are embedded within the program slides and handbooks. The use of a variety of engaging learning experiences such as small groups/pairs challenges and brainstorming, role plays, spot quizzes, debates, and group trivia competitions help to engage participants and maintain their interest with the intervention content.

The pedagogical techniques of *connectedness* and *background knowledge* refer to applying new information to ‘real-life’ contexts or problems and to explicitly build upon individuals’ existing knowledge and experiences. We aim to make the information presented in our programs meaningful and engaging by recognizing the preferences, valued outcomes and prior experiences of study participants. For example, in HDHK we provide practical demonstrations of effective parenting strategies and role-playing of common scenarios faced at home. By role-playing scenarios, such as child responses to parenting efforts to reduce screen-time and encourage outdoor play, fathers are engaged in real-life examples, some of which may connect deeply with their own life experiences.

Failure to address the important role of intervention delivery may explain why promising findings from pilot studies with carefully selected facilitators are often not replicated in larger-scale effectiveness RCTs. Indeed, research has demonstrated that physical activity interventions delivered by research staff have been more effective than those delivered under ‘train-the-trainer’ models (7). Although a comprehensive understanding of the science of teaching is not pre-requisite knowledge for researchers and program facilitators, teaching skills can be improved with appropriate training and ongoing support. In recognition of this, 50% of the HDHK facilitator training course now focuses solely on effective teaching strategies. Similarly, in addition to learning about the ‘SAAFE’ (Supportive, Active, Autonomous, Fair, and Enjoyable) teaching principles during the professional learning workshops, ATLAS facilitators experience follow-up observations of their sessions and receive constructive feedback to ensure these pedagogical principles are

being implemented appropriately.

CONCLUSION / SUMMARY

This paper has presented a conceptual model illustrating key factors that characterize our targeted approach to intervention design and delivery. We propose that intervention planning must begin first with an in-depth understanding of the socio-cultural values and preferences of the target sample. This information can then be used as a *socio-cultural lens* to inform the recruitment strategy and develop the core *design* (content, format) and *delivery* (facilitator, pedagogy) components of the intervention in a way that will optimize recruitment and enhance participant engagement. A second aim of this paper was to highlight the important, but under-recognized influence of intervention delivery on trial efficacy. Specifically, we suggest that the characteristics of the facilitator and their pedagogical approach may have a powerful moderating effect on intervention effectiveness, regardless of the quality of the design components of the intervention. Notably, although the independent pathways in this model have been examined to varying degrees across multiple disciplines to date, we believe this paper presents the first integration of these concepts into a single model to guide the design, conduct and evaluation of socio-culturally relevant and effective physical activity interventions in the future. Our recommendations for researchers and practitioners designing and delivering targeted physical activity interventions are located in Table 2.

Importantly, this model was informed by our experience designing and delivering health promotion programs, which have continually evolved in response to the feedback of participants, facilitators and other key stakeholders. As a result, our model has not only been informed by effective program components, but also those components that did not align as strongly with the preferences of the target sample. For example, in response to participant feedback the format of the HDHK program was updated to include significantly more ‘dads and kids’ sessions, to include mothers in a greater number of sessions, and to start the

program with rough-and-tumble games rather than fitness activities. Similarly, when adapting the PALs program into the ATLAS program, we considered participant feedback and included more interactive games, more variety in activities and more autonomy support for participants to ensure optimal engagement.

As social-cultural targeting is a dynamic and iterative process, it is important to consider and observe participants' views throughout all aspects of intervention design, delivery and evaluation. In the initial stages of our program development (including pilot testing), we personally delivered our programs and ran the professional development workshops, which provided extremely rich and immediate insight into the unique perceptions, barriers, beliefs, values and preferences of our target samples. These insights were also enhanced through informal conversations with participants before and after the program sessions, where they would often share candid and unbiased reflections on whether the core intervention components were as engaging and effective as we intended. As such, we strongly recommend that lead researchers of targeted physical activity projects take an active 'hands-on' role during the program 'delivery' as well as 'design', particularly in efficacy/pilot trials. In cases where researchers do not have the time or the expertise to effectively deliver the program, it is imperative that the trained facilitators are available to have these conversations with participants before and after the sessions and regularly communicate any notable information and insights back to the lead researchers.

Currently, the experiential nature of our model is its primary limitation. As such, further testing is required to validate each component of the model in controlled research studies. For example, future research could examine whether socio-culturally appropriate recruitment materials are more effective at recruiting under-represented groups into physical activity trials compared to generic recruitment materials. Further, exploring the mechanisms by which socio-culturally relevant interventions affect physical activity is a rich area for

future research studies. In particular, studies that compare the effectiveness of providing participants with a socio-culturally relevant physical activity program compared to a standardized program (or a program that had been socio-culturally targeted for a different subgroup) would provide valuable data to test the model. It is also important to recognize that varying degrees of socio-cultural identity or alignment will be experienced by members of any given subgroup. However, the additional level of individual adaptation required to provide further tailoring for individuals needs to be matched against feasibility and cost. This will require experimental manipulation of intervention components in well-powered and high-quality trials. Future research could also consider capturing measures of socio-cultural homogeneity and investigating whether the effects of socio-culturally targeted interventions are moderated by these factors.

Finally, to improve our understanding of the important impact of intervention delivery on study outcomes, researchers should strive to provide comprehensive details of who is delivering physical activity interventions, how they were selected and trained and which pedagogical principles were selected and how they were applied in facilitator training and program delivery to ensure optimal participant engagement.

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Figure caption

Figure 1. Conceptual model of a socio-culturally relevant approach to the design and delivery of health behavior interventions targeting physical activity.

Statement of originality

Table 1, Table 2, Supplementary Table S1 and Figure 1 were created originally by the authors and have not been previously published.

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