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1      **The use of commitment techniques to support weight loss maintenance in obese**  
2      **adolescents**

### ABSTRACT

**OBJECTIVES:** Obesity is a rising problem in adolescents related to unhealthy behaviours. Commitment devices are one type of behavioural intervention that may help people change their behaviours. The current pilot trial tests whether commitment devices delivered via text message help adolescents maintain their recent weight loss.

**METHODS:** During a 12-week pilot trial adolescents who attended a weight loss camp were randomly assigned to either received text messages that contained only information, i.e., advice, about weight loss management (n=13) or asked for them to commit to following the same advice (n=14).

**RESULTS:** The BMI of the adolescents in the commitment group did not change. In contrast, the BMI of adolescents in the information group increased. A linear regression revealed that group was a significant predictor of BMI change. A logistic regression revealed that adolescents in the information group were nearly eight times more likely to regain weight than those in the commitment group.

**CONCLUSIONS:** This is the first study with adolescents to show weight maintenance using a commitment device. The results suggest that commitment devices can help adolescents maintain their recent weight loss.

**Keywords:** nudge; commitment device; weight maintenance; adolescents.

## Introduction

Obesity is an increasing global health problem<sup>1,2</sup>. As behaviour is a large component of what causes and maintains obesity (e.g., physical activity and eating), behavioural interventions are well suited to address this problem.<sup>3</sup> Tackling adolescent obesity is important because a high proportion of adolescents who are obese become adults who are obese<sup>4,5</sup>. The current paper supports the use of a behavioural intervention, commitment devices, to help adolescents maintain their recent weight loss.

Interventions that help people maintain weight loss are sorely needed. Regardless of what interventions people use to lose weight, pharmacological<sup>6</sup> or behavioural<sup>7</sup>, the weight is commonly regained. Typically half the weight lost is regained in the first year. Weight regain then continues so that 3-5 years post-treatment about 80% of people return to or exceed their pre-intervention weight<sup>8</sup>. Therefore, finding effective interventions for weight loss maintenance is crucial for the long-term success of many initial obesity interventions<sup>9</sup>.

Commitment devices are one promising tool developed by behavioural economists that may help people maintain weight loss. Commitment devices draw out a promise from people to act in a specific way; for example, a person who wants to lose weight may promise to walk 45-minutes after breakfast each day. **In terms of the prominent dual-process psychological theory of decision making and action, commitment devices are thought to work through the ‘automatic system’ (as opposite to the ‘reflective system’), so that people automatically, and often subconsciously, feel the need to act on their commitments<sup>10,11,12</sup>.** Making such commitments public typically makes them more effective, plausibly because breaking a public commitment may lead to reputational damage and social disapproval<sup>13</sup>. For example, making a commitment to one’s self to walk 45-minutes each day is typically less effective than making that same commitment to a respected friend.

Commitment devices can be a type of nudge<sup>14</sup>. Nudges are interventions that involve altering stimuli within micro-environments with the intention of changing target behaviours. Typically nudges are implemented within the same environment the target behaviour expected, require minimal conscious engagement and are not tailored to specific individuals<sup>15</sup>. Commitment devices alter the environment by adding an explicit agreement for the person to act in a specific way. These commitments can be placed into the environment the target behaviour is expected; for example a written contract to eat less could be posted on a fridge or a personal phone could be set up to deliver periodic reminder messages. In addition commitment devices typically require minimal conscious effort to alter behaviour even when they are generically tailored<sup>16</sup>.<sup>1</sup>

Commitment devices can be delivered many ways. Casually, a friend's invitation to walk 45-minutes with a person who is trying to lose weight is a commitment device. In more conventional treatment settings, health care workers may ask patients to indicate their commitment to a certain treatment plan by signing a behavioural contract. Similar commitment devices can be delivered via mobile phones using text messages. Text messages are generally less expensive than in-person meetings and often more cost-effective. Text messages have proven a particularly successful delivery method for adolescents and so are used in the current trial<sup>17-21</sup>.

The current pilot trial tests whether commitment devices delivered via text message help adolescents maintain their recent weight loss. We expect that adolescents asked commit to

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<sup>1</sup> Commitment devices affect behaviour through a two-step process. In step one, the commitment device itself nudges individuals to commit to changing their behaviour, e.g., eating. In step two, the commitment itself then (often subconsciously and automatically) affects what the person decides to do, e.g., eat less. The commitment itself is generally not considered a nudge (at least in a narrow sense of the term), but the device that evokes the commitment can be. In accordance with the operational definition of nudge in the literature, to be considered a nudge, the commitment device should be present in the environment the behaviour is expected, require minimal conscious engagement, able to influence many people simultaneously, and generically tailored.<sup>12</sup>

following behavioural advice that promotes weight maintenance will maintain their weight better than those who are not.

## Method

*Design.* The pilot trial took place after the MoreLife camp and lasted 12-weeks. During this time all participants received three Short Message Service text messages each week. Participants were randomised, stratified by age, into either the information or commitment groups.

*Pre-intervention.* The participants were recruited from a group of 50 adolescents who recently attended an eight-week weight loss camp offered by MoreLife. All of these adolescents received funding to attend the camp through applications made to their NHS Health and Local authorities in the UK that support individuals with limited financial resources achieve better health. During the camp, all camp attenders' BMIs were regularly assessed by the MoreLife team using calibrated equipment. MoreLife's camp is conducted around its Lifestyle syllabus that lays out a framework for education and behaviour change related to health (e.g., exercise routines and portion control)<sup>22</sup>. The pilot trial was conducted by a research team independent of MoreLife. MoreLife provided the independent research team with the information they collected from consenting participants.

*Participants.* After the camp ended parental informed consent was obtained for 27 of the 50 camp attenders' to participate in the pilot trial, and these participants were then randomised into groups. In the information group 13 participants (8 Female, Mean age = 13.7) received text messages that provided general information, i.e., advice, about weight loss maintenance. In the commitment group 14 participants (10 Female, Mean age = 13.8) received text messages that asked them to commit to a behavioural task based on the same information.

*Intervention Materials.* The independent research team used the information contained in MoreLife’s Lifestyle syllabus to create eight different information messages. Based on these information messages, parallel commitment messages were created. The information messages were sent to participants in the information group and the commitment messages were sent to participants in the commitment group. After the 8th week, the initial 4 messages were repeated for the 9<sup>th</sup> through 12<sup>th</sup> weeks. All messages contained fewer than 161 characters, were sent in the evening, and were addressed from ‘MoreLife’.

*Information group.* Participants in the information group received one of the information texts each week, the first on Sunday and then the same message repeated two later days. For example, one of the information messages read: “Remember it is important to make sure your food portion size is right for you.” All information messages are displayed in the second column of Table 1.

*Commitment group.* Participants in the commitment group also received three text messages per week. The first text message each week asked them to commitment to act in a specific way, based on the same information given to the information group. For example, when the participants in the information group read about portion sizes, the participants in the commitment group read: “Can you promise to eat 30g of cereals each morning before school (This is the same as one variety pack). Please txt back CAMP followed by Yes or No to 8810.” If participants indicated their commitment to this message, then the subsequent messages only reminded them of their commitment; for example: “Are you managing to eat cereals in the morning? Text back CAMP followed by Yes or No to 8810.” If they did not indicate their commitment initially, then the subsequent messages also asked them to commit. All replies were sent to the independent research team. In Table 1, the third, fourth, and fifth columns contain all the messages sent to participants in the commitment groups.

INSERT TABLE 1 HERE

*MoreLife Calls.* All 50 camp attenders received fortnightly calls from a MoreLife counsellor who had no stake in the experiment's outcome and would want all camp attenders to succeed. During these calls the counsellor discussed the campers' progress, social support and any potential barriers to weight loss, for about 10 minutes. All calls followed a similar format except that participants in the commitment group were also reminded of their commitment in a single sentence, such as: 'Remember you have made a promise to eat 30g of cereal for breakfast each day this week'.

*Post-intervention.* All 50 camp attenders were invited to a camp reunion hosted by MoreLife 12 weeks after camp ended. At this reunion, camp attenders' BMIs were reassessed by the MoreLife team using the same calibrated equipment. The MoreLife team also asked the 14 participants in the commitment group if they experienced any problems responding to MoreLife's text messages.

## Results

Before our trial, participants in both groups experienced similar weight loss. Over the camp the average decrease in BMI of participants in the information and commitment groups were -2.63 kg ( $SE = 0.32$ ) and -2.32 kg ( $SE = 0.27$ ) respectively. The difference between the two groups was compared using an independent samples t-test, no significant difference was obtained  $t = 0.75$ ,  $p = 0.462$ . At the end of camp, the mean BMI of participants in the information and commitment groups were 32.2 ( $SE = 2.16$ ) and 31.3 ( $SE = 1.15$ ) respectively. The difference between the two groups was compared using an independent samples t-test, no significant difference was obtained,  $t = 0.80$ ,  $p = 0.44$ .

During the trial, most participants complied with the protocol and planned intervention. Of the fortnightly counselling calls, 72% were attended. Participants in the commitment group responded to 60% messages they received (302 responses / 504 total messages). The total



number of messages is calculated from the 14 participants who received 3 texts per week for 12 weeks). The most common reasons they did not respond included: not knowing whether to respond, having no credit, phone not allowing a reply and the participants having changed their mobile number.

All participants attended the reunion where their BMI was reassessed. As the data were non-normally distributed, a Wilcoxon sign-ranked was used rather than an ANOVA. A one-tailed test was applied, with a significance level of 0.05, in line with the hypothesis that participants' BMI would increase because that is what typically occurs. The BMI of participants in the information group significantly increased, Mean change (after-before) = 1.06 kg,  $SE=0.65$ ;  $Z = -1.73$ ,  $p = .04$ . In contrast, the BMI of participants in the commitment group was more stable, Mean change (after-before) = -0.12,  $SE=0.52$ ;  $Z = -0.41$ ,  $p = .34$ .

A linear regression was then used to compare the changes in participants' BMI (the dependent variable) as a result of their group and other potential individual differences: age, gender, and initial BMI (four predictor variables). The overall model was significant,  $F(4,22) = 2.85$ ,  $p = .048$ ;  $R^2 = 0.34$ . Group and initial BMI were significant predictors of BMI change (group- $\beta = 1.63$ ,  $t = 2.14$ ;  $p = .043$ ; initial BMI- $\beta = -0.19$ ,  $t = 2.92$ ;  $p = .008$ ). Age ( $p = .220$ ) and gender ( $p = .608$ ) were not significant predictors.

Notably, the difference between the two intervention groups' BMI change is likely due to the weight regain in the information group. To further scrutinise these results the before-after change scale was converted to binary data using a median split into 'high BMI gain' (1) and 'low BMI gain' (0) participants (i.e., depending on whether they are above or below the median (0.7) change respectively). This binary measure was used as the dependent variable in a logistic regression, which confirmed that the intervention was a significant predictor of BMI regain ( $\beta = 2.04$ ,  $Wald = 4.04$ ,  $df = 1$ ,  $p = .045$ ). The 'odds ratio'  $\text{Exp}(\beta)$  for the intervention coefficient

was 7.71, which suggests that those who were only given information were almost eight times more likely to regain weight than those who were asked to commit.

## Discussion

Commitment devices are one type of behavioural interventions health care workers can use to help adolescents maintain their recent weight loss. In the current pilot trial, the BMI of participants in the commitment group was stable while the BMI of participants in the information group increased.

This is the first pilot trial to demonstrate that generic commitment devices delivered via text message can help adolescents maintain their recent weight loss. Other pilot trials that have helped people maintain their weight using text messages included personalised information, without commitments<sup>23,24</sup>. As developing personalised messages can be costly and labour intensive, generic commitment messages like the ones used in the current trial are likely more cost-effective.

The results of the current trial with adolescents are clinically important and unique. Stable weight, even temporally, in growing adolescents with obesity is associated with an improvement in cardiovascular risk factors and co-morbidities of obesity, e.g., diabetes, osteoarthritis, etc<sup>25</sup>. To date, no other stand-alone email or phone based weight loss intervention for adolescents has been successful<sup>26</sup>.

The generalisability of this trial may be limited by at least two factors. First, the study contained a notably small sample-size. Second, all participants had recently attended the same weight loss camp. Third, MoreLife's counsellors (not the research team) conducted the phone calls. While MoreLife's counsellors had no stake in the experiment, they could not be blinded to the participants' groups and therefore bias was possible. Further fidelity checks could not be performed to ensure the calls were conducted in a consistent manner. The encouraging findings

reported here should be used to organise a larger-scale randomised controlled trial before the intervention's general efficacy can be assessed.

These results add to a growing literature demonstrating the power of behavioural interventions to positively influence behaviour, with low financial costs, little cognitive efforts on part of the participants, and likely fewer negative side-effects than many pharmacological interventions. Commitments devices are just one tool described by the MINDSPACE framework that may prove beneficial<sup>27</sup>. MINDSPACE is an acronym that provides interventionists with a checklist of tools that influence behaviour (Messenger, Incentives, Norms, Defaults, Salience, Priming, Affect, Commitment, Ego). Its theoretical aim is to demonstrate how these seemingly diverse types of nudge effects can still be explained in terms of a small set of underlying theoretical mechanisms for action. How these other tools could also help people maintain their weight loss (separately or in conjunction) should be considered in further work.

## Conclusion

Behavioural interventions, like commitment devices, are promising tools health care workers can use to help adolescents maintain their recent weight loss. In order to reaffirm these findings, a larger study using a longer follow-up period is necessary, preferably with a cost-effective analysis. However, these preliminary findings are encouraging.

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