

Using a Combined Motivational and Volitional Intervention to
Promote Exercise and Healthy Dietary Behaviour among
Undergraduates

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Abstract

Aims: This study tested the impact of combining a motivational intervention based on protection motivation theory (PMT, Rogers, 1983) plus a volitional intervention based on action planning and coping planning, as a way to promote the prevention of type 2 diabetes among UK undergraduates.

Methods: Eighty-four participants were randomly assigned to either a control group or one of three experimental conditions: motivational intervention (PMT), volitional intervention (APCP), or combined motivational and volitional intervention (PMT&APCP). PMT variables, dietary and exercise behaviours were measured at three time-points over a four-week period.

Results: The motivational intervention significantly changed PMT variables. The combined motivational and volitional intervention significantly decreased fat intake and increased the frequency of exercise relative to all other groups, and significantly increased the amount of fruit and vegetables consumed relative to control and volitional intervention groups.

Conclusions: These results suggest that motivational intervention is effective at changing cognitions but changing behaviour requires an intervention based on both motivation and volition.

1. Introduction

The increasing incidence of type 2 diabetes in the UK is in large part due to rising obesity rates combined with people living more sedentary lifestyles [1-2]. With the increasing rate of type 2 diabetes, the incidence of complications, e.g., cardiovascular diseases, are also increasing [3].

Type 2 diabetes used to occur among the middle-aged and elderly, however, the age of onset has changed as individuals at increasingly younger ages are being identified with the disease [4]. Thus, to be effective in reducing the risk of type 2 diabetes, lifestyle modification must begin at an earlier age. Young adults are one group who could benefit from interventions promoting eating a healthy diet and exercise: daily fruit and vegetable consumption is lower than the recommended five or more portions per day [5] and exercise levels are low [6].

Lifestyle interventions that focus on modifying physical activity and dietary behaviour have been shown to reduce the risk of Type 2 diabetes [3, 7-9]. However, most lifestyle interventions designed to prevent the onset of diabetes [10-12] have failed to integrate theoretical approaches [13]. Theories outline key predictors of behaviour, (e.g. intentions), so theory-based interventions can increase the effectiveness of interventions by targeting these predictors [14, 15]. Moreover, theory-based interventions can help explain why some interventions are successful, while others are not, by examining predictor variables as mechanisms of behaviour change. [14, 16-17]. The present study used Protection Motivation Theory (PMT) [18] to promote the prevention of Type 2 diabetes among UK undergraduates by increasing their motivation to perform risk reducing behaviours (diet/exercise) associated with Type 2 diabetes.

PMT [18] promotes behaviour change through persuasive communication, such as health warning messages. Rogers[18] states that these messages stimulate two parallel appraisal processes: threat appraisal and coping appraisal. Threat appraisal consists of: (1)

self-estimated likelihood of suffering the disease (perceived vulnerability); (2) self-estimated seriousness of the disease (perceived severity); and (3) fear. Coping appraisal covers: (1) the effectiveness of the recommendations in removing or averting the threat (response efficacy) and the (2) belief in one's ability to successfully execute the recommended behaviour (self-efficacy). According to PMT, people's intention to adopt an adaptive response (protection motivation) or a maladaptive response (avoidance and denial) is a function of an individual's threat appraisal and coping appraisal. Reviews of the model support its structure [19].

Plotnikoff and Higginbottom [20] applied PMT to the prediction of dietary behaviour in two community samples with high rates of coronary heart disease. Dietary behaviour was predicted by intentions, perceived vulnerability and fear. Tulloch *et al.* [21] applied PMT to predict of exercise behaviour in patients with coronary artery disease. Exercise behaviour was predicted by intentions and self-efficacy.

Several PMT-based health education interventions have been conducted [22-25]. In these studies, the intervention group received information about a health threat and suggested preventive behaviours, while the control group received no information. In a review, Milne *et al.* [24] found that PMT interventions significantly affect PMT constructs, but have limited effects on behaviour.

One reason that PMT interventions do not always change behaviour is that changing motivation is only the first step to changing behaviour. Heckhausen [26] proposed that goal achievement occurs in two phases. First, there is a motivational phase, analogous to models like PMT, where individuals form an intention. Second, there is a volitional phase, where individuals form a plan stating when, where and how they will achieve their intention. Planning interventions promote behaviour change [27] and have been found to be particularly effective in encouraging people to eat a healthy diet [28-30] and exercise more [24, 31-35].

The present study used action and coping plans (cf. Sniehotta *et al.* [34]). Action planning involves individuals completing a planning sheet stating when, where and how they will achieve a behavioural goal over the next week. Coping plans outline how to deal with barriers to goal achievement. Sniehotta *et al.* [34] found that cardiac patients who formed action and coping plans exercised more than patients who did not form plans.

Nonetheless, studies by Milne *et al.* [24] and Prestwich *et al.* [31] show that interventions which target both motivational and volitional processes are the most effective way to promote behaviour change. Specifically, participants who received a motivational intervention *prior* to completing a plan engaged in significantly more exercise than control groups and/or groups that received a motivational or volitional intervention. To date, no studies have been carried out to examine the ability of a combined motivational and volitional intervention to promote behaviour change for multiple behaviours. Therefore, the present study combines a PMT-based motivational leaflet with a planning intervention to promote dietary and exercise behaviour change among UK undergraduates in a longitudinal study.

Three hypotheses were tested:

Hypothesis 1. The motivational intervention will increase scores on PMT variables relative to control.

Hypothesis 2. The volitional intervention will promote behaviour change relative to control at Time 3.

Hypothesis 3. The combined motivational and volitional intervention will promote behaviour change significantly more than all other conditions at Time 3.

2. Materials and methods

2.1 Design and Participants

Independent-groups design was used, with participants randomized to one of four conditions: control, motivational intervention (PMT), volitional intervention (Action Plan &

Coping Plan (APCP)), motivational plus volitional intervention (PMT&APCP).

Randomization was via a computer-generated sequence generated by the second author. The second author printed all study materials and put them into unmarked envelopes following the random sequence; this ensured the first author (who did the data collection) was blind to study condition. The study was carried out three times over a four-week period from March to June 2008. The motivational intervention was delivered at Time 1, and the volitional intervention was delivered at Time 2.

Participants who do not have diabetes history were eligible for inclusion in this study. The study was designed to have 80% power to find a medium effect size. Using these assumptions, we aimed to recruit 128 participants. One-hundred seventy three students studying at a UK university completed measures at Time 1. Two weeks later (Time 2), 112 students completed measures. Four weeks after Time 1 (Time 3), 84 participants (48% of the initial sample) completed measures. Twenty-nine participants received course credit for completing the study, while the remaining 55 volunteers did not. The final sample consisted of 43 males and 41 females, aged between 18-24 years ($M=20.56$, $SD=1.62$).

2.2 Procedure

Figure 1 shows the study procedure. At time 1, all participants gave written consent prior to participate and completed measures of age, gender, previous exercise and dietary behaviour. Next, participants were randomized to condition: Participants in PMT and PMT&APCP groups received the motivational intervention then completed the PMT questionnaire. Participants in Control and APCP groups just completed the questionnaire. Time 1 measurement was carried out in laboratory and library settings.

At Time 2, participants completed the PMT questionnaire and reported their behavior over the last two weeks. All questionnaires were sent and received by email. After completing the PMT questionnaire and behavior measures, participants in APCP and PMT&APCP groups

received the volitional intervention. Participants in the control and PMT groups did nothing further. At Time 3, all participants completed measures of PMT variables and behaviour via email before receiving a debrief outlining the study aims.

2.3 Interventions

2.3.1 Motivational intervention (PMT/PMT&APCP groups)

The motivational intervention was a leaflet containing information from the websites of Diabetes UK, the NHS, the American Diabetes Association, and WHO, designed to target PMT variables in relation to type 2 diabetes¹. For example, perceived severity was targeted by stating ‘If diabetes is not treated it can lead to many health problems Heart disease and stroke, foot complications, kidney disease, eye complications, diabetic neuropathy and nerve damage, and skin complications.’ Self-efficacy was targeted by stating ‘Most young adults are able to stick to a healthy diet and engage in regular exercise.’

2.3.2 Volitional intervention (APCP/PMT &APCP groups)

Participants in the volitional condition completed action and coping planning sheets adapted from Sniehotta *et al.* [34]. For exercise, the action plan form started with the instruction, ‘Exercise is known as physical activity and includes anything that gets you moving. Ideally you should take twenty minutes of vigorous exercise at least three times a week. Please think about when, where, and how you plan to be physically active. Please write down your exercise plans for next week using the form below. The more precisely, concretely and personally you formulate your plans, the more they will help you.’ The form contained three rows headed Plan 1, Plan 2 and Plan 3, and four columns labelled ‘Where’, ‘When’, ‘How’, and ‘With whom’. The exercise coping planning sheet started with the questions, ‘Which obstacles or barriers might interfere with the implementation of your exercise plans?’ and ‘How could you successfully cope with such problems?’ The healthy diet action planning

¹ The leaflet is available on request from the first author.

sheet was the same as the exercise sheet except the text read, ‘Healthy eating is a diet low in fat and high in fruit and vegetables and fibre. Please make a healthy diet plan for next week using the form below.’ The coping planning sheet asked about ‘your healthy eating plans.’

2.4 Measures

2.4.1 Diet and exercise behavior measures

Baseline dietary behaviour was measured by using four items from BUPA Wellness Health Check Questionnaire [36]: ‘How often do you eat bread, cereal, potatoes, rice or pasta? 1) as part of every meal 2) as part of 1 or 2 meals every day 3) never or hardly ever’; ‘How many pieces of fruit or portions of vegetables do you eat per day? 1) 5 or more 2) 3-4 3) 1-2 4) none’; ‘How often do you eat fat or sugary food, e.g. biscuits, chocolate, fried food or savory snacks? 1) rarely or never 2) 2-3 times a week 3) everyday’; and ‘How often do you eat food cooked in animal fat (butter or lard)? 1) rarely or never 2) 2-3 times a week 3) everyday’.

Dietary behaviour was measured at time 2 and 3 by the frequency of eating 31 commonly consumed foods, which were adapted from the Food Frequency Questionnaire (FFQ) developed by Cade and Margetts [37-38] that has shown good validity. Responses from the FFQ were combined with standard portion size data and nutritional data to compute the fruit and vegetable intake (i.e. portions of fruit and vegetables consumed per day) and fat intake (i.e. percentage food energy from fat). We adapted the FFQ measure reported by Conner *et al* [39] using their definition of healthy diet as comprising a diet high in fruit and vegetable consumption and low in fat intake. Exercise was measured at all timepoints using two items from Milne *et al.* [24]: ‘Did you engage in vigorous exercise for at least 20 minutes last week (e.g. sport, swimming, aerobics, dancing, running, or walking briskly)? (Yes / No)’, and ‘If so, how many times?’

2.4.2 PMT Questionnaire

PMT variables were adapted from Milne *et al.* [24]. Vulnerability was measured by

two items e.g., ‘My chance of developing type 2 diabetes in the future are very high (strongly disagree – strongly agree)’. Severity was measured by two items, e.g., ‘If I were to develop type 2 diabetes I would develop other serious complications (strongly disagree – strongly agree)’. Fear was measured by response to the statement, ‘The thought of developing type 2 diabetes makes me feel ...’ on four bipolar scales (e.g., not at all frightened – very frightened). Response efficacy for eating a healthy diet and exercise were measured by three items, e.g., ‘Eating a healthy diet (Taking at least three 20-minute sessions of vigorous exercise per week) will reduce my chances of developing type 2 diabetes, strongly disagree – strongly agree. Self-efficacy for eating a healthy diet and exercise was measured by four items, e.g., ‘I have the confidence to eat a healthy diet (take part in at least three 20-minute sessions of vigorous exercise) during the next week (strongly disagree – strongly agree)’, (strongly disagree – strongly agree)’. Intention to eat healthy diet and exercise was measured by three items, e.g., ‘I intend to eat a healthy diet (take part in at least three 20-minute sessions of vigorous exercise) during the next week (strongly disagree – strongly agree)’. Each statement was measured on a 5-point response scale. All constructs were internally consistent (Cronbach’s alpha $>.70$ at all three time points).

2.5 Data analysis

Data analysis proceeded in three steps. First, data screening, randomisation checks and drop-out analyses were conducted. Second, the effect of interventions on PMT variables was tested. Third, the effect of interventions on behaviour was tested.

3. Results

3.1 Data screening, randomization checks and drop-out analyses

Data screening identified four outliers for exercise behaviour and no outliers for dietary behaviours. In order to reduce the influence of the outliers, data for exercise were transformed using square root transformation. After this transformation, there were no longer

any outliers, so transformed data was used in all analyses. No significant group differences were found in age, gender, baseline exercise or baseline dietary behaviours, suggesting randomisation was successful. Chi-square analysis found no significant difference in dropout rates between groups at Time 2 ($\chi^2(3) .66, p = .88$) or Time 3 ($\chi^2(3) .29, p = .96$). Drop-out analyses were carried out using independent t-tests. The 61 participants who dropped out at Time 2 did not differ from participants who completed Time 2 measures on any study variable at Time 1. The 28 participants who dropped out at Time 3 did not differ from participants who completed Time 3 measures on any study variable at Time 2.

3.2 Effects of interventions on PMT variables

Table 1 presents the means, standard deviations and Cronbach's alpha values for study variables. Three-way mixed ANOVAs were run to explore the effects of the interventions, over time, on PMT variables. Analysis revealed significant main effects for the motivational intervention, no main effects for the volitional intervention, or time, on all PMT variables (see Table 2). The motivational intervention produced the biggest changes in response efficacy for eating a healthy diet ($F(1,80) = 64.96, p < .001, \eta^2 = .45$) and taking regular exercise ($F(1,80) = 75.16, p < .001, \eta^2 = .48$), respectively. There was an interaction between the volitional intervention and time for perceived severity ($F(2,160) = 5.72, p < .01, \eta^2 = .07$). Participants who received the volitional intervention had higher severity scores than participants who did not receive this intervention at Time 2 only. There was a significant three-way interaction for exercise self-efficacy ($F(2,160) = 5.20, p < .01, \eta^2 = .06$). To interpret the three-way interaction, ANOVAs were run for each timepoint with motivation and volition as independent variables and exercise self-efficacy as the dependent variable. Examination of plots revealed little evidence of an interaction at Time 1 or 2. At Time 3 there was some evidence of a crossover effect, with participants in the volition only condition having the lowest exercise self-efficacy, whereas participants in the combined group had the highest

exercise self-efficacy. Overall, findings suggest that the motivational intervention successfully targeted PMT variables, providing support for hypothesis 1.

3.3 Effect of interventions on behaviour

Three-way mixed ANOVAs were conducted to test the effect of interventions, over time, on fat intake, fruit and vegetable consumption and exercise behaviour. For dietary behaviours, the baseline measures were added as covariates. Analysis for fat intake revealed a main effect for the motivational intervention ($F(1,79) = 10.05, p < .05, \eta^2 = .11$), no main effects for the volitional intervention, time, or the covariate. Participants who received the motivational intervention had lower fat intake ($M = 30.36, SD = 1.27$) compared with participants who did not received the intervention ($M = 36.14, SD = 1.30$). There was a significant three-way interaction ($F(1,79) = 10.63, p < .01, \eta^2 = .12$), and two-way interactions between motivational intervention and time ($F(1,79) = 13.54, p < .001, \eta^2 = .15$) and volitional intervention and time ($F(1,79) = 13.72, p < .001, \eta^2 = .15$). Firstly, participants who received the motivational intervention decreased their fat intake at Time 3. Secondly, participants who received the volitional intervention reduced their fat intake at Time 3.

Analysis for fruit and vegetable consumption revealed a main effect for the motivational intervention ($F(1,79) = 21.98, p < .001, \eta^2 = .22$), no main effects for the volitional intervention or time, and a significant effect of the covariate ($F(1,79) = 12.33, p < .01, \eta^2 = .14$). Participants who received motivational intervention had higher fruit and vegetable consumption ($M = 3.50, SD = 0.12$) compared with those who did not receive the intervention ($M = 2.72, SD = 0.12$). There was a significant interaction between motivational intervention and time ($F(1,79) = 5.68, p < .05, \eta^2 = .07$); participants who received the motivational intervention increased fruit and vegetable consumption at Time 3.

Analysis for exercise revealed main effects for the motivational intervention ($F(1,80) = 7.62, p < .01, \eta^2 = .09$) and time ($F(2,160) = 2.97, p < .01, \eta^2 = .08$) and no main effect for

the volitional intervention. Participants who received the motivational intervention did more exercise ($M = 1.16$, $SD = 0.10$) compared with those who did not receive this intervention ($M = 0.69$, $SD = 0.10$). Participants engaged in significantly more exercise at Time 3 ($M = 1.05$, $SD = 0.07$) compared with Time 1 ($M = 0.87$, $SD = 0.08$) or Time 2 ($M = 0.86$, $SD = 0.08$; $p = .01$ for both comparisons). There were significant interactions between motivational intervention and time ($F(2,160) = 4.08$, $p < .05$, $\eta^2 = .05$), and between volitional intervention and time ($F(2,160) = 7.25$, $p = .01$, $\eta^2 = .08$). Firstly, participants who received the motivational intervention increased their exercise at Time 3. Secondly, participants who received the volitional intervention increased their exercise at Time 3. Overall, results do not support hypothesis 2.

To test hypothesis three, planned contrasts were performed using independent-groups t-tests to compare Time 3 behaviour for the combined group with other groups. Participants who received the combined intervention had significantly lower fat intake ($M = 26.03$, $SD = 6.92$) than participants who received the motivational intervention ($M = 32.31$, $SD = 8.36$), the volitional intervention ($M = 36.73$, $SD = 9.06$) and the control group ($M = 36.27$, $SD = 9.27$; $2.68 < t < 4.28$, all comparisons $p < .01$, see Figure 2).

Participants who received the combined intervention had significantly higher fruit and vegetable consumption ($M = 3.95$, $SD = 0.84$) compared with participants in the volitional intervention ($M = 2.82$, $SD = 0.73$; $t(41) = 4.78$) and the control group ($M = 2.74$, $SD = 0.87$; $t(41) = 4.54$; both p 's = .000). There was a trend towards higher consumption for combined group compared with the motivational intervention group ($M = 3.47$, $SD = 0.87$; $t(41) = 1.83$, $p = .08$; see Figure 3).

Participants who received the combined intervention had significantly higher exercise levels ($M = 1.59$, $SD = .33$) compared with participants who received the motivational intervention ($M = 1.07$, $SD = 0.64$) the volitional intervention ($M = 0.75$, $SD = 0.71$) and the

control group ($M = 0.78$, $SD = 0.64$; $2.85 < t < 5.23$, all comparisons $p < .01$, see Figure 4). In sum, results support hypothesis 3.

4. Discussion

This is the first longitudinal study to use a combined motivational and volitional intervention to promote behaviour change for multiple behaviours (exercise and dietary behaviour) to reduce the risk of developing type 2 diabetes among UK undergraduates.

The motivational intervention had significant positive effects on PMT variables providing support for hypothesis 1. Results support Milne *et al.* [24] that manipulation of specific PMT variables can produce successful changes in corresponding variables. Compared with previous PMT-based interventions [37, 38], the present intervention not only produced significant changes for coping appraisals (response efficacy, self efficacy), but also significant changes for threat appraisals (perceived vulnerability, perceived severity, fear). The motivational intervention also increased participants' intentions. The results consolidate the utility of PMT as a way to increase individuals' motivation to achieve health goals [24].

There are several reasons for the impact of the leaflet on PMT variables. First, the leaflet was designed to target PMT variables, using information closely linked to PMT constructs. Thus, there was a clear overlap between leaflet information and theory variables as recommended by Michie and Prestwich [15]. Second, the leaflet was tailored for young people, referring to developmental trends in the disease among young adults, potentially heightening the personal relevance of the information and increasing threat appraisals. Third, the leaflet provides clear definitions of 'healthy diet' and 'exercise', providing participants with information about how they can reduce their risk. Finally, the leaflet recommended different ways to incorporate physical activities and healthy dietary behaviour into their daily life. Therefore, participants might feel that it is quite easy for them to follow the recommendations and increase their coping appraisals (see Table 2). The success of the

present study confirmed Abraham and Sheeran's view [42] that an effective health education intervention should specify the focal behaviour and involve its target population.

The present study also tested the impact of a volitional intervention, completing action and coping plans for exercise and diet at Time 2, as a way to promote increased levels of exercise and improve dietary behaviour. In contrast to previous research, [24, 28-35] there was no significant effect of receiving the volitional intervention on either dietary or exercise behaviour. Thus the present study found no evidence to support hypothesis 2. There are several reasons why the volitional intervention did not change behaviour. One explanation is that because planning was done using online forms, participants did not fully engage with the task and formed sub-optimal plans. However, participants in the combined group also completed plans online, and this group engaged in behaviour change. A more plausible explanation, is that the volition only group had low motivation, which lead to poor planning; scores on PMT variables for the volition only group were similar to scores for the control group, indicating lower motivation than groups who received the motivational intervention. It has been shown that planning interventions are rarely successful when individuals are not also motivated [43-46].

The combination of the motivational and volitional interventions (i.e. the PMT&APCP group) increased exercise behaviour and decreased fat intake, relative to all other conditions, and promoted fruit and vegetable consumption relative to control and volitional groups, with a trend for the combined group to consume more fruit and vegetables than the motivation only group. These results provide good support for hypothesis 3, and provide the first evidence, that we are aware of, that combined interventions can successfully promote multiple health behaviours at the same time. Therefore, study results are mostly consistent with previous research demonstrating that interventions which target motivation and volition are superior to interventions targeting either motivation or volition in promoting behaviour change [24, 31].

Together, these findings confirm the views of Heckhausen [26] and Sniehotta [47] that behaviour change subsumes two mental stages, a motivational stage and a volitional stage. In the motivational phase, individuals weigh up the pros and cons of behaviour, and then make a decision whether or not to perform that behaviour. In the volitional phase, individuals form a plan to link the specific cues (where, when) with specific response (how), and thus these connections lead to the performance of behaviour when the individuals meet the specific cues. Therefore, motivational and volitional phases are two essential and qualitatively different stages in the process of behaviour change.

5. Implications and future directions

This study used a novel intervention that combining motivational and volitional elements to promote multi-behaviour changes over time, following the recommendations for theory-based interventions [15]. The findings of the present study have implications for campaigns aimed at the prevention of type 2 diabetes. They suggest that the combination of motivational and volitional interventions is most effective in promoting exercise and dietary behaviour change among UK undergraduates. Further interventions need to be run with clinical and general samples to see if this approach is equally effective. Jackson *et al.*'s [43] study is a clear example that volition only interventions do not always promote behaviour change in clinical populations, although Sniehotta *et al.*'s [34] study shows that volition only interventions can be successful with a motivated clinical population.

The present study confirms the impact of combined motivational and volitional interventions for promoting exercise behaviour [24, 31] and provides the first example of how combined intervention can promote a healthy diet. Further studies examining the impact of combined interventions on other health behaviours are now needed. In particular, we need research that tests combined interventions for health risk behaviours (e.g., alcohol consumption, smoking) because it is not guaranteed that interventions which lead to

behaviour change for health promoting behaviours (like diet and exercise) will be equally effective for health risk behaviours.

Finally, in tackling serious health conditions, such as type 2 Diabetes, it is important to attempt to modify multiple behaviours, for example diet and exercise, as changing both behaviours is a more effective strategy for preventing type 2 Diabetes than modifying either behaviour alone.

6. Limitations

First, drop-out rates were high in the present study. Thus, the data were collected only from certain kinds of participant – those who were willing to spend time completing the questionnaires across three time-points. This can create a biased sample and may have affected and limited the results obtained. Nonetheless, drop-out analyses show no differences between participants who completed measures at T1, T2 and T3 and those who only completed T1 or T1 and T2 measures, and there were no group differences in drop-out rates. Second, PMT variables were not measured at baseline. So, differences in PMT variables between participants who received motivational intervention and those who did not may not have been caused by motivational intervention, but might already have existed among the two groups before they came to participate in this study. However, randomization check on Type 2 diabetes-related behaviour found no differences between the groups, meaning it is unlikely the groups differed at baseline. Finally, the follow-up period was relatively short in the present study. In future studies, the longer-term impact of the combined motivational and volitional intervention on subsequent behaviour should be assessed.

In conclusion, the present study supports the idea that combining motivational and volitional interventions is the most effective way to promote behaviour change.

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Table 1. Means, standard deviations, and alpha co-efficients for study variables

Variable	M (SD)			Alpha		
	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3
Perceived vulnerability	3.05 (1.10)	3.10(1.06)	3.10(1.03)	.93	.90	.94
Perceived severity	3.91(.83)	3.94(.84)	3.90(.84)	.79	.82	.85
Fear	3.46(.76)	3.49(.74)	3.51(.69)	.93	.91	.91
Response efficacy (exercise)	4.11(.71)	4.09(.75)	4.12(.73)	.80	.80	.79
Self-efficacy (exercise)	3.71(.77)	3.69(.80)	3.71(.77)	.92	.87	.95
Intention (exercise)	3.48(.66)	3.49(.65)	3.51(.67)	.89	.94	.89
Exercise behaviour*	.88(.73)	.87(.73)	1.06(.71)	-	-	-
Response efficacy (diet)	4.05(.78)	4.04(.79)	4.05(.80)	.72	.84	.81
Self-efficacy (diet)	3.67(.76)	3.68(.81)	3.68(.74)	.92	.94	.93
Intention (diet)	3.56(.74)	3.62(.74)	3.57(.76)	.91	.89	.94
Fat intake (%)	-	33.60(8.71)	32.92(9.30)	-	-	-
Fruit and vegetable intake	-	2.99(.98)	3.25(.94)	-	-	-

Note. *Exercise behaviour values are after square root transformation

Table 2. Analyses testing main effects of interventions and interactions, over time, on study variables

Variable	Time	Control	PMT	APCP	PMT& APCP	Motivation	Volition	Time	Motivation	Motivation	Volition	Motivation
		N = 22	N = 21	N = 19	N = 22				x volition	x Time	x Time	x Volition
		M (SD)	M (SD)	M (SD)	M (SD)							
1 Perceived vulnerability	T1	2.43(.89)	3.3(1.01)	2.53(.75)	3.84(1.06)	30.88(.00)	2.11 (.15)	1.41(.25)	1.93(.17)	.05(.95)	1.56(.21)	3.07(.05)
	T2	2.55(.79)	3.36(.96)	2.55(.85)	3.91(.97)							
	T3	2.59(.70)	3.33(.95)	2.47(.77)	3.90(.98)							
2 Perceived severity	T1	3.45(.69)	4.36(.73)	3.66(.96)	4.16(.62)	21.52(.00)	.06 (.81)	.87(.42)	1.21(.28)	1.04(.36)	5.72(.00)	.43(.65)
	T2	3.41(.77)	4.31(.78)	3.71(.95)	4.31(.52)							
	T3	3.43(.66)	4.40(.75)	3.57(.93)	4.18(.65)							
3 Fear	T1	3.08(.50)	3.77(.80)	3.07(.74)	3.80(.74)	28.23(.00)	.09 (.76)	.96(.39)	.01(.94)	.66(.52)	1.26(.29)	1.72(.18)
	T2	3.11(.52)	3.83(.71)	3.20(.72)	3.80(.73)							
	T3	2.68(.57)	3.76(.94)	2.74(.87)	3.95(.84)							
Diet												
4 Response efficacy	T1	3.61(.55)	4.54(.56)	3.44(.82)	4.56(.45)	64.96(.00)	.33 (.56)	.43(.65)	.76(.38)	1.07(.35)	.57(.57)	1.36(.26)
	T2	3.58(.54)	4.53(.57)	3.44(.46)	4.58(.79)							
	T3	3.62(.56)	4.54(.57)	3.39(.81)	4.59(.49)							
5 Self-efficacy	T1	3.31(.74)	3.94(.59)	3.42(.78)	4.15(.67)	36.71(.00)	.01 (.92)	.40(.67)	.07(.80)	3.01(.05)	.71(.93)	2.39(.10)
	T2	3.21(.82)	3.93(.69)	3.51(.74)	4.09(.68)							
	T3	3.36(.73)	3.95(.58)	3.33(.78)	4.15(.66)							
6 Intention	T1	3.23(.62)	3.87(.68)	3.04(.71)	4.10(.53)	35.82(.00)	.04 (.84)	2.49(.08)	2.92(.09)	1.14(.32)	.13(.88)	.40(.67)
	T2	3.31(.52)	3.86(.61)	3.12(.80)	4.13(.59)							
	T3	3.24 (.62)	3.88(.68)	3.06(.79)	4.17(.85)							
7 Fat intake (%)	T2	35.57(9.76)	31.92(8.07)	36.36(8.88)	30.85(7.23)	10.05(.00)	.62 (.44)	.31(.58)	1.13(.29)	13.54(.00)	13.72(.00)	10.63(.00)
	T3	36.27(9.27)	32.31(8.36)	36.73(9.59)	26.03(6.92)							

8 F&V intake	T2	2.81(1.05)	3.29(.78)	2.63(1.07)	3.18(.78)	21.98(.00)	.51 (.48)	.32(.58)	2.11(.15)	5.68(.02)	3.13(.08)	1.41(.24)
	T3	2.81(.73)	3.47(.87)	2.74(.87)	3.95(.84)							
Exercise												
9 Response efficacy	T1	3.62(.56)	4.56(.43)	3.59(.66)	3.57(.66)	75.16(.00)	.02 (.89)	.56(.57)	.42(.52)	.30(.74)	1.31 (.27)	.46(.63)
	T2	3.61(.65)	4.52(.45)	3.58(.72)	4.64(.41)							
	T3	3.65(.55)	4.57(.42)	3.54(.69)	4.65(.40)							
10 Self-efficacy	T1	3.31(.74)	3.94(.59)	3.42(.78)	4.15(.67)	20.38(.00)	1.14 (.29)	.25(.78)	.04(.84)	.47(.63)	3.03 (.05)	5.20(.01)
	T2	3.21(.82)	3.93(.69)	3.51(.74)	4.09(.68)							
	T3	3.36(.73)	3.95(.58)	3.33(.78)	4.15(.66)							
11 Intention	T1	3.25(.50)	3.84(.63)	3.02(.56)	3.88(.58)	34.00(.00)	.43(.52)	1.45(.24)	1.26(.27)	1.24(.29)	.19 (.83)	.03(.98)
	T2	3.24(.48)	3.78(.63)	3.03(.60)	3.85(.56)							
	T3	3.25(.50)	3.84(.63)	3.02(.56)	3.88(.58)							
12 Exercise behaviour	T1	.77(.69)	1.08(.72)	.52(.78)	1.10(.64)	7.62(.00)	.03(.86)	7.30(.00)	.33(.57)	4.08(.02)	7.25 (.00)	2.68(.07)
	T2	.77(.69)	1.11(.67)	.52(.78)	1.03(.68)							
	T3	.78(.64)	1.07(.77)	.75(.71)	1.59(.33)							

Note. PMT = motivational group, APCP = volitional group, PMT&APCP = combined motivational and volitional group; F&V = fruit and vegetable.

p values are in brackets after F values.

Figure list

Figure 1. Consort flow diagram of participant recruitment and follow-up over time.

Figure 2. Percentage of food energy derived from fat by condition over time.

Figure 3. Portions of fruit and vegetables consumed per day in by condition over time.

Figure 4. Sessions of exercise engaged in per week by condition over time.







