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Review

Breaking Barriers: Mobile Health Interventions for Cardiovascular Disease

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ABSTRACT

Cardiovascular disease (CVD) is a leading global cause of death and morbidity and prevention needs to be strengthened to tackle this. Mobile health (mHealth) might present a novel and effective solution in CVD prevention, and interest in mHealth has grown dramatically since the advent of the smartphone. In this review, we discuss mHealth interventions that target multiple cardiovascular risk factors simultaneously in the context of primary as well as secondary prevention. There is some evidence that mHealth interventions improve a range of individual CVD risk factors, but a relative paucity of evidence on mHealth interventions improving multiple CVD risk factors simultaneously. The existing data suggest mHealth programs improve overall CVD risk, at least in the short term. Interpretation of the evidence is difficult in the context of poor methodology and mHealth modalities often being a part of large complex interventions. In this review we identify a number of unanswered questions including: which mode of mHealth (or combination of interventions) would be most effective, what is the durability of intervention effects, and what degree of personalization and interactivity is required.

RÉSUMÉ

La maladie cardiovasculaire (MCV) est une des principales causes de mortalité et de morbidité dans le monde et il est urgent de mettre l'accent sur sa prévention pour s'attaquer à ce problème. Les applications mobiles en santé pourraient constituer une solution innovante et efficace pour la prévention de la MCV, et l'intérêt pour ce type de technologie a connu un essor fulgurant depuis les premiers téléphones intelligents. Dans cette revue, nous examinons les applications mobiles en santé qui ciblent simultanément plusieurs facteurs de risque cardiovasculaire dans le contexte de la prévention tant primaire que secondaire. Les données probantes dont on dispose indiquant que les interventions utilisant des applications mobiles en santé ont pour effet d'améliorer plusieurs facteurs de risque de MCV individuels sont relativement plus nombreuses que celles attestant une amélioration simultanée des facteurs de risque de MCV multiples. Les données existantes laissent croire que les programmes d'applications mobiles en santé diminuent le risque de MCV global, du moins à court terme. L'interprétation des données probantes est difficile dans le contexte d'une méthodologie inadéquate et du fait que les modalités utilisant des applications mobiles en santé sont souvent intégrées à des interventions complexes à grande échelle. Dans cette revue, nous recensons plusieurs questions encore sans réponse, y compris les suivantes : quel serait le mode d'utilisation le plus efficace des applications mobiles en santé (ou d'une combinaison d'interventions), quelle est la durabilité des effets de l'intervention, et quel est le degré de personnalisation et d'interactivité requis.

Cardiovascular disease (CVD) is the leading cause of death and disability worldwide, with coronary heart disease (CHD) being the largest contributor.[1,2] In 2012, 31% of all global deaths were due to CVD, with 80% occurring in low- and middle-income countries.[1] Multiple nonmodifiable (age, sex, ethnicity, family history) and modifiable (lifestyle and behavioural) risk factors contribute to the lifetime risk of CVD. Modifiable risk factors such as smoking, dyslipidemia, hypertension, abdominal obesity, physical inactivity, psychosocial factors, and diet account for most of the global risk for myocardial infarction (MI).[3] Thus, effective prevention programs aimed at a combination of these modifiable CVD risk factors in primary as well as secondary prevention settings are likely to yield best results.

Secondary prevention of CHD, including pharmacotherapy and lifestyle modification, has been shown to reduce

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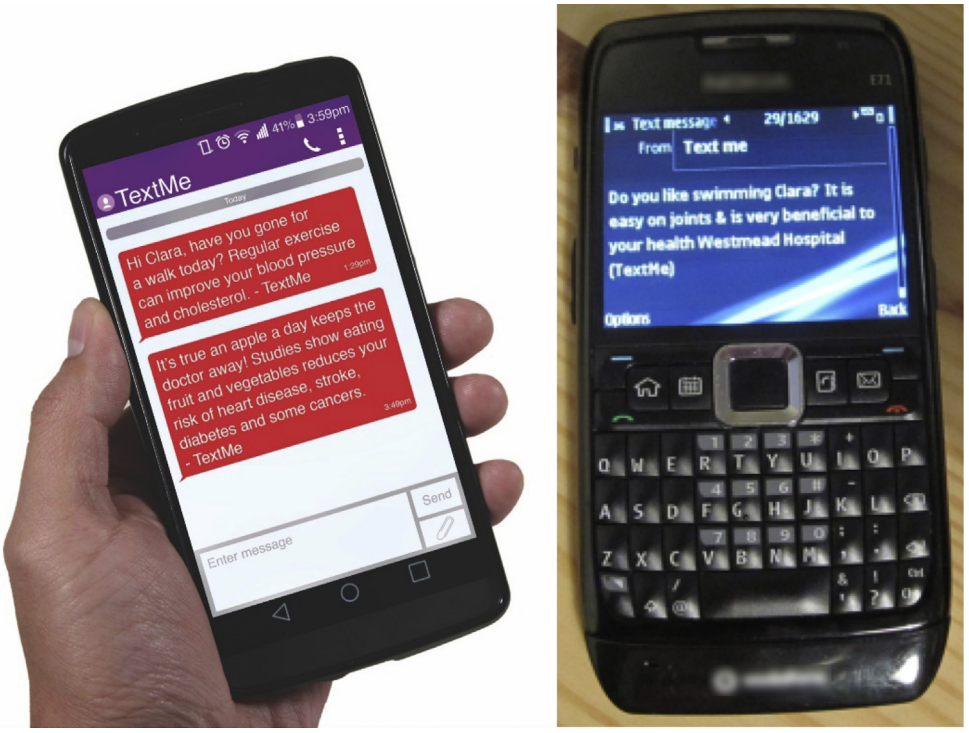

Figure 1. A text-message based prevention program delivered on a smartphone (**left**) and a standard cellular phone (**right**). The TEXT ME program sends regular text messages to encourage participants to lead healthier lifestyles. Photograph courtesy of Clara Chow. Reproduced with permission from Clara Chow on behalf of TEXT ME.

morbidity, mortality, and improve functional status and quality of life.[4] However, despite strong evidence, there is substantial underutilization of secondary prevention measures in patients with CHD.[5,6] For example, the **Euro**pean **A**ction on **S**econdary and **P**rimary Prevention by **I**ntervention to **R**educe **E**vents (EUROASPIRE IV) study[7] showed that most patients who had a coronary event did not meet guideline recommendations on CHD risk factor control. The reasons for the relatively poor implementation of secondary prevention are multiple, and include health system-, community-, and individual level-factors.[8] Changing lifestyle behaviours and maintaining medication adherence is difficult for many individuals even if they know that they have CHD, and in the primary prevention setting it is even more challenging to engender enough motivation to aggressively manage risk factors.

Mobile health (mHealth) technology has gained increasing interest as a means to improve the delivery of CVD prevention in a scalable and affordable way. It has particular potential to assist lifestyle modification and improve medical adherence. The Global Observatory for eHealth defines mHealth as "Medical and public health practices supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs) and other wireless devices."[9] It is expected that by 2018, 50% of the global population will own a smartphone (mobile phones with a computer operating system), and total mobile phone ownership in low-income countries will almost reach ubiquitous levels.[10,11] Due to the widespread global penetration of mobile technology, mHealth approaches might support the exchange of health information, improve community-based health assessment by reducing access barriers, and support improved lifestyle choices.[9,12]

Another particular potential of mHealth is its ability to address multiple risk factors. Although many traditional approaches have focused on targeting single risk factors,[13] targeting multiple risk factors in those at high global risk are more likely to be cost effective than treatment decisions on the basis of individual risk factor targets.[14] Targeting multiple cardiovascular risk factors is an important principle of CHD prevention.[15]

The aim of the current report is to review the evidence on mHealth interventions for simultaneous multiple risk factor reduction in primary as well as secondary prevention settings.

Modes of mHealth Delivery

Smartphone applications (apps) and text messaging (short messaging service or SMS) are 2 popular means of delivering mHealth interventions (Figs. 1 and 2).

Smartphone apps

Smartphone usage has been increasing, with 39% of adults globally using a smartphone in 2012 to 61% in 2014[16] and this has powered the growth in apps. Health-related apps are popular, and easily accessible via the iTunes store or Google Play. Many are free, although some incur a cost to download or purchase additional features. In April 2015, there were 12,991 apps in the iTunes store and 1420 apps in Google Play targeting multiple cardiovascular risk factors.[12] These apps might use different functions of the phone such as cameras, global positioning system, as well as sensors/accelerometers.