

Review Article

Guiding the design of behavioral and lifestyle modification interventions for risk reduction, prevention, and treatment of non-communicable diseases in low- and middle-income countries: An overview of relevant literature

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Abstract

Background: The increasing burden of chronic non-communicable diseases (NCDs) in low- and middle-income countries (LMICs) calls for the development and dissemination of effective and viable interventions. In this respect, behavioral and lifestyle modification interventions (BLMIs) offer the most effective means of addressing the underlying lifestyle behaviors associated with NCDs at multiple disease prevention levels (primordial, primary, and secondary). This review aims to provide an overview of key features and components of BLMIs as well as some practical considerations when implementing them in LMIC settings.

Methods: An exploratory approach was used to provide an overview of salient issues in the design of BLMIs; and the PubMed and Google Scholar databases, as well as gray literature, were searched. Based on the review's aim, the most important issues and themes were identified using a narrative thematic synthesis and analysis approach.

Results: Thirty-three publications were included as the most relevant literature to the topic, and eight overarching themes were identified: understanding the target health behavior; using behavioral and psychological theories; applying behavior change techniques/strategies; providing effective support and follow-up; intervention delivery formats and providers; cultural sensitivity; feasibility consideration; and addressing multiple lifestyle behaviors.

Conclusion: Targeting lifestyle and behavioral modification interventions with a proper understanding of their essential design components and practical contextual considerations is crucial for reducing the rising burden of NCDs in LMICs. Future direction on the importance of conducting original research and systematic reviews on the subject was also emphasized. [*Ethiop. J. Health Dev.* 2023; 37(1) 000-000]

Keywords: chronic disease prevention; lifestyle-related risk behavior; lifestyle modification; behavioral intervention; low- and middle-income countries.

Introduction

Non-communicable diseases (NCDs) – primarily cardiovascular disease, cancer, chronic respiratory disease, and diabetes – have become the main health concern for the majority of countries worldwide (1-3). Many of these are classified as lifestyle-related health conditions, and they share one or more common lifestyle behaviors, such as excess body weight/obesity, low levels of physical activity, poor nutrition, and substance use (4, 5). To tackle these behavioral risk factors, several interventions have been proposed and implemented around the world, especially in high-income countries. Likewise, there is an urgent global need for successfully addressing the underlying lifestyle behaviors associated with these diseases, and it is of great importance to examine ways of translating the evidence of intensive research trials for low socio-economic populations and settings (6, 7).

Behavior change can be difficult and complex, but if it is approached scientifically and systematically, people can change their behaviors and improve their health (8). Behavioral and lifestyle modification interventions (BLMIs) involve a lifelong process of incrementally building more health-promoting practices into daily routines, thereby shifting the overall behavioral balance in favor of habits that reduce NCD risk. Behavior change techniques (BCTs) have become the foundation of BLMIs and there are multiple BCTs and strategies commonly employed for changing unhealthy

behaviors, including establishing behavioral goals, self-monitoring, individual counseling using motivational interviewing, training in problem-solving procedures, making changes to the environment to support positive changes, and relapse-prevention planning (9, 10). However, assessing health behaviors and assisting in their modification requires a culturally competent, individual, or patient-centered orientation rooted in an appreciation of the broader social, economic, cultural, and gender contexts (8, 11).

The striding burden of NCDs in low- and middle-income countries (LMICs) calls for the development and dissemination of effective and feasible interventions (12, 13). Consequently, initiatives to promote healthy behaviors should be at the forefront across all prevention strategies (i.e., primordial, primary, and secondary), as they offer the ultimate options to successfully address the underlying lifestyle behaviors associated with NCDs. Yet, many LMICs face challenges in designing and implementing robust prevention strategies to combat NCDs, and the promise for identifying effective and feasible BLMIs in LMICs is far behind (14-16). A possible explanation for this significant setback could be a lack of knowledge about how to design BLMIs and tailor them to the target segment of the general population.

The purpose of this narrative review is to provide an overview of BLMIs with implications for the risk

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reduction, prevention, and treatment of NCDs in LMICs. The following research questions framed our review: (1) what are the key features of BLMIs? (2) What important practical aspects need to be considered in designing BLMIs in LMIC contexts? As this literature review covers a breadth of topics that are applicable across multiple BLMIs, a systematic or scoping review was not feasible or appropriate to address the research questions. Therefore, rather than aggregate or summarize details in response to a narrow research question, an exploratory approach was taken to provide an overview of pertinent issues in the design of BLMIs.

Methods

Study design

A narrative review methodology was considered the best fit for our larger study aim because of the wide range and heterogeneous nature of the literature relating to our research question (17). In addition, when reviewing the literature, greater emphasis was placed on relevant literature that conceptually converged with the review's purpose.

Search method

To identify relevant papers, the PubMed and Google Scholar search engines, as well as gray literature, were searched. The search was comprehensive but not exhaustive, and we tried to narrow enough and focus the effort on the most pertinent survey of publications. Various combinations of the following keywords and general search terms were used: lifestyle behavior; behavioral modification; behavioral intervention; behavior change intervention; health promotion intervention; non-communicable disease; and chronic disease. The search was limited to papers published in English between January 2000 and December 2020, with recent articles prioritized when feasible. References within relevant articles were also screened to identify additional relevant literature. The corresponding author of this paper selected and screened the relevant literature between February and June 2021, and consistency was checked by the other authors.

Rationale and basis for identifying key literature

The included works of literature were selected based on their importance to the research topic and research questions. However, the review remains selective due to the authors' focus on highlighting key features of BLMI design rather than presenting a comprehensive compilation of data. Partly, the selectivity is owed to a lack of available guidance on BLMIs in LMIC contexts and populations. Where the publication was found authoritative and the issues discussed appeared to be applicable in LMIC contexts, the paper was given higher consideration for inclusion as relevant literature in the review.

As our review topic requires a broader scope of BLMIs, the following inclusion criteria were

considered to determine if the literature is eligible: (1) Papers: peer-reviewed scientific journals, gray literature, commentaries, or editorials that focus on BLMI-related topics or at least one of the research questions; (2) Intervention target-group: apparently healthy general population, those at risk of developing NCDs (e.g., obese/overweight population groups), or people with chronic NCDs; (3) Intervention-type: any intervention that uses one or more BLMI strategies or approaches to reduce risk, prevent, or treat chronic NCDs. The following papers were excluded: (1) Papers focusing on issues not specific to BLMIs; (2) Studies focusing on issues not relevant to LMIC contexts.

Quality appraisal

Due to the nature of the included papers, i.e., some are books, commentaries, and editorials, which can be difficult to get specific quality assessment guides/checklists, as well as the review's overall purpose of providing an overview of the subject, a quality appraisal of the selected papers was not applicable.

Data extraction, synthesis, and analysis

Data were extracted from the included papers using an Excel template to describe the author(s), year of publication, aim or focus, and main discussion topic of the papers concerning BLMIs. Relevant key features and practical considerations of BLMIs were also identified across all included papers.

A narrative thematic synthesis was used to review the included literature. Initially, an in-depth evaluation of the included publications was carried out by comparing, contrasting and extrapolating content and major discussion topics. The identified focus topics from the literature were then synthesized to form themes and topic categories. The findings were organized and referred to as 'themes' pertaining to important concepts and review questions. Finally, all content related to BLMIs was summarized and presented as key issues or themes. The data extraction, synthesis, and analysis were conducted by the corresponding author, and the other review authors independently cross-checked the process to verify its appropriateness and reliability.

Results

A total of thirty-three publications were ultimately selected as relevant and formed the basis of this narrative review, including four books, eight original research articles, twenty reviews, and one editorial. A detailed summary of the selected relevant literature is presented in Table 1.

Table 1: List of relevant publications included in the review

Author (publication year)	Publication Type	Title	Aim/focus of the paper	Relevant issue(s) discussed
Artinian et al. (2010) [37]	Review article	Interventions to promote physical activity and dietary lifestyle changes for cardiovascular risk factor reduction in adults: a scientific statement from the American Heart Association	Evidence-based recommendations on designing and implementing physical activity and dietary interventions in adults	Cognitive-behavioral strategies, intervention delivery strategies
Barrera et al. (2013) [39]	Review article	Cultural adaptations of behavioral health interventions: a progress report	Stages in developing cultural adaptations, common elements, and the effectiveness of culturally enhanced interventions	Cultural adaptation of behavioral interventions
Bartholomew et al. (2016) [20]	Book	Planning health promotion programs: An intervention mapping approach	Guide how to plan and develop health promotion programs using an intervention mapping framework	Practical application of systematic and evidence-based approaches in using theories for developing health promotion programs
Besculides et al. (2008) [36]	Original research	Best practices in implementing lifestyle interventions in the WISEWOMAN program: adaptable strategies for public health programs	Best practices in implementing a variety of lifestyle interventions targeting cardiovascular disease risk factors	The importance of understanding behavior change theory, training staff, and tailoring interventions
Burke et al. (2012) [27]	Original research	Using mHealth technology to enhance self-monitoring for weight loss: a randomized trial	Tested if self-monitoring diet using a mHealth technology only or combined with daily tailored feedback was superior to using a traditional paper diary on weight loss and maintenance	Use of technology in self-monitoring of diet and weight-loss behaviors
Castro et al. (2010) [40]	Review article	Issues and challenges in the design of culturally adapted evidence-based interventions	Design and conduct of adapted interventions, and their effectiveness	Cultural adaptation of evidence-based interventions
Coupe et al. (2018) [42]	Original research	Tailoring lifestyle interventions to low socio-economic populations: a qualitative study	How best to tailor weight loss lifestyle interventions to low socioeconomic populations	Cultural and other important considerations when designing and tailoring lifestyle interventions for low socioeconomic populations
Geller et al. (2017) [49]	Review article	Future directions of multiple behavior change research	Discussed research needs on multiple health behavior change	Targeting multiple health behavior change interventions to impact NCDs

Author (publication year)	Publication Type	Title	Aim/focus of the paper	Relevant issue(s) discussed
Glanz (eds) (2008) [8]	Book	Health behavior and health education: Theory, research, and practice	Comprehensive and in-depth analysis of major health behavior theories	Behavioral theories
Glanz and Bishop (2010) [11]	Review article	The role of behavioral science theory in the development and implementation of public health interventions	Theory use for designing and conducting health-promotion interventions	Multiple determinants and levels of health behavior, behavioral theories, and their use in health behavior intervention
Glasgow (2008) [46]	Editorial	What types of evidence are most needed to advance Behavioral Medicine?	Perspective on types of evidence most needed to advance behavioral medicine	Practicality and external validity of behavioral trials, contextual and real-world considerations in designing trials
Green and Kreuter (2005) [18]	Book	Health promotion planning: an educational and ecological approach	Guide the planning of a health promotion program using the PRECEDE-PROCEED model	The importance of using and applying behavioral theories in the planning of health promotion programs
Hagobian and Phelan (2013) [29]	Review article	Lifestyle interventions to reduce obesity and diabetes	Key components of effective behavioral weight control interventions	Key components of effective lifestyle interventions, behavior change strategies, continued support
Johnston and Moreno (2014) [30]	Review article	Promotion of long-term adherence to a healthy lifestyle	Long-term adherence to healthy lifestyle behaviors	Behavioral strategies for achieving long-term adherence to a healthy lifestyle
Kang et al. (2010) [34]	Original research	Comparison of family partnership intervention care vs conventional care in adults with poorly controlled type 2 diabetes in a community hospital: a randomized controlled trial	Effectiveness of family partnership intervention care for patients with poorly controlled type 2 diabetes	Importance of enhancing family support to improve diabetes control and self-care behaviors
Linke et al. (2014) [21]	Review article	Applying psychological theories to promote healthy lifestyles	Description and application of commonly-used psychological theories and models	Psychological theories and models
Mayberry and Osborn (2012) [35]	Original research	Family support, medication adherence, and glycemic control among adults with type 2 diabetes	Relationships between perceived family support, medication adherence, and glycemic control	The importance of family support for diabetes self-care behaviors

Author (publication year)	Publication Type	Title	Aim/focus of the paper	Relevant issue(s) discussed
Michie and Abraham (2009) [9]	Review article	Effective techniques in healthy eating and physical activity interventions: A meta-regression	Effectiveness of behavior change interventions designed to promote physical activity and healthy eating	Components and behavior change techniques of effective interventions
Michie et al. (2009) [10]	Review article	Low-income groups and behaviour change interventions: a review of intervention content, effectiveness, and theoretical frameworks	Effectiveness of interventions targeting low-income groups to reduce smoking or increase physical activity and/or healthy eating	Evidence of effect and what type of interventions, in terms of content/techniques and theory-used, are effective in low-income groups
Michie et al. (2013) [25]	Original research	The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions	Development of behavior change techniques taxonomy	Description of an important list of behavior change techniques for precise specification of content of an intervention in behavior change interventions
Miller and Dimatteo (2013) [32]	Review article	Importance of family/social support and impact on adherence to diabetic therapy	The relationship between social support and treatment adherence in patients with diabetes	Social/family support and adherence to diabetes treatment
Miller and Rollnick (2013) [28]	Book	Motivational interviewing: helping people change	Application of Motivational Interviewing	Practical Motivational Interviewing strategies as a tool for facilitating behavior change
Noar et al. (2007) [41]	Review article	Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions	A meta-analytic review on the effects of tailored print health behavior change interventions	Effectiveness and importance of tailoring health behaviour change messages
Noar et al. (2008) [24]	Review article	Applying health behavior theory to multiple behavior change: considerations and approaches	How to apply health behavior theory to multiple behavior change	Use of theory in multiple behavior change
Painter et al. (2008) [23]	Review article	The use of theory in health behavior research from 2000 to 2005: a systematic review	Type and extent of theory use in behavioral researches	Use and application of behavioral theories
Peyrot and Rubin (2007) [22]	Review article	Behavioral and psychosocial interventions in Diabetes	Key behavioral/psychosocial interventions for diabetes patients	Behavioral theories, behavior change techniques and strategies, providing effective support, feasibility issues

Author (publication year)	Publication Type	Title	Aim/focus of the paper	Relevant issue(s) discussed
Prestwich et al. (2014) [19]	Original research	Does theory influence the effectiveness of health behavior interventions? Meta-analysis	The extent and type of theory use in physical activity and dietary interventions, and its association with intervention effectiveness	The association between theory use and intervention effectiveness
Prochaska JJ and Prochaska JO (2011) [47]	Review article	A review of multiple health behavior change interventions for primary prevention	Reviewed randomized clinical trials that have evaluated multiple health behavior change interventions	Multiple behavior change interventions
Prochaska et al. (2008) [48]	Review article	Multiple health behavior change research: An introduction and overview	Conceptual and methodological issues on the rationale and need for multiple health behavior change research and interventions	Multiple lifestyle behaviors intervention
Rosland et al. (2008) [33]	Original research	When is social support important? The association of family support and professional support with specific diabetes self-management behaviors	Tested whether perceived family and friend support differentially affects diabetes self-management behavior compared to support from health professionals	Effect of family and friend support on diabetes self-management behaviors
Van Dorsten and Lindley (2011) [26]	Review article	Cognitive and behavioral approaches in the treatment of Obesity	Cognitive and behavioral components of lifestyle interventions for weight loss	Cognitive-behavioral strategies for weight loss, behavioral maintenance
Venditti and Kramer (2012) [38]	Review article	Necessary components for lifestyle modification interventions to reduce Diabetes risk	Components and translation of behavioral lifestyle interventions for effective self-management of diet, activity, and weight	Behavior change techniques and strategies, modes of delivering lifestyle interventions, intervention providers, effective support and follow-up
Verheijden et al. (2005) [31]	Review article	Role of social support in lifestyle-focused weight management interventions	Theoretical and practical framework for social support, the mechanisms by which social support affects weight loss and weight loss maintenance	Social support

Eight key features/components and practical adaptation considerations of BLMIs emerged as themes (or important issues) from the included papers: understanding the target health behavior, use of behavioral/psychological theories, applying behavior change techniques and strategies, providing effective support and follow-up, intervention delivery formats and providers, cultural sensitivity, consideration of feasibility issues, and addressing multiple lifestyle behaviors. The synthesized results are presented below.

Understanding the target health behavior: multiple determinants and levels

The development, change, and maintenance of health-related behaviors are influenced by a range of social, cultural, and economic factors (8). There is no single factor or set of factors that adequately explains why people engage in unhealthy behaviors; rather, a broad understanding of the most important individual, social, economic, cultural, and policy factors can provide a basis for understanding health behaviors and inform the development of interventions (11). Furthermore, lifestyle behaviors, like most health behaviors, are influenced by a complex interplay of factors at multiple levels (individual, social, environmental, and policy), and recognizing all types of influences can inform the development of multi-level interventions with the best chance of success (5).

Behavioral modification interventions should not only target individuals, but also interpersonal, organizational, and environmental factors; and this mindset is crucial in the design of BLMIs. As this process is complex and determined by factors at multiple levels, identifying the most influential factors for a particular person or population can help intervention developers focus on the most relevant issues, and strategies for influencing lifestyle behaviors will need to be informed by evidence on the most important behavioral determinants. In general, to increase the chance of developing successful BLMIs, program designers and researchers should be attentive to the various determinants and levels of influence that could affect individuals' and populations' behaviors in LMICs in a more pressing way, due to their prevalent and higher-risk low-socioeconomic population group. To this end, behavior- and context-specific approaches are needed to comprehend these multiple determinants, which should consider not only the behavior itself but also the surrounding social, environmental, and policy influences on the target behavior.

Use of behavioral (psychological) health theories

Theory is essential to intervention development because it provides a framework for researchers to design, implement, and evaluate the effects of health promotion programs (11, 18). Increasing evidence also suggests that public health and health promotion interventions developed with an explicit theoretical basis are more effective than those developed without a theoretical basis. Additionally, some strategies that combine multiple theories and concepts have larger effects (11, 19). When BLMIs are based on behavioral/psychological health theories, implemented

effectively and skillfully using evidence-based principles, and measured accurately, they are more likely to improve lifestyle behaviors and health (11, 18, 20). Therefore, it is important to use relevant behavior change theories to enhance the efficacy and adherence of BLMIs.

Behavior change interventions are usually designed using theory- or model-based behavior change strategies or by combining previously successful interventions. Self-determination theory, theory of planned behavior, social cognitive theory, trans-theoretical model, and social-ecological model are among the most effective theories/models used in lifestyle behavior change interventions (21). Most behavior change theories and models focus on four types of factors in BLMIs: motivators, inhibitors/facilitators, intentions, and triggers. Motivators are factors that predispose individuals to action, such as perceived need, perceived benefits of the intervention, outcome expectations, rewards or incentives, and cues to action. Inhibitors/facilitators are barriers to (i.e., resources, skills, or support) or enablers for action. Intentions are the proximal cause of behavior change, and triggers are the events that shift a person from being predisposed to action into an action state (22). It is important to understand how constructs of behavior change theories are rigorously measured and analyzed in theory-based BLMIs, including the measurement and analysis of potential behavioral mediators and moderators, as this is the building block of the evidence-base for change in health behavior (23).

The selection of an appropriate theory should begin with identifying the problem, goal, and units of practice (11). When deciding on which theories to use, it is crucial to consider how culture, context, and health problems can and should influence the selection and application of theories and interventions (18, 24). In this regard, considerations on the practicability and generalizability of translating theory into real-world community settings or clinical practice, as well as empirically testing theories in the field, prior to their use in research, are beneficial (8, 11).

Applying behavior change techniques and strategies

Behavior change techniques (BCTs) and strategies that are more commonly applied in BLMIs typically comprise a combination of information and skill rehearsal (educational interventions). The more common BCTs include goal setting, self-monitoring with feedback, motivational interviewing, problem-solving and coping skills training, environmental change (barrier reduction), behavioral contracting, use of incentives/rewards, relapse prevention, and social support (10, 25). These "packages" of BCTs can be linked to key behavioral targets and behavior change, and they have shown positive results on BLMIs outcomes in several clinical trials (10). Some important BCTs and strategies are outlined as follows.

Cognitive restructuring: Emotional factors can have a significant impact on a person's commitment to

behavior change, and participants are taught to recognize and modify their thoughts and beliefs concerning lifestyle behaviors through cognitive restructuring. Cognitive restructuring can be used to replace negative and punitive statements with statements that are encouraging, empowering, and affirming for participants who have a poor self-concept. Effective BCT packages frequently include cognitive approaches to identify and modify maladaptive thoughts and self-perceptions associated with unhealthy lifestyle behaviors. In this case, participants are taught to recognize and change maladaptive thoughts and emotions, such as dichotomous thinking and rationalizations (26).

Self-monitoring: It is often regarded as the most important component of BLMIs, and it is significantly associated with both short- and long-term health outcomes (9). Participants are taught to write down or record everything (e.g., eating habits and frequency, minutes of exercise) and then use the diary to evaluate their current behavior, identify problems, and select specific behaviors to target for change. Interventionists review participants' behavioral records and provide specific guidance and supportive feedback. In addition to providing feedback, self-recording can also help in establishing proper baseline values of behavior, raising awareness of maladjusted behavior patterns, and encouraging initial changes in the desired lifestyle behavior.

However, frequent and thorough self-monitoring may cause behavioral fatigue among individuals, and considerations of the intensity of self-recording and its well-augmented use as a means of reinforcement may be warranted (26). In addition, as adherence to self-monitoring tends to disappear over time, any potential access for the use of new technologies in research, such as smartphones or accelerometers, may be perceptively considered to make the task of self-monitoring easier (27).

Goal setting: It is a relatively simple technique and may be especially important for low socio-economic settings, as it can be successfully taught to a wide range of people with varying educational and social backgrounds (10). Self-help and self-care support are important component of BLMIs as they improve intervention compliance and motivate behavior change. Typically, in BLMIs, participants are given goals and asked to monitor and modify these aspects of their behavior. Although the overall behavioral goals are quite general (e.g., eat 1500 kcal/d, <30% from fat, and exercise 150 minutes per week), more specific daily goals (e.g., taking a daily 30-minute walk) help break the behavior change into small, achievable steps rather than a general goal. Goal setting can also be most effective when the goals are realistic, short-term, flexible, and set by the participant rather than imposed by interventionists (27).

Motivational Interviewing (MI): It is a person-centered approach that focuses on techniques that help participants/patients address their self-motivation to change behavior. The role of interventionists in MI is

not to provide advice or information, as these actions may be perceived as insensitive to the person's personal needs, leading to a breakdown in communication. Rather, the main focus is to have most of the conversation that guides the process to encourage the research participant to internalize the change process and make the decision to change. It is considered a collaborative conversation between the interventionist/practitioner and the participant/patient, to about change and overcoming barriers to change. Every MI intervention should include at least these three MI skills that reflect the *engaging, focusing, and evoking* processes of MI: mastery of a person-centered counseling style, clear identification of one or more change goals toward which the intervention is directed, and differential evocation of participants' motivational statements (change talk) to increase the participants'/patients' readiness to change (28).

Stimulus control: As environmental factors play a role in influencing lifestyle behaviors, most lifestyle interventions teach stimulus control techniques to reduce cues for unhealthy behaviors and strengthen cues for healthy behaviors. The aim of stimulus control techniques is to reorganize the environment to support desired behaviors. Participants are instructed to reduce or eliminate cues that encourage unhealthy behaviors (for example, remove chips, desserts, or other tempting foods from the house) and to make good choices as simple as possible (for example, having low-fat snacks readily available) (26). This kind of behavioral strategy is more common in meal-replacement and partial-meal-replacement programs, which usually replace one or two meals per day with a portion-controlled, vitamin- and mineral-fortified low-energy meal. In addition to the benefit of balanced nutrient content, these meal replacement techniques provide opportunities to educate participants about proper portion sizes, and they reduce the probability of poor food choices by restricting meal options (29).

Relapse prevention: While long-term adoption of lifestyle behaviors is imperative for lowering chronic disease risk, many people find it challenging to maintain healthy habits over time. Participants need to be taught how to identify specific situations that might pose problems for their behavioral adherence, how to use behavioral and cognitive coping strategies, and how to apply problem-solving techniques to overcome barriers and prevent behavioral relapse. As most individuals are faced with competing priorities and other demands in life (including work, family, and community obligations) that make it difficult to adhere to a healthy lifestyle, initiating and maintaining a healthy lifestyle requires a good deal of time, planning, and organization, and intervention providers can play a meaningful role in helping participants prioritize behavioral changes that will be beneficial to supporting long-term adherence (30). This will likely require supporting individuals to reprioritize their current investment of time and resources to support behavioral adherence to meaningful changes.

Social support: Support from a spouse, family, or significant other is an important factor in influencing

participation in lifestyle behavior change interventions. It is also a powerful tool to help people succeed in making and sustaining behavioral changes, and it could be used to improve motivation for individuals at the greatest risk of failing in their attempts at lifestyle change (31, 32). Involving family members is central to lifestyle behavior change (33-35), and efforts to engage family members in BLMIs must be well coordinated to achieve good intervention success. Family involvement and support are important because an individual's lifestyle behaviors are likely to mirror those of the people with whom they live and have close relationships.

Providing effective support and follow-up

When dealing with chronic rather than acute health conditions, long-term support is expected, and an integrated set of interventions as a behavior change support process consists of a step-by-step approach in which interventions occur in a specific sequence while taking individual contexts into account (i.e., tailoring or personalizing the intervention). It is preferable to begin the behavior change support process with issues that prevent the participant from implementing the intervention actions (participant-centered approach). This approach increases participants' confidence in their abilities to change their behavior and achieve the intervention goal/s (22).

Behavioral gains are best maintained when the intervention includes routine, ongoing follow-up support. This is not usually straightforward, and it is important to be aware of common challenges from participants during the implementation stage (30). Establishing an ongoing participant-provider partnership and tracking system has also revealed good intervention success in terms of enhancing intervention sustainability (36).

Intervention delivery formats and providers

Intervention delivery formats

Lifestyle behavior change interventions can be delivered in diverse settings, including clinics, workplaces, community settings, and homes. It also appears that BLMIs can be delivered through a variety of different intervention delivery formats, such as face-to-face (in-person), media outlets (print media, television, and radio), digital/mHealth/telehealth technologies, the Internet, potential new ways of communication (i.e., messaging via social media), or combinations of these options (multicomponent-based) (37). Recent advances in technology have also created new ways for individuals to track their diet, physical activity, and weight. In the planning of BLMIs for specific target groups (youths, adults, etc.), there should be an emphasis on efforts to identify effective delivery alternatives, with ongoing potential opportunities for personal interaction with clinicians, health educators, and counselors. Although conducting an intervention in person is likely to maximize adherence, providing effective BLMIs with minimal human interaction may be possible with the use of other modes to significantly reduce costs and greatly improve the scalability of interventions. Indeed, the transition to a reduced session frequency and other

contact options besides face-to-face is motivated not only by the provider's cost concerns (e.g., time, space, labor, materials, and access) and the advantage of improved scalability but also by competing demands, motivational plateaus, and intervention/treatment fatigue on the part of the participant.

Technology-based remotely delivered interventions (telephone interventions, internet interventions) have high reachability for a large number of people. These interventions represent less-intensive formats, allowing for greater flexibility, long-term delivery of the intervention, and substantially less time and resources for administration (37). However, concerns about access, the literacy status of participants, and weak ICT infrastructure may hamper their widespread application in LMICs. Thus, critical exploitation of the potentially effective usage of these technology-based intervention delivery formats in LMICs is desired in the design of BLMIs. For example, the support of digital technologies (telehealth, mHealth) can enable the routine gathering and exchange of meaningful information, facilitating home monitoring of BLMIs. Furthermore, advances in social media can offer a novel approach to lifestyle and behavioral interventions for sharing intervention experiences and the effective exchange of testimonials between individuals to improve social support and adherence to BLMIs.

Intervention providers

The selection and cost of interventionists raises another important question: who can be trained to deliver effective interventions, what type of training and ongoing supervision are required, and who is available to provide the necessary "master training" to sustain scalable models of behavioral intervention in the population at large [38]. BLMIs are delivered by trained interventionists including health professionals (such as health counselors, registered dietitians, exercise specialists, or psychologists) or, less often, by trained laypersons. Community health workers and lay health educators/health coaches, who are members of the community and role models due to their personal histories of healthy lifestyles, have been trained to administer behavioral interventions to widen the reach of BLMIs into more community settings (38). The sustainability of lay interventionist workforce models and how they can be best integrated into community-based healthcare delivery systems need further exploration in LMICs. In this regard, monitoring the level of training adequacy and quality for providers, as well as field observation for intervention fidelity and dosage, should be briefly described in intervention protocols and result reporting.

Cultural sensitivity/adaptability

Culture influences health behaviors, and the cultural sensitivity of a behavioral intervention should incorporate observable aspects of local culture in the intervention content. When designing BLMIs, the "one-size-fits-all" approach does not work; interventions must address the cultural practices and value systems of the cultural (or subcultural) group; and tailoring the intervention to specific cultural norms and preferences of the target population is considered

beneficial. People are more interested in health messages when they are approached in a culturally sensitive manner. In addition, culturally appropriate advice can be easier to implement straightaway, because participants do not have to modify the advice on their own to account for common lifestyle choices in their community (39-41).

Cultural adaptability/sensitivity is the middle ground between two extreme positions: a universal approach (a “top-down” approach) vs. a culture-specific approach (a “bottom-up” approach). A culture-specific approach (a “bottom-up” approach) emphasizes culturally grounded content consisting of the unique values, beliefs, and customs of a particular culture, while a universal approach (a “top-down” approach) views the original intervention's content as applicable to all cultural groups and does not require any modification. Therefore, cultural sensitivity is not essentially a “top-down” intervention modification, but rather a set of procedures that integrate both “top-down” and “bottom-up” approaches through a series of adaptation stages that include meaningful input from the cultural group members themselves. The fundamental theories and procedures from the initial efficacy trials are used as a basis (“top-down” elements), and the original intervention protocol is modified with input from cultural group members at various stages (“bottom-up” elements) to improve the adapted-version intervention. In this regard, informed judgments from a community advisory panel, which may include members of cultural groups, are required, and quantitative and qualitative methods, such as focus groups, literature searches, or surveys, can be combined to inform modifications and guide culturally sensitive intervention design (39, 42).

Feasibility issues

Feasibility, or practicability, is an important aspect of designing BLMIs or health promotion interventions in general. This includes considerations of how much the designed intervention and the implementation of its components are applicable in “real-world” settings and can be widely scaled up to the target population (43).

Lifestyle behavior change interventions should not go unused or underutilized by their intended audience; therefore, it may be useful to gain a better understanding of the intervention users/target group, potential practitioners, and the health system at large. To this end, conducting implementation feasibility or pilot studies before the full intervention trial (43, 44) and reaching out and consulting potential relevant stakeholders (local health care providers, community agents, local administrators, community organizations, etc.) during the development process (45) can help identify potential refinements and make the intervention pragmatic – rather than theoretical. Moreover, improving the external validity of the research enables greater generalizability of the proposed intervention to “real-world” settings (46).

Addressing multiple lifestyle behaviors

Multiple unhealthy behaviors often co-occur together, and the multiple health behavior change approach is based on the presumption that success in changing one

or more lifestyle behaviors may increase one’s confidence or self-efficacy to improve risk behaviors for which individuals have low motivation to change. As such, healthy behavior may serve as a gateway to a more healthy way of life. Targeting change in multiple risk behaviors has the potential to capitalize on beneficial synergies to increase health impact, maximize health promotion, and increase cost-effectiveness (47, 48). However, there is little understanding of the relative advantages of *simultaneous* versus *sequential* delivery of multiple behavior change interventions (49).

Discussion

This review is intended to provide knowledge as a call to action for researchers in LMICs to address the need for behavioral interventions that target lifestyle behaviors relevant to NCDs prevention and control by outlining the key features/components of BLMIs and some practical considerations. The design of BLMIs needs an understanding and consideration of different aspects, and these are highlighted as the most important issues that researchers and planners should be aware of when developing behavior change interventions and programs.

Addressing the increasing burden of NCDs in LMICs has become a global priority, and more focus is needed on identifying successful and cost-effective preventive interventions that can be contextually adapted to the conditions of these countries (6, 50). The World Health Organization (WHO) recommended “best buy” options that target the four key modifiable behavioral risk factors for NCDs (51). However, there are major challenges in delivering these “best buys” in local LMIC contexts with fidelity (52), which could suggest that interventions need, of course, to be tailored to LMIC settings and should be sensible to the social, economic, and cultural aspects of target communities if the approaches are to be effective (53). In this respect, beyond individual-focused interventions, approaches that address larger social, environmental, and policy issues through multisectoral and multistakeholder actions are more important in bringing about behavioral changes in lifestyles that could essentially promote healthy living and impact the reduction of NCDs (54). Consequently, having an understanding of comprehensive socio-ecological approaches is vital in efforts to address target lifestyle behaviors in LMICs (11).

In most LMICs, the number of public health intervention studies focusing on behavioral risk factors for NCD prevention and control remains limited (55, 56). There is a scarcity of locally appropriate evidence on how to apply health promotion interventions that could potentially be impactful in reducing the current rising burden of NCDs in LMIC contexts, and as a result, many LMICs struggle with NCD policy implementation gaps (57-61). Likewise, sound research evidence is required on each specific issue pinpointed in this review to determine the most effective ways and specific approaches that should be followed to achieve great success in changing lifestyle behaviors in LMIC contexts. Accordingly, novel original research and

systematic reviews that favor the identification of more specific, culturally-oriented, and feasible BLMIs are urged.

Furthermore, while BLMIs are opted for as they are more cost-effective and viable options for controlling chronic NCDs, LMIC health systems are markedly less well-versed in integrating them into other public health priority services (7, 62, 63). This can be reflected in the focus of most LMICs' primary health care (PHC) systems, which were designed and continue to deliver preventive and curative services primarily for communicable diseases, rather than becoming integrative for the rising burden of NCDs (62, 64). To tackle the NCD epidemic and respond to the greatest public and global health needs, LMIC health systems should now take action and leverage BLMI's in preventive and curative health service delivery by recognizing existing PHC and continuum-of-care approaches (65-69).

This review should be examined in light of some limitations. Primarily, this review is not exhaustive but is intended to provide an overview of relevant literature, and this approach may have resulted in the loss of information on some topics. The second limitation is that some detailed methodological aspects (e.g., ways to improve recruitment and retention of study participants, procedures, or methods to ensure intervention fidelity), which are noticeably important when designing behavioral interventions, were not discussed. Despite these limitations, this review provides a resource on the current understanding of BLMIs, and how and from what perspectives this knowledge can be applied to design BLMIs in LMIC settings and beyond.

Conclusion

The alarming rise in incidence and prevalence rates of NCDs in LMICs in recent years demands attention to the need to embark on effective and viable interventions. Thus, targeting BLMIs should be a national health priority for LMICs, which in turn, needs a proper understanding of their essential design components, as well as practical contextual considerations, as an important first step. In this regard, our review identified eight key features and practical considerations of BLMIs: understanding the target behavior, using behavioral theories, applying behavior change techniques and strategies, providing effective support and follow-up, intervention delivery formats and providers, cultural sensitivity, feasibility considerations, and addressing multiple lifestyle behaviors.

It is noticeable that the health systems of LMICs should be accommodative to such potentially impactful interventions and initiatives by applying innovative and comprehensive approaches to current NCD prevention and treatment practices. Furthermore, the development of BLMIs requires an interdisciplinary approach, and integrating experts from a different mix of health and social sciences (e.g., psychology) disciplines in this field is worthwhile. The limitations of this review also justify the need for original research and systematic

reviews on each specific feature or theme of BLMIs to identify successful and feasible interventions that could work best in LMIC contexts.

Abbreviations

BLMIs: Behavioural and lifestyle modification interventions

BCTs: Behaviour change techniques

LMICs: Low- and middle-income countries

NCDs: Non-communicable diseases

Declarations

Ethical approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

This is a literature review; data is contained within the article.

Conflict of Interests

The authors declare no conflict of interest.

Acknowledgments

The authors would like to thank the Addis Ababa University Thematic Research Fund for its financial support. This article is available as a preprint in Research Square.

Contribution of authors

Conceptualization: AN, AW, and EG; Planned search strategy and data extraction: AN; Data synthesis, analysis, and interpretation: AN, AA, AW, and EG; Writing – original draft preparation: AN; Writing – review, editing, and providing critical insights: AA, AW, and EG. All authors have read and agreed to the published version of the manuscript.

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