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Can skin cancer prevention and early detection be improved via mobile phone text messaging? A randomised, attention control trial

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ABSTRACT

Objective. To test the impact of a theory-based, SMS (text message)-delivered behavioural intervention (Healthy Text) targeting sun protection or skin self-examination behaviours compared to attention control.

Method. Overall, 546 participants aged 18–42 years were randomised using a computer-generated number list to the skin self-examination ($N = 176$), sun protection ($N = 187$), or attention control ($N = 183$) text messages group. Each group received 21 text messages about their assigned topic over 12 months (12 weekly messages for 3 months, then monthly messages for the next 9 months). Data were collected via telephone survey at baseline, 3, and 12 months across Queensland from January 2012 to August 2013.

Results. One year after baseline, the sun protection (mean change 0.12; $P = 0.030$) and skin self-examination groups (mean change 0.12; $P = 0.035$) had significantly greater improvement in their sun protection habits (SPH) index compared to the attention control group (reference mean change 0.02). The increase in the proportion of participants who reported any skin self-examination from baseline to 12 months was significantly greater in the skin self-examination intervention group (103/163; 63%; $P < 0.001$) than the sun protection (83/173; 48%) or attention control (65/165; 36%) groups. There was no significant effect of the intervention for participants' self-reported whole-body skin self-examination, sun tanning, or sunburn behaviours.

Conclusion. The Healthy Text intervention was effective in inducing significant improvements in sun protection and any type of skin self-examination behaviours.

Trial registration. The Australian and New Zealand Clinical Trials register (ACTRN12612000577819).

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Introduction

Melanoma incidence rates vary widely across the world but are highest in countries with a large proportion of Caucasians and high ultraviolet radiation (UVR) such as Australia/New Zealand (age standardised incidence 40/100000 in men and 30/100,000 in women), where rates are about double compared to those observed in the United States of America (USA), Northern, or Western Europe (Ferlay et al., 2013). Among Australians 15–44 years, melanoma is the most common cancer (loss of 22,300 disability-adjusted life years [DALYs] each year) (Australian Institute of Health and Welfare, 2010). While most skin cancer deaths are attributable to melanoma (1,430 deaths per year), keratinocyte cancers cause 420 deaths per year and costed the Australian health system $511 million in 2010 (Fransen et al., 2012).

Risk factors for all skin cancers include sun exposure, susceptible skin, eye, or hair colour, and a propensity to burn (Green et al., 1999). Sunburn reflects the biological active dose of UVR people receive relative to their skin melanin density (Del Bino and Bernerd, 2013). Additionally, melanoma is associated with large numbers of naevi, family history, or genetic predisposition (Armstrong and Kricker, 2001; Dennis et al., 2008; Veierod et al., 2003). The 2010 U.S. National Health Interview Survey data ($N = 24,970$) revealed sunburn was most common among younger adults (52.0%), those with sun-sensitive skin (45.9%), white ethnicity (44.3%), those with a family history of melanoma (43.9%), the highly physically active (41.7%), and indoor tanners (44.1%) (Holman et al., 2014).

Prevention programs focused on preventing skin cancer have been conducted in Australia, the USA, and form part of the European Code against Cancer (Dobbinson et al., 2014; Glanz et al., 2001; Lombard et al., 1991; Volkov et al., 2013) for at least the past 20 years. More recently, providing health promotion programs via short message service (SMS) has been successfully trialled for various health behaviours (Cole-Lewis and Kershaw, 2010; Fjeldsoe et al., 2009), often achieving small to moderate effect sizes. However, success has been

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heterogeneous, with greater effect for smoking cessation and physical activity interventions. Tailored and personalised messages produced larger effects (Head et al., 2013). One factor that may limit the observed impact of studies is changes in desired behaviour in both the control and intervention groups (Waters et al., 2011, 2012).

Few studies have used SMS-delivered interventions for sun protection or skin examination behaviour outcomes, and the U.S. Surgeon General called for more research in this area (U.S. Department of Health and Human Services, 2014). One study reminded adults via SMS to use sunscreen and observed a significant increase in use in the intervention group (Armstrong et al., 2009). Another tested the value of sun-safe SMS messages on mobile phone subscribers (Gold et al., 2011). Further, SMS messages formed part of a comprehensive interactive computerised education program for dermatology clinic participants (Aneja et al., 2012a, 2012b).

The aim of the Healthy Text study was to test in a randomised trial design the impact of a social cognitive theory-based, SMS-delivered behavioural intervention targeting either sun protection or skin self-examination behaviours compared to attention control, with the main outcomes being sun protection, skin self-examination, as well as sunburn in a population aged 18–42 years at high risk of skin cancer.

Methods

Study design and participants

The Healthy Text trial, conducted in Queensland, Australia, used a three-group design with two intervention groups (sun protection or skin self-examination) and an attention control group which received an equivalent number of messages about physical activity. Approval was received from the Queensland University of Technology's ethics committee (QUT1100000942). All efforts were made to keep the trial information and consent forms generic rather than specifically referring to skin cancer. This trial was designed in accordance with the guidelines published by the Consolidated Standards of Reporting Trials group (CONSORT), except for blinding of participants to intervention type (not possible due to the nature of the behavioural intervention).

A random sample of 15,000 men and women 18–42 years of age (the upper age range was determined by the groupings in the recruitment source database) from the Queensland electoral roll or Medicare register (the population-wide free health insurance for Australian residents) were invited to participate via mailed invitation from January to May 2012. Of the 678 (4.5%) potential participants who indicated interest by e-mail, text message, or return mail, 574 (84.7%) were eligible and 546 completed the baseline telephone interview. Complete data was available for 512 (93.7%) participants at the end of the intervention period (August 2013).

Randomisation and masking

After the baseline telephone survey conducted in the southern hemisphere autumn (March to May), participants were randomised using a computer-generated random number list. The randomisation list was derived by the study statistician, separate from all other study procedures. The interviewers were blinded to the participants' group allocation.

Interventions

Participants received weekly SMS over 12 weeks in the southern hemisphere winter (in Queensland, people receive almost as much personal ultraviolet exposure in winter as in summer) (Neale et al., 2010) and then completed the 3-month follow-up telephone interview. Thereafter, participants received monthly text messages for the remaining 9 months, resulting in a full year of intervention delivery to accommodate potential differences in sun protection by season. The intervention was followed by a 12-month telephone interview. Text messages were designed using data from a pilot study (Mair et al., 2012), examples from a previous physical activity text message study (Fjeldsoe et al., 2010), and according to social cognitive theory (Bandura, 1986). Messages were personalised using participants' name and gender, skin cancer risk factors (e.g., hair colour), number of times being sunburnt, previous performance of skin self-examinations (Janda et al., 2013b), and reviewed for quality (Centers for Disease Control and Prevention, 2012). As previously reported (Janda et al., 2013b), they aimed to address the constructs of the social cognitive model, such as increasing self-efficacy (example message: <Participant Name>, melanoma rarely has symptoms so look out for the AC rule when checking your moles ASYMMETRY (halves that differ) and more than one COLOUR. HealthyTexts); Building behavioural capacity (example message: Hi <Participant Name>. Always have your exercise clothes clean & ready. Leave your shoes where you can see them to remind you. HealthyTexts); or guiding outcome expectations (<Participant Name>, it's great that you have thought about reducing your risk of skin cancer. Make this a reality by protecting your skin from the sun when outdoors. HealthyTexts).

Main outcome measures

A telephone survey company independent from the researchers collected all outcome data across Queensland. The main outcome measure for sun protection behaviours was the sun protection habits (SPH) index developed by Glanz et al. (Glanz et al., 2009; Hall et al., 2009). This index correlates well with other measures of sun protection evidencing its validity and has good test–retest reliability (0.78). It queries the frequency of six sun-protective methods that are used when outdoors between 10:00 a.m. and 3:00 p.m. (4-point Likert scale, 1 = never/rarely to 4 = always), including wearing a shirt with sleeves, sunglasses, hat or sunscreen, staying in the shade, and limiting time in the sun during midday hours. Answers to the six questions are averaged (range: 1–4). Data on sunburn (any/frequency) and suntan over the past 12 months were also collected.

For skin self-examination outcomes, participants were asked whether (ever, during the past 3 months and during the past 12 months), "you or someone who is not a doctor, such as your spouse or partner, deliberately checked any part of your skin for early signs of skin cancer." For those who answered yes, a series of questions assessed frequency and thoroughness (any, part-body, whole-body). We used these questions in previous studies (Aitken et al., 2004; Janda et al., 2011) and found them reasonably reliable (better reliability with shorter recall periods) (Aitken et al., 2004). We also collected data on participants' socio-demographics, skin cancer risk factors (hair, eye/skin colour, tendency to burn, ability to tan, personal or family history of skin excisions, or skin cancer), and measures to allow assessment of whether behaviour change was enacted through the proposed components of the social cognitive theory (data not reported here). At the end of the 12-month interview, two questions assessed overall level of satisfaction with the intervention and importance of the allocated health behaviours (10-point Likert scales, 1 = not at all to 10 = extremely satisfied; 1 = unimportant to 10 = very important, respectively). As measures of engagement, we asked whether participants' sent a message back to Healthy Text, whether they referred back to the SMS's after receiving them, or forwarded them to a friend/family member.

Statistical analyses

Sample size calculations were reported previously (Janda et al., 2013b) and indicated that at least 126 participants per group were required. The intention-to-treat principle was used for analysis. The change from baseline in the SPH index score was compared for each intervention to the attention control group using *t*-tests. For binary outcomes, logistic regression analyses were used to compare intervention and control groups at each time-point; generalised estimating equations for overall group-by-time interactions. To assess whether the intervention was more effective for subgroups based on commonly known differences in response to behavioural sun protection or sun exposure interventions (moderator analyses), we compared the odds of performing any skin self-examination in the past 3 months at 12-month follow-up by age (<32 years versus age ≥32 years), gender (male versus female), skin colour (very fair/fair versus medium/olive skin), and baseline skin self-examination intentions (yes versus no). We also calculated the mean difference in SPH index score between the sun protection intervention group and the control group by age, gender, skin colour, and baseline intention to reduce skin cancer risk.

Results

Fig. 1 presents participant flow through the study (The Consort Group, 2009). As reported previously (Janda et al., 2013b), the groups were well balanced at baseline with only a few exceptions, specifically a larger proportion of skin self-examination group participants indicted they had attempted to suntan during the past year ($p < 0.012$) (Table 1).