



## MHEALTH APPLICATIONS AND LIFESTYLE BEHAVIORS CHANGES; A NARRATIVE REVIEW

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Article History: Received: 09.06.2023

Revised: 12.07.2023

Accepted: 15.07.2023

### Abstract

**Background:** Lifestyle modification is the act of changing someone's habit for an extended time to maintain good health. An overwhelming body of scientific and medical literature supports the concept that daily habits and actions exert an enormous impact on short-term and long-term health and quality of life.

**Aim:** In this review we aimed to identify behavior change techniques (BCTs) commonly used in mHealth, assess their effectiveness based on the evidence reported in interventions and reviews to highlight the most appropriate techniques to design an optimal strategy to improve adherence to data reporting, and provide recommendations for future interventions and research,

**Methods:** We made study of MEDLINE by PubMed & Web of Science [Science Citation Index Expanded], Social Sciences Citation Index, & Emerging Sources Citation Index] of all scientific literature published from May2020until April 2023,

**Summary:** The potential of mHealth applications to improve access to healthcare resources and real-time monitoring is already recognized. Medical health practice supported by mobile devices continues to scale up, and current literature suggests that higher levels of engagement of both patients and healthcare providers are often associated with better health outcomes. Also, these tools could help healthcare professionals motivate patients in remote settings to adopt healthier lifestyles, manage chronic diseases and reduce complications.

**Keywords:** behavior change techniques; mHealth apps; lifestyle; mobile app; mobile health; mobile phone

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### INTRODUCTION

Metabolic diseases are a global rising health burden, mainly due to the deleterious interaction of current lifestyles with the underlying biology of these diseases. Daily habits and behaviors, such as diet, sleep, and physical exercise impact the whole-body circadian system through the synchronization of the peripheral body clocks that contribute to metabolic homeostasis. The disruption of this system may promote the development of metabolic diseases, including obesity and diabetes, emphasizing the importance of assessing and monitoring variables that affect circadian rhythms (1).

Advances in technology are generating innovative resources and tools for health care management and patient monitoring, particularly important for chronic conditions. The use of mobile health technologies, known as mHealth, is increasing and these approaches are contributing to aiding both patients and healthcare professionals in disease management and education (2).

The mHealth solutions allow continuous monitoring of patients, sharing relevant information and data with physicians and other healthcare professionals and accessing education resources to support informed decisions. Thus, if

properly used, these tools empower patients and help them to adopt healthier lifestyles (3).

Several mHealth apps have been developed to assist patients in managing chronic diseases, such as metabolic diseases. Through education, diet, activity tracking, and personalized health advice, these apps have the potential to guide behavior change. Dietary changes combined with healthy lifestyle adjustments should be the first approach since they have been identified as one of the most effective interventions for preventing, managing, and reversing chronic conditions. mHealth apps designed to support these actions may have a central role in health promotion and care (4).

In modern society, the rushed lifestyle and excessive adulteration in food products have caused health-related disorders, making them an inevitable part of modern life. This is associated with the development of non-communicable diseases, which are related to 16 million premature deaths per year worldwide. The treatment of these lifestyle-related disorders demands long-term clinical help and can last a lifetime (5).

Besides, smartphones have become an essential tool in our daily lives, impacting 7.2 billion users worldwide with more than 70% of them in low- and middle-income countries. Smartphone sensor

technology has significantly improved and become more stable for collecting real-time data, which can be saved and processed for multiple analyses, making it possible to monitor our health through mobile health (mHealth) apps <sup>(6)</sup>.

Recently, the popularization of mHealth apps for public health or medical care purposes has transformed human life substantially. Strategies such as reminders, counselling, reinforcement, or education have been used to improve people's adherence to the app, thus improving lifestyle behaviors and chronic condition management (CCM). These strategies are known as behavior change techniques (BCTs). There is a need to improve the adherence to one's well-being, regular health monitoring, and expert involvement <sup>(7)</sup>.

The World Health Organization (WHO) estimated that in high-income countries the average adherence rate is 50% in patients with chronic medical illness, with even lower rates in low-income countries. It considers the extent to which a person's behavior—taking medication, following a diet, or making lifestyle changes—corresponds to recommendations agreed upon with a health professional directly or through a mobile app <sup>(8)</sup>.

Non-adherence leads to considerable morbidity, mortality, and avoidable health care costs, and it

#### **Mobile health (mHealth)**

Mobile health (mHealth) is the use of mobile technology (eg, smartphones) to improve health practices. mHealth interventions have incredible potential to implement large-scale health interventions at low cost, and their efficacy to promote health behaviors such as physical activity and diet has been established <sup>(11)</sup>.

#### **•Mobile health apps (MHAs) and medical apps (MAs)**

With regard to the properties of smartphone applications, it is important to make a distinction between the terms Mobile health apps (MHAs) and medical apps (MAs). MHAs, often referred to as health apps, are smartphone apps that are dedicated to consumers and are supposed to support a health-promoting lifestyle as a preventive measure. In contrast, MAs, also called smartphone apps, are subject to a medical purpose limitation and therefore have to be classified under the legal regulations for medical devices <sup>(12)</sup>.

MHAs and MAs are becoming increasingly popular as digital interventions in a wide range of health-related applications in almost all sectors of healthcare. In the context of the application of digital ICT in general and MHAs and MAs in particular, there are numerous terms used to define this field more specifically <sup>(13)</sup>.

According to recent estimates, there are currently approximately 325000 smartphone apps available on health-related topics. In addition, there are certainly smartphone apps that are not specifically

may be caused by people's intentional or unintentional behaviors. Intentional non-adherence refers to deciding not to report data based on the person's perceptions such as incomplete disease-related knowledge. In contrast, unintentional non-adherence means that the person intends to report data but fails because of forgetfulness or carelessness <sup>(9)</sup>.

Awareness and proper screening of these intentional and unintentional determinants for the target population are necessary to design and develop tailored solutions to ensure a methodology that improves adherence to data reporting. mHealth has the potential to improve lifestyle and CCM, and can be rapidly adopted on a large scale and at low cost, but inconsistent findings have been reported on its effectiveness <sup>(10)</sup>.

In this review we aimed to identify behavior change techniques (BCTs) commonly used in mHealth, assess their effectiveness based on the evidence reported in interventions and reviews to highlight the most appropriate techniques to design an optimal strategy to improve adherence to data reporting, and provide recommendations for future interventions and research.

available via an online platform and are not available for public download <sup>(14)</sup>.

The areas of application and functionalization of MHAs and MAs are extremely diverse and range from the management of chronic diseases, the support of health behaviors and even self-diagnostics. MHAs and MAs can also provide infrastructure or support clinicians with clinical decision-making <sup>(15)</sup>.

#### **Health Behavior Change**

Health behavior is those personal attributes such as beliefs, expectations, motives, values, perceptions, and other cognitive elements; personality characteristics, including affective and emotional states and traits; and overt behavior patterns, actions, and habits that relate to health maintenance, to health restoration, and to health improvement <sup>(16)</sup>.

Behavior is so closely related to health that it promotes the development of health education that takes cultivating and changing people's health behavior as its core. Many achievements have been made in the research of health behavior change during this period, which can be used not only to explain the change and maintenance of health behavior, but also to guide the implementation of health education and health behavior intervention projects <sup>(17)</sup>.

#### **Theoretical Frame work for Behavior change**

**Healthy lifestyles:** It includes: **Creating a Culture that Fosters Health with:** Interdependence between lifestyle and social environment and

collective and individual lifestyles<sup>(18)</sup>. **Fostering a Collective Orientation to Health;** My health impacts the lifestyles of others, My actions influence the lifestyles of other people, I influence the conditions in my community that contribute to healthy lifestyles and we (acting together) influence the health of others<sup>(19)</sup>.

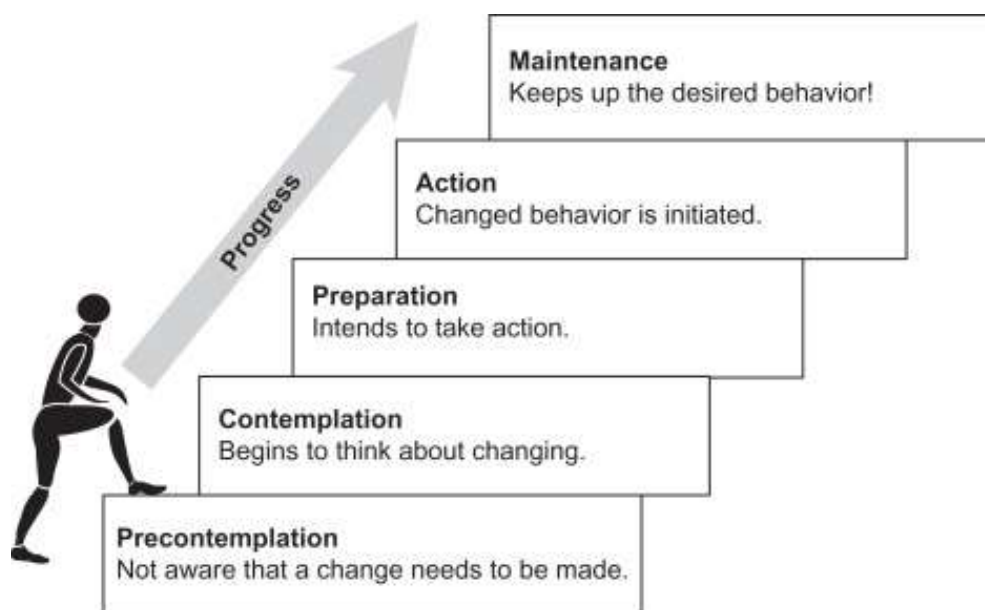
**Behavior change principles:** It includes the following Principles: Maximizing individual relevance through assessments, feedback and tailoring, tailoring to stage-of-change, individual diet habits, exercise preferences, goal setting, small-steps toward new habits, continued feedback and reinforcement, Increasing salience and motivation through health information, tips and reminders and encouraging social support<sup>(20)</sup>.

#### Behavior change tools

This include: **Commitment:** People who have initially agreed to a small request are subsequently more likely to agree to a larger request, **Prompts:** People have to remember to perform the desired actions, **Norms:** Social guidelines for behavior and **Incentives:** Particularly useful when motivation to engage in action is low<sup>(21)</sup>.

**Example of behavior change tools:** Health Behavior Change Model, Health Belief Model, Social marketing and Social Cognitive (Learning) Theory<sup>(22)</sup>.

**Health Behavior Change Model:** The Stages of Change Model, also called the Transtheoretical Model, explains an individual's readiness to change their behavior. It describes the process of behavior change as occurring in stages.



**Fig (1):** stages of change model<sup>(23)</sup>

The Stages of Change Model describes how an individual or organization integrates new behaviors, goals, and programs at various levels. At each stage, different intervention strategies will help individuals progress to the next stage and through the model. Individuals within a population will likely vary in their readiness to change. In addition, it is important to recognize that movement through this model is cyclical – individuals may progress to the next stage or regress to a previous stage<sup>(24)</sup>.

The Stages of Change model can be applied to health promotion and disease prevention programs to address a range of health behaviors, populations, and settings. It may be an appropriate model for health promotion and disease prevention programs related to worksite wellness, tobacco use, weight management, medication compliance, addiction, and physical activity, among other health topics<sup>(25)</sup>.

#### Health Belief Model

The Health Belief Model (HBM) is a theoretical model that can be used to guide health promotion and disease prevention programs. It is used to explain and predict individual changes in health behaviors. It is one of the most widely used models for understanding health behaviors<sup>(26)</sup>.

Key elements of the Health Belief Model focus on individual beliefs about health conditions, which predict individual health-related behaviors. The model defines the key factors that influence health behaviors as an individual's perceived threat to sickness or disease (perceived susceptibility), belief of consequence (perceived severity), potential positive benefits of action (perceived benefits), perceived barriers to action, exposure to factors that prompt action (cues to action), and confidence in ability to succeed (self-efficacy)<sup>(27)</sup>.

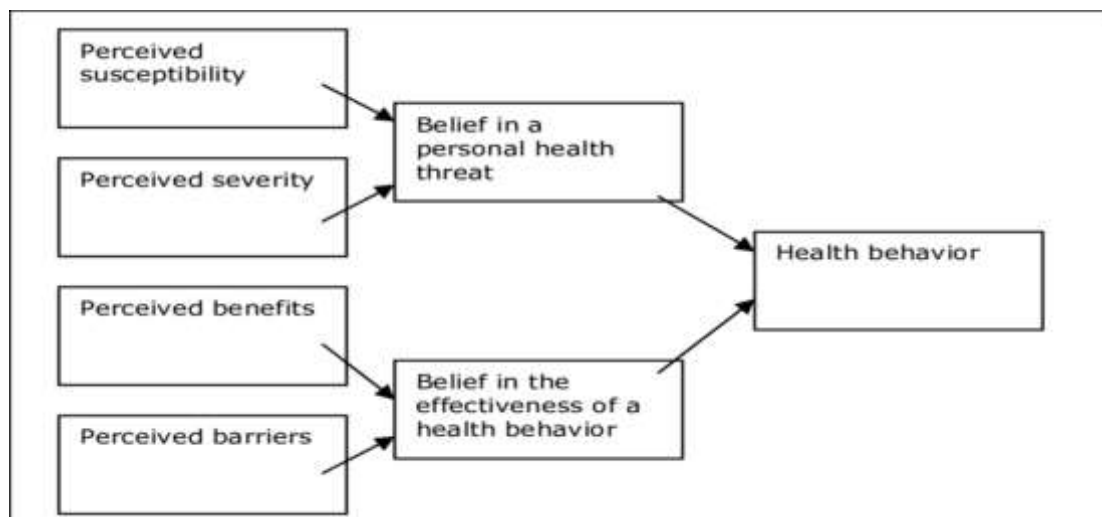


Fig (2): Schematic representation of the health belief model <sup>(28)</sup>

### Adoption of mHealth in lifestyle

mHealth applications and wearable devices have the potential to help individuals adopt a healthy lifestyle such as adopting a healthy diet and exercise routines. mHealth technologies/applications would effectively contribute to reducing the risk of being diagnosed with chronic diseases such as stroke, cancer, and diabetes. Furthermore, the use of mHealth applications could be one of the core strategies to introduce self-health care monitoring to induce healthy lifestyles. In this instance, the use of self-health care monitoring applications can help people improve their behaviour and attitude towards what they eat and exercise routines <sup>(29)</sup>.

**Dute et al.**, <sup>(30)</sup> conducted a study with European adolescents and students to examine the use of mobile applications to promote a healthy lifestyle. They reported that these applications can enable users to set goals, monitor their behaviour, and increase awareness on how to live a healthy lifestyle without incurring more expenses.

**Watterson et al.**, <sup>(31)</sup> conducted a study to assess how mobile applications could be used to improve adolescent confidence in living a healthy lifestyle (eating healthy and exercising daily). The authors found that adolescents would engage more with applications that are interactive to improve their healthy lifestyles. The results also suggest that factors such as family and friend's support increase the prospects of the adolescents' meeting the minimum daily requirements of healthy eating and physical activity.

### Challenges to the adoption of mHealth to induce healthy lifestyles

There are several challenges that can impede the adoption of mHealth to induce healthy lifestyles among university students. One challenge is limited access to technology. Despite the widespread use of mobile devices among university students, some

students may not have access to the necessary technology to participate in mHealth interventions. This can be particularly true for students from low-income backgrounds or for students in remote areas <sup>(32)</sup>.

Another challenge is a lack of engagement with mHealth interventions. Even when students have access to technology and are provided with mHealth interventions, they may not be motivated to use them. This can be due to a lack of perceived usefulness or a lack of understanding of how to use the interventions effectively <sup>(33)</sup>.

Privacy and security concerns can also be a challenge to the adoption of mHealth interventions. Students may be hesitant to share personal information or health data with mHealth interventions, especially if they do not trust the security of the intervention or the organization providing it. This can make it difficult to encourage students to use mHealth interventions, and may also prevent students from fully participating in interventions that require personal information <sup>(34)</sup>.

Another challenge is the lack of compatibility with the students' lifestyle; students may find it difficult to fit the mHealth interventions in their daily routine and schedule. Additionally, students may have limited time and attention to devote to mHealth interventions, making it difficult to sustain engagement over time <sup>(35)</sup>.

Despite the vast evidence in the literature highlighting the benefits of mHealth, poor public adoption remains a challenge among university students. Various patterns of mHealth usage have been found among different demographics. Socioeconomic factors were found to be one barrier to the adoption <sup>(36)</sup>.

**Jeon and Park**, <sup>(37)</sup> investigated factors that affect the acceptance of smartphone applications that seek to induce healthy lifestyles. Using the theory acceptance model (TAM), the results depicted that

technical support and training have a significant impact on the perceived ease of use of the applications. The findings implied that having the

### Conclusion

Lifestyle interventions to treat and prevent chronic metabolic diseases need to consider the daily circadian rhythms since aligning those behaviors with the individual biological rhythm potentiates the health benefits. The use of mHealth is increasing and these solutions represent an interesting opportunity to monitor and measure health variables and lifestyle habits in normal living conditions, helping patients and healthcare professionals in disease management. In the future, it is expected that this platform becomes a clinically validated therapeutic tool used to integrate individual biological rhythms in the treatment and prevention of metabolic diseases supporting interventions directed to lifestyle changes.

The potential of mHealth applications to improve access to healthcare resources and real-time monitoring is already recognized. Medical health practice supported by mobile devices continues to scale up, and current literature suggests that higher levels of engagement of both patients and healthcare providers are often associated with

necessary infrastructure and support would encourage more adults to adopt mHealth interventions.

better health outcomes. Also, these tools could help healthcare professionals motivate patients in remote settings to adopt healthier lifestyles, manage chronic diseases and reduce complications. However, these solutions may also present some issues, particularly concerning data privacy and the protection of sensitive information shared by patients. Another challenge faced is the digital gap experienced by some patients and the intellectual capabilities of users which could lead to high attrition rates.

In the future, evidence-based mHealth solutions may be integrated into traditional clinical treatment approaches to improve health results and access to primary care prevention. This could be particularly important in the context of chronic diseases, such as metabolic diseases since they frequently need to be managed from their onset with few options for a full recovery and these solutions could help patients achieve better results. Patients can benefit from mHealth solutions that allow them to self-monitor, stay in control, and be better informed about their health by recording and analyzing information.

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