

Guiding the design of behavioural 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, behavioural and lifestyle modification interventions (BLMIs) offer the most effective means of addressing the underlying lifestyle behaviours 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 BCIs, as well as practical considerations when implementing in LMIC settings.

Methods

An exploratory approach was used to provide an overview of salient issues in the design of BLMIs. A narrative review of relevant scientific literature was conducted. Based on the review's aim, the most important themes or issues were extracted.

Results

Thirty-four publications were included as the most relevant literature to the topic, and eight overarching themes were identified: understanding the target health behaviour; use of behavioural health theories; applying behaviour change techniques/strategies; providing effective support and follow-up; intervention delivery formats and providers; the need for cultural sensitivity; feasibility issues; and addressing multiple lifestyle behaviours.

Conclusion

Targeting lifestyle and behavioural modification interventions with a proper understanding of their essential design components and practical implementation considerations is crucial in reducing the rising burden of NCDs in LMICs. The importance of conducting original researches and systematic reviews on the subject was also emphasized.

Background

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 behaviours, such as excess body weight/obesity, low levels of physical activity, poor nutrition, and substance use [4, 5]. To tackle these behavioural-related 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 behaviours associated with these diseases, and it is of great importance to examine ways of translating evidence of intensive research trials for low socio-economic populations and settings [6, 7].

Behaviour change can be difficult and complex, but if it is approached in a scientific and systematic way, people can change their behaviours and improve their health [8]. Behavioural and lifestyle modification interventions (BLMIs) involve a lifelong process of incrementally building more health-promoting practices into daily routines, thereby shifting the overall behavioural balance in favor of habits that reduce NCD risk. Behaviour change techniques (BCTs) have become the foundation of BLMIs and there are multiple BCTs and strategies commonly employed for changing unhealthy behaviours, including establishing behavioural 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 behaviours 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 for promoting healthy behaviours should be at the forefront across all prevention strategies (i.e., primordial, primary, and secondary), as they offer ultimate options to successfully address the underlying lifestyle behaviours associated with NCDs. Yet, many LMICs face challenges in 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 predominant segment of the general population – low socio-economic groups. This review aims (1) to explore current understandings of BLMIs and (2) provides some important key features and considerations for their optimal designing in LMIC contexts.

Methods

This literature review covers a breadth of diverse aspects that can be applicable across multiple BLMIs for NCDs prevention, so performing a systematic review was not appropriate to fully address the research objective. Therefore, an exploratory approach was taken to provide an overview of pertinent issues in designing of BLMIs. Accordingly, when reviewing the literature, greater emphasis was placed on relevant works that conceptually converge to the purpose of this review, which is to understand basic salient features and potential practical considerations when designing BLMIs.

To ensure that no relevant literature was missed, a computer-assisted narrative review of a wide range of scientific literature was conducted using the PubMed database, Google, and Google Scholar World Wide Web search engines. These searches were carried out using various combinations of the following keywords or MeSH terms: health behaviour; lifestyle behaviour; behavioural modification; behavioural intervention; behaviour change intervention; health promotion intervention; non-communicable disease; and chronic disease. The reference lists of the retrieved publications, as well as other relevant review articles, were also examined. The review was restricted to papers written in English between January 2000 and December 2020.

Publications identified through keyword searches were retrieved and critically appraised for relevance by screening the titles (first step), abstracts (second step), and the entire paper (third step). Key issues or themes were extracted using an Excel template, and the extracted data were synthesized into groups based on the key features and practical considerations identified as important in the selected papers. The selection and data extraction of the relevant literature was performed by the corresponding author of this paper between February and June 2021, and consistency was checked by the other two authors.

Results

A total of thirty-four publications were ultimately selected as relevant to the purpose of this review, including four books, eight original research articles, twenty-one reviews, and one editorial. The detailed summary of the selected relevant literature is presented in Table 1. Eight key features/components and practical adaptation considerations of BLMIs were extracted and synthesized as themes (or important issues): understanding the target health behaviour, use of behavioural theories, applying behaviour change techniques and strategies, providing effective support and follow-up, intervention delivery formats and providers, the need for cultural sensitivity, consideration of feasibility issues, and addressing multiple lifestyle behaviours. The synthesized results are presented below.

Table 1
List of relevant publications included in the review

Author (publication year)	Publication type	Title	Reference
Artinian et al. (2010)	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	[37]
Barrera et al. (2013)	Review article	Cultural adaptations of behavioral health interventions: a progress report	[39]
Bartholomew et al. (2016)	Book	Planning health promotion programs: An intervention mapping approach	[19]
Besculides et al. (2008)	Original research	Best practices in implementing lifestyle interventions in the WISEWOMAN program: adaptable strategies for public health programs	[36]
Burke et al. (2012)	Original research	Using mHealth technology to enhance self-monitoring for weight loss: a randomized trial	[26]
Castro et al. (2010)	Review article	Issues and challenges in the design of culturally adapted evidence-based interventions	[40]
Coupe et al. (2018)	Original research	Tailoring lifestyle interventions to low socio-economic populations: a qualitative study	[42]
Geller et al. (2017)	Review article	Future directions of multiple behavior change research	[49]
Author (publication year)	Publication type	Title	Reference
Glanz (eds) (2008)	Book	Health behavior and health education: Theory, research, and practice	[8]
Glanz and Bishop (2010)	Review article	The role of behavioral science theory in development and implementation of public health interventions	[11]
Glasgow (2008)	Editorial	What types of evidence are most needed to advance Behavioral Medicine?	[46]
Green and Kreuter (2005)	Book	Health promotion planning: An educational and ecological approach	[17]
Hagobian and Phelan (2013)	Review article	Lifestyle interventions to reduce Obesity and Diabetes	[29]
Johnston and Moreno (2014)	Review article	Promotion of long-term adherence to a healthy lifestyle	[30]

Author (publication year)	Publication type	Title	Reference
Kang et al. (2010)	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	[34]
Linke et al. (2014)	Review article	Applying psychological theories to promote healthy lifestyles	[20]
Mayberry and Osborn (2012)	Original research	Family support, medication adherence and glycemic control among adults with type 2 diabetes	[35]
Michie and Abraham (2009)	Review article	Effective techniques in healthy eating and physical activity interventions: A meta-regression	[9]
Michie et al. (2009)	Review article	Low income groups and behaviour change interventions: a review of intervention content, effectiveness and theoretical frameworks	[10]
Author (publication year)	Publication type	Title	Reference
Michie et al. (2013)	Original research	The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions	[24]
Miller and Dimatteo (2013)	Review article	Importance of family/social support and impact on adherence to diabetic therapy	[32]
Miller and Rollnick (2013)	Book	Motivational interviewing: helping people change	[27]
Miller and Rose (2009)	Review article	Toward a theory of Motivational Interviewing	[28]
Noar et al. (2007)	Review article	Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions	[41]
Noar et al. (2008)	Review article	Applying health behavior theory to multiple behavior change: considerations and approaches	[23]
Painter et al. (2008)	Review article	The use of theory in health behavior research from 2000 to 2005: a systematic review	[22]
Peyrot and Rubin (2007)	Review article	Behavioral and psychosocial interventions in Diabetes	[21]
Prestwich et al. (2014)	Original research	Does theory influence the effectiveness of health behavior interventions? Meta-analysis	[18]

Author (publication year)	Publication type	Title	Reference
Prochaska JJ and Prochaska JO (2011)	Review article	A review of multiple health behavior change interventions for primary prevention	[47]
Prochaska et al. (2008)	Review article	Multiple health behavior change research: An introduction and overview	[48]
Author (publication year)	Publication type	Title	Reference
Rosland et al. (2008)	Original research	When is social support important? The association of family support and professional support with specific diabetes self-management behaviors	[33]
Van Dorsten and Lindley (2011)	Review article	Cognitive and behavioral approaches in the treatment of Obesity	[25]
Venditti and Kramer (2012)	Review article	Necessary components for lifestyle modification interventions to reduce Diabetes risk	[38]
Verheijden et al. (2005)	Review article	Role of social support in lifestyle-focused weight management interventions	[31]

Understanding the target health behaviour: Multiple determinants and Multiple levels

The development, change, and maintenance of health-related behaviours 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 behaviours; rather, a broad understanding of the most important individual, social, economic, cultural, and policy factors can provide a basis for understanding health behaviours and inform the development of interventions [11]. Furthermore, lifestyle behaviours, like most health behaviours, are influenced by a complex interplay of factors at multiple levels (individual, social, environmental, and policy), and recognizing all types of influence can inform the development of multilevel interventions with the best chance of success [5].

Behavioural 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 and enable intervention developers to focus on the most relevant issues, and strategies for influencing lifestyle behaviours will need to be informed by evidence on

the most important behavioural determinants. In general, in order 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' behaviours in LMICs in a more pressing way, due to their prevalent and higher risk low-socioeconomic population group. To this end, behaviour- and context-specific approaches are needed to comprehend these multiple determinants, which should consider not only the behaviour itself, but also the surrounding social, environmental, and policy influences on the target behaviour.

Use of behavioural (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, 17]. Increasing evidence also suggests that public health and health-promotion interventions developed with an explicit theoretical basis(s) are more effective than those developed without a theoretical basis; additionally, some strategies that combine multiple theories and concepts have larger effects [11, 18]. When BLMIs are based on behavioural/psychological health theory, implemented effectively and skillfully using evidence-based principles, and measured accurately, they are more likely to improve lifestyle behaviours and health [11, 17, 19]. Therefore, it is important to use relevant behaviour change theories in order to enhance the efficacy and adherence of BLMIs.

Behaviour change interventions are usually designed using theory/model-based behaviour change strategies or by combining previously successful interventions. Self-determination theory, theory of planned behaviour, social cognitive theory, trans-theoretical model, and social-ecological model are among the most effective theories/models used in lifestyle behaviour change interventions [20]. Most behaviour 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/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 behaviour change; and triggers are the events that shift a person from being predisposed to action into an action state [21]. It is important to understand how constructs of behaviour change theories are rigorously measured and analyzed in theory-based BLMIs, including the measurement and analysis of potential behavioural mediators and moderators, as this is the building block of the evidence-base for change in health behaviour [22].

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 [17, 23]. 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 behaviour change techniques and strategies

Behaviour 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), behavioural contracting, use of incentives/rewards, relapse prevention, and social support [10, 24]. These “packages” of BCTs can be linked to key behavioural targets and behaviour change, and they have shown positive results on BLMIs outcomes in several clinical trials [10]. Some common BCTs and strategies are outlined as follows.

Cognitive restructuring

Emotional factors can have a significant impact on a person's commitment to behaviour change; and participants are taught to recognize and modify their thoughts and beliefs concerning lifestyle behaviours 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 or self-perceptions associated with unhealthy lifestyle behaviours. In this case, participants are taught to recognize and change maladaptive thoughts and emotions, such as dichotomous thinking and rationalizations [25].

Self-monitoring

Self-monitoring is often regarded as the most important component of lifestyle BLMIs, and it has been found to be significantly associated to 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 behaviour, identify problems, and select specific behaviours to target for change. Interventionists review participants' behavioural records and provide specific guidance and supportive feedback. In addition to providing feedback, self-recording can also help in establishing proper baseline values of behaviour, raising awareness of maladjusted behaviour patterns, and encouraging initial changes in the desired lifestyle behaviour.

However, frequent and thorough self-monitoring may cause behavioural fatigue among individuals, and considerations of the intensity of self-recording and its well-augmented use as a means of reinforcement may be warranted [25]. 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 [26].

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/self-care support is an important component of BLMIs as it improves intervention compliance and motivates behaviour change. And typically, in BLMIs, participants are given goals and asked to monitor and modify these aspects of their behaviour. Although the overall behavioural 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., take a daily 30-minute walk) help break the behaviour 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 [26].

Motivational Interviewing (MI)

It is a person-centered approach that focuses on techniques that help participants/patients address their self-motivation to change behaviour. 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 in order to encourage the research participant to internalize the change process and make the decision to change. It is considered as a collaborative conversation between the interventionist/practitioner and the participant/patient, with the goal of bringing 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' own motivational statements (change talk) to increase the participants'/patients' readiness to change [27, 28].

Stimulus control

As environmental factors play a role in influencing lifestyle behaviours, most lifestyle interventions teach stimulus control techniques to reduce cues for unhealthy behaviours and strengthen cues for healthy behaviour. The aim of stimulus control techniques is to reorganize the environment to support desired behaviours. Participants are instructed to reduce or eliminate cues that encourage unhealthy behaviours (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) [25]. This kind of behavioural 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 behaviours is imperative for lowering chronic disease risk, many people find it challenging to maintain health habits over time. Participants need taught to identify specific situations that might pose problems for their behavioural adherence, how to use behavioural and cognitive coping strategies, and how to apply problem-solving techniques to overcome barriers and prevent a behavioural 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 good deal of time, planning, and

organization, and intervention providers can play a meaningful role in helping participants to prioritize behavioural 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 in order to support behavioural adherence to meaningful changes.

Social support

Support from a spouse, family, or significant other is an important factor in influencing participation in lifestyle behaviour change interventions. It is also a powerful tool to help people succeed in making and sustaining behavioural changes, and it could be used to improve motivation for individuals at greatest risk of failing in their attempts at lifestyle change [31, 32]. Involving family members has been found to be central for lifestyle behaviour change [33-35], and efforts to engage family members in BLMIs must be well coordinated in order to achieve good intervention success. Family involvement and support are important because an individual's lifestyle behaviours 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 behaviour 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 of the intervention). It is preferable to begin the behaviour change support process with the issues that trouble the participant from implementing the intervention actions (participant-centered approach). This approach increases participants' confidence in their own abilities to change their behaviour and achieve the intervention goal/s [21].

Behavioural gains are best maintained when the intervention includes ongoing routine and continuing follow-up support. And 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 strong partnership and tracking systems have also revealed a good intervention success in terms of enhancing intervention sustainability [36].

Intervention delivery formats and providers

Intervention delivery formats

Lifestyle behaviour 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 medias), 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 interactions with clinicians, health educators, and counselors. Although conducting the 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, 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 to 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, literacy status of participants, and weak ICT infrastructure may hamper their widespread application in LMICs. Thus, critical exploitation of the potential 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 behavioural interventions for sharing of intervention experiences and 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 is required, and who is available to provide the necessary "master training" to sustain scalable models of behavioural 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 behavioural interventions in an effort 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 health care 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.

The need for cultural sensitivity/adaptability

Culture influences health behaviours, and the cultural sensitivity of a behavioural intervention should incorporate observable aspects of a 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 to 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 an 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 cultural group members themselves. The fundamental theories and procedures from 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 in designing BLMIs or health promotion interventions in general. This includes considerations that how much the designed intervention and implementation of its components are applicable in "real-world" settings and can be widely scaled up to the target population [43].

Lifestyle behaviour 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 prior to the full intervention trial [43, 44] and reaching out and consulting potential relevant stakeholders (local health care providers, community agents, local administrate, community organizations, etc.) during the development process [45] can benefit in identifying potential refinements and make the intervention pragmatic rather than theoretical. Moreover, improving the external validity of the research enables for greater generalizability of the proposed intervention to "real-world" settings [46].

Addressing multiple lifestyle behaviours

Multiple unhealthy behaviours often co-occur together, and the multiple health behaviour change approach is based on the presumption that success in changing one or more lifestyle behaviours may increase one's confidence or self-efficacy to improve risk behaviours for which individuals have low

motivation to change. As such, health behaviour change may serve as a gateway to a more healthful way of life. Targeting change in multiple risk behaviours 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 behaviour change interventions [49].

Discussion

This review intended to provide knowledge as a call to action for researchers from LMICs to address the need for behavioural interventions that target lifestyle behaviours relevant for NCDs prevention and control by outlining key features/components of BLMIs and some practical considerations. The design of BLMIs needs an understanding of and consideration for different aspects, and these are highlighted as most important issues that researchers and planners should be aware of when developing behaviour change programs and interventions. Due to the wide range and high volume of studies on the topic, more emphasis was focused on only the most relevant literature.

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 buys” options which target the four key modifiable behavioural risk factors for NCDs [51]. However, there are major challenges in delivering of these “best buys” in the local LMIC contexts with fidelity [52], which could suggest that interventions need, of course, 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]. With 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 behavioural changes in lifestyles that could essentially promote healthy living and impact the reduction of NCDs [54]. Consequently, having an understanding for comprehensive socio-ecological approaches is vital in efforts to address target lifestyle behaviours 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 evidences are required on each specific issues pinpointed in this review in order to determine the most effective ways of the specific approaches that should be followed to achieve great success in changing lifestyle behaviours in LMIC contexts. Accordingly, novel original researches and systematic reviews that favor the identification of more specific, culturally-oriented, and feasible BLMIs are urged.

Furthermore, while BLMIs are opted 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 BLMIs in preventive and curative health service delivery through recognizing existing PHC and continuum-of-care approaches [65-69].

Limitations of this review

This review is not exhaustive but is intended to provide a summary of relevant literature; and this approach may have resulted in the loss of information in some topics. A 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 behavioural interventions, weren't discussed. Despite these limitations, this review provides a resource on the current understanding about BLMIs, and how and with 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 recent years in LMICs demands attention for the need to embark on effective and viable interventions. In this regard, 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 adaptation considerations, as an important first step.

It is noticeable that health systems of LMICs should be accommodative for such potentially impactful interventions and initiatives through applying innovative and comprehensive approaches in current NCDs prevention and treatment practices. Furthermore, the development of BLMIs requires an inter-disciplinary approach and integrating experts from different mix of health and social science (e.g. psychology) disciplines in this field is worthwhile. The limitations of this review also justifies the need for original researches and systematic reviews on each specific feature or theme of BLMIs to identify successful and feasible interventions which could work best to LMIC contexts.

Abbreviations

BLMIs

Behavioural and lifestyle modification interventions

BCTs

Behaviour change techniques

LMICs

Low- and middle-income countries

NCDs

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