Preventive Medicine 90 (2016) 121–132

Contents lists available at ScienceDirect

Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

Review Article

Can skin cancer prevention be improved through mobile technology interventions? A systematic review

Linda Finch [a], Monika Janda [a], Lois J. Loescher [b], Elke Hacker [a,*]

[a] School of Public Health and Social Work, Institute for Health and Biomedical Innovation, Queensland University of Technology, Brisbane, Queensland, Australia
[b] The University of Arizona Cancer Center and Colleges of Nursing and Public Health, Tucson, AZ, USA

ARTICLE INFO

Article history:
Received 11 February 2016
Received in revised form 19 June 2016
Accepted 27 June 2016
Available online 29 June 2016

Keywords:
Skin cancer
Prevention
Text messaging
Mobile applications
Cell phones

ABSTRACT

Objective. Print-based health promotion interventions are being phased out to bring forth more appealing and assessable new technology applications. This review aimed to evaluate the current literature on the use of mobile text messaging and similar electronic technology interventions in the area of skin cancer prevention.

Method. A search of studies guided by Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) was conducted on mobile technology interventions for improving skin cancer prevention in the electronic databases PubMed, MEDLINE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and PsycINFO.

Results. Overall, 136 articles were screened for eligibility between 2001 (earliest relevant article found) and November 2015. Eight studies fulfilled the inclusion criteria and were reviewed according to the PRISMA guidelines. Of these, five were randomised controlled trials (RCTs), two were controlled clinical trials, and one was a cohort study. Five studies used text messages as an intervention, two used mobile phone applications, and another used electronic messages via email. All studies resulted in self-reported behaviour change in at least one of their outcome measures (e.g., sunscreen application, seeking shade).

Conclusion. While the behaviour change outcomes are promising, the lack of change in more objective measures such as sunburn indicates a need to further improve mobile phone technology-delivered interventions in order to have a greater impact on skin cancer prevention. Future studies may consider the use of objective outcome measures (e.g., sunscreen weight), electronic diaries, or behavioural outcomes in social networks.

Contents

* Corresponding author at: Queensland University of Technology, School of Public Health and Social Work, Institute of Health and Biomedical Innovation, Victoria Park Road, Kelvin Grove, Queensland 4059, Australia.
E-mail address: elke.hacker@qut.edu.au (E. Hacker).

http://dx.doi.org/10.1016/j.ypmed.2016.06.037
0091-7435/

1. Introduction

Skin cancer is a major public health problem in Australia. Australia has the highest incidence rate of melanoma in the world, 40.5/100,000 for men and 30.0/100,000 for women, due to the outdoor lifestyle of being exposed to regular ultraviolet (UV) radiation (Ferlay et al., 2013). These rates are more than double compared to other countries with a large proportion of fair skinned people such as the United States (US) (28.2/100,000 for men and 16.8/100,000 for women) or the United Kingdom (UK) (13.7/100,000 for men and 15.6/100,000 for women) (Ferlay et al., 2013; National Cancer Institute, 2012).

In Australia, melanoma is the most common cancer in young people 15 to 44 years (Australian Institute of Health and Welfare, 2010). Keratinocyte skin cancers, comprised of both basal cell carcinomas (BCC) and squamous cell carcinoma (SCC), also have high incidence rates in Australia (1170/100,000 per year) (Rowell et al., 2015). Keratinocyte cancers cost an estimated $703 million AUD for diagnosis, treatment, and pathology during 2015, while the total cost of treatment for melanomas in 2012 was over $70 million AUD. These costs place an increasing burden on the Australian health care system (Fransen et al., 2012; Gordon and Rowell, 2015); however, skin cancer prevention initiatives can be highly cost-effective (Gordon and Rowell, 2015).

Over the past three decades, Australia has successfully implemented, disseminated, and evaluated skin cancer prevention campaigns such as 'Slip! Slop! Slap!' and 'protect yourself in five ways from skin cancer' using standard public health and media message channels (e.g., posters, brochures, television, radio, and newspaper advertising) (Dobbinson et al., 2008; Montague et al., 2001; Volkov et al., 2013). These programs have led to positive sun-related behaviour changes and attitudes, and may have contributed to the plateaued or reduced skin cancer incidence rates in young Australians (Baade et al., 2015; Olsen et al., 2015). Campaigns in the US and UK draw on similar experiences to the Australian health promotion programs, but the change in the populations' media consumption patterns require a need to illustrate the link between previous approaches and new technologies (Diffey and Norridge, 2009).

Against a backdrop of community-wide awareness campaigns, the reduction in skin cancer incidence could be further accelerated via the roll-out of individually tailored health promotion interventions using mobile phones. Increasingly, print-based media promotions are being phased out to bring forth the more appealing and accessible avenues to reach younger audiences which include web-based, interactive multimedia, or mobile phones-delivered pathways (Free et al., 2013). The mobility and popularity of mobile technologies means that many people carry these devices with them wherever they go; this portability allows temporal synchronisation of the intervention delivery so that the intervention can capture an individual's attention when it is most relevant (Free et al., 2013). Text messaging using short-message service (SMS) has become a popular form of social communication, with regular use reported among young Australians (93% of 18 to 39 year olds) (Australian Bureau of Statistics (ABS), 2007, 2008). Due to the mobile phone culture, health promotion interventions addressing a wide range of behaviours have been delivered through mobile technology, especially text messaging (Cole-Lewis and Kershaw, 2010; Fjeldsoe et al., 2009; Fjeldsoe et al., 2010). These interventions have demonstrated efficacy in changing health behaviours including physical activity, healthy eating, and sun protection in the short-term, but not enough is known about their long-term effectiveness (Cole-Lewis and Kershaw, 2010; Fjeldsoe et al., 2009; Fjeldsoe et al., 2010). Important features of text-message delivered interventions include their ability to deliver interactive dialogue, tailored content, and quick responsiveness to participants' needs. Furthermore, the sound or vibration associated with the arrival of a text message may trigger an operant conditioning response, with very few people easily resisting to check an incoming message (Lewis, 2014). Mobile phone applications ("apps") have also been applied extensively to the area of healthcare. Apps are pre-installed software on smartphones and portable tablets ranging from books to exercise tools. In recent years with the increase use of smartphones, there has been a substantial interest in apps due to their high user engagement and persuasive impact on the user's attitude (Bellman et al., 2011).

An estimated seven billion people worldwide have access to mobile phones (World Health Organisation [WHO], 2011), allowing information to reach the vast majority of the community in a cost-effective manner (Fjeldsoe et al., 2009). While several previous reviews have assessed the impact of text-message delivered interventions more widely, this review focusses on the use of mobile text messaging and similar electronic technology interventions on skin cancer prevention. Therefore, the purpose of this review was to evaluate the current literature on the use of mobile text messaging and similar electronic technology interventions on skin cancer prevention outcomes and to assess how health promotion programs can utilise mobile technologies to achieve behaviour change.

2. Methods

2.1. Inclusion and exclusion criteria

This review was undertaken according to Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines. Studies that evaluated mobile technology interventions for skin cancer prevention were included. Articles that included mobile text messaging and similar electronic technology interventions which reported at least one outcome measure of skin cancer prevention-related behaviours were also eligible. Review articles, as well as any books, conference proceedings, editorials, magazine and newspaper articles, reports, and any other web-based lay health articles were excluded. Studies that covered skin cancer risk, dermatology, or telemedicine that did not report on skin cancer prevention behaviour outcomes were excluded. Eligible study designs included randomised controlled trials (RCTs), controlled clinical trials, and pre-post one arm studies. Participants were both men and women of all ages.

2.2. Search strategy for identification of selected studies

A search of studies on mobile technology interventions for improving skin cancer prevention was performed in the electronic databases PubMed, MEDLINE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and PsycINFO conducted between 2001 (earliest relevant article found) and November 2015. The main Medical Subject Heading (MeSH) terms used were: 'mobile phone*', 'cell phone*', 'wearable technolog*', 'smartphone*', AND 'skin cancer' OR 'melanoma' OR 'skin neoplasm'. The search was limited to English-language