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Improved confidence in performing nutrition and physical activity behaviours mediates behavioural change in young adults: Mediation results of a randomised controlled mHealth intervention

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ABSTRACT

Background: The burden of weight gain disproportionally affects young adults. Understanding the underlying behavioural mechanisms of change in mHealth nutrition and physical activity interventions designed for young adults is important for enhancing and translating effective interventions.
Purpose: First, we hypothesised that knowledge, self-efficacy and stage-of-change for nutrition and physical activity behaviours would improve, and second, that self-efficacy changes in nutrition and physical activity behaviours mediate the behaviour changes observed in an mHealth RCT for prevention of weight gain.
Methods: Young adults, aged 18–35 years at risk of weight gain (n = 250) were randomly assigned to an mHealth-program, TXT2BFiT, consisting of a three-month intensive phase and six-month maintenance phase or to a control group. Self-reported online surveys at baseline, three- and nine-months assessed nutrition and physical activity behaviours, knowledge, self-efficacy and stage-of-change. The mediating effect of self-efficacy was assessed in multiple PROCESS macro-models for three- and nine-month nutrition and physical activity behaviour change.
Results: Young adults randomised to the intervention increased and maintained knowledge of fruit requirements ($P = 0.029$) compared to controls. Intervention participants' fruit and takeaway behaviours improved to meet recommendations at nine months, with a greater proportion progressing to action or maintenance stage-of-change ($P < 0.001$ and $P = 0.012$ respectively) compared to controls. Intervention participants' vegetable and physical activity behaviours did not meet recommendations, thereby halting progress to action or maintenance stage-of-change. Indirect effects of improved nutrition and physical activity behaviours at three- and nine-months in the intervention group were explained by changes in self-efficacy, accounting for 8%–37% of the total effect.
Conclusions: This provides insights into how the mHealth intervention achieved part of its effects and the importance of improving self-efficacy to facilitate improved eating and physical activity behaviours in young adults.

1. Background

More than two-thirds of Australian young adults aged 18–35 years are overweight or obese (Australian Bureau of Statistics, 2015). Research has shown that a large portion of the Australian young adult population does not adhere to national dietary and physical activity recommendations (Australian Bureau of Statistics, 2015). Young adults have sub-optimal nutrition and physical activity behaviours, which contribute to weight gain (Bertoia et al.,

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2015; Boeing et al., 2012; Duffey, Gordon-Larsen, Steffen, Jacobs, & Popkin, 2010; Hankinson et al., 2010; Larson, Neumark-Sztainer, Laska, & Story, 2011) and place them at a high risk of overweight and obesity (Allman-Farinelli, Chey, Bauman, Gill, & James, 2008; Tanamas et al., 2013). Only 3.2% of 18–24-year-olds meet the recommended intakes of fruit and vegetables (Australian Bureau of Statistics, 2015). Young adults—particularly males—consume excess sugar sweetened beverages (SSBs), many frequently consume energy-dense takeaway meals and 47% are not sufficiently physically active (Australian Bureau of Statistics, 2015).

Researchers have responded to the issue of weight gain in young adulthood by designing behavioural lifestyle interventions that take into account determinants of weight gain (Allman-Farinelli, 2015). Increasingly, researchers are using technology such as websites and smartphones as platforms for intervention delivery (Allman-Farinelli, 2015). Our recent systematic literature review of 21 randomised controlled trials (RCTs) revealed six studies that used technology for intervention delivery; however, none of these studies investigated causal behavioural mechanisms (Partridge, Juan, McGeechan, Bauman, & Allman-Farinelli, 2015). Improvements in eating and physical activity behaviours have been shown to mediate the prevention of weight gain in middle-aged women (Hollis et al., 2014) and mediate weight loss in overweight and obese adults (Lubans et al., 2012; Norman, Kolodziejczyk, Adams, Patrick, & Marshall, 2013). However, weight management is not a behaviour, but rather an outcome of multiple behavioural changes. Further causal investigation of the theoretical constructs of eating and physical activity behaviours will enable us to increase our understanding of weight gain prevention intervention effects and plan more effective interventions (Michie, Rothman, & Sheeran, 2007). This is important to advance the field of behavioural interventions, particularly for new delivery platforms such as websites and smartphones.

Our smartphone-delivered intervention, TXT2BFiT, was developed in 2011 and was one of the first mHealth programs targeted for young adults then trialled in a randomised controlled trial with a six month maintenance phase (Hebden et al., 2013). The intervention, based on the theoretical constructs, namely, from the Transtheoretical model and control theory (Prochaska, DiClemente, & Norcross, 1992), aimed to improve multiple dietary and physical activity behaviours in overweight young adults, and subsequently result in prevention of further weight gain (Hebden et al., 2013). The program was designed to improve self-efficacy and self-change of four targeted lifestyle behaviours (fruit and vegetable intake, SSB intake, energy-dense take-away meal intake and physical activity levels) by encouraging the intervention participants to perform the desired behaviour to meet national recommendations or targets set by the program. Participants were supported further by behaviour change techniques such as self-monitoring, motivational interviewing, goal setting and restructuring social and physical environments, behaviour substitution and problem solving. During the TXT2BFiT intervention, it was anticipated that reported self-efficacy would gradually increase as the participants increased their knowledge and progressed through the stages-of-change (Bandura, 1977).

The program was aimed at preventing further weight gain and was subsequently effective in achieving significantly modest weight loss, and it showed improvements in nutrition and physical activity behaviours (Allman-Farinelli et al., 2016; Partridge, McGeechan, et al., 2015). We have previously shown that weight loss is mediated by improved lifestyle behaviours—particularly increased vegetable intake and decreased SSB intake (Partridge, McGeechan, Bauman, Phongsavan, & Allman-Farinelli, 2016). To our knowledge, no research study to date has examined the effect of participation by young adults in a mHealth intervention for the prevention of weight gain on the theoretical constructs of the program, nor the mediating effect of these theoretical constructs on the targeted behaviours of the program. The purpose of this analysis was to assess the intervention effects on knowledge, self-efficacy and stage-of-change independently for each of the four target lifestyle behaviours, and to investigate the mediating effects of self-efficacy on each of the four targeted lifestyle behaviours in the mHealth weight gain prevention intervention, TXT2BFiT.

2. Methods

2.1. Study design

The two-arm parallel-group RCT was nine months in total, consisting of a three-month intervention phase followed by an additional six-month maintenance phase (Hebden et al., 2013). The trial was approved by the University Human Research Ethics Committee in September 2012 (Approval Number 15226), and all participants gave written informed consent. The trial was registered with the Australian New Zealand Clinical Trials Registry (ACTRN12612000924853).

2.2. Participant recruitment and inclusion criteria

Print and electronic media strategies in primary care and community settings were used to recruit 250 young adults in the greater Sydney area between November 2012 and July 2014 (Partridge, Balestracci, et al., 2015). To be eligible for the study, participants were required to have a mobile phone model capable of receiving text messages; access to the internet at least once a week; 18–35 years old; have a BMI between 23.0 and 31.9 kg/m^2; did not meet daily recommended fruit and/or vegetable intake per day and/or had SSB intake in excess of one litre per week and/or had energy-dense meals prepared away from home (i.e., takeaway meals) more than once per week; and/or engaged in moderate-intensity physical activity less than 60 min per day. Exclusion criteria included pregnancy or planning to fall pregnant within the study period; enrolment in another weight loss program; weight loss greater than 10 kg in the three months before the study; taking medications that have caused weight gain of more than 2 kg; medical conditions that precluded following dietary or physical activity recommendations; and/or not speaking English. Participants were blinded to the allocation until after completion of the nine-month study.

2.3. Intervention group

Details of the TXT2BFiT intervention are available elsewhere (Hebden et al., 2013; Partridge, McGeechan et al., 2015). In brief, the intervention targeted four lifestyle behaviours. The behavioural program aimed to (Australian Bureau of Statistics, 2015) increase fruit and vegetable consumption (Duffey et al., 2010), decrease takeaway meal and (Larson et al., 2011) SSB consumption, and (Hankinson et al., 2010) increase physical activity levels. Each intervention participant received the three-month intervention, which involved five personalised coaching calls with a dietitian based on motivational interviewing with goal setting and review, eight weekly text messages personalised by gender and stage-of-change, weekly reminder emails, and access to four behaviour specific educational and self-monitoring smartphone applications (Hebden, Cook, van der Ploeg, & Allman-Farinelli, 2012) and the study website for education. The study website contained an 18-page nutrition and physical activity e-booklet, which was also mailed as a hard copy and other resources including information sheets on planning for budget eating, last minute meal preparation,