Improving fruit and vegetable consumption: a self-efficacy intervention compared with a combined self-efficacy and planning intervention

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Abstract

Effects of interventions targeting self-efficacy alone or combined with action plans were examined in the context of fruit and vegetable consumption. E-mail messages were sent to a self-efficacy group, a combined self-efficacy and action planning group and a control group. At a 6-month follow-up, 200 adults reported their fruit and vegetable consumption, along with current levels of self-efficacy and planning. The two experimental groups gained equally from the interventions, as documented by changes in behavior. In both intervention groups, change in respective cognitions predicted change in fruit and vegetable consumption. Parsimonious interventions might contribute to health behavior change.

Introduction

Increasing fruit and vegetable intake in the general population is one of the major concerns and aims of health promotion programs across the world [1]. Self-efficacy is among the factors most strongly and consistently associated with higher consumption of fruit and vegetables [2, 3]. Perceived self-efficacy is concerned with individuals’ beliefs in their capability to exercise control over challenging demands and their own functioning. These self-regulatory cognitions determine whether actions will be initiated, how much effort will be expended and how long it will be sustained in the face of obstacles and failures. Self-efficacy can be enhanced by verbal persuasion (e.g. a health educator reassures patients that they will certainly maintain a healthy diet due to their competence) [4].

Showing why an intervention works is as important as providing the evidence that it works [5]. A large body of evidence suggests that enhancing self-efficacy results in nutrition change [2]. One of the mechanisms explaining why social-cognitive interventions work is that they enhance social cognitions, which, in turn, affect behavior change. Therefore, changes in self-efficacy beliefs evoked by a self-efficacy intervention may mediate the effects of an intervention on health behavior [4, 6, 7].

Action plans (or implementation intentions) translate intentions into specific actions and into situational circumstances of performance [8, 9] by specifying the ‘when’, ‘where’, and ‘how’ of a desired action. Planning may be particularly beneficial for individuals who intend to act [10]. Research showed that individuals who made action plans ate less fat at 1-month follow-up [11]. People who were asked to plan exactly what they would eat and drink on one selected day reported consuming significantly more healthy foods and beverages over the 5 days following the intervention [12].

Forming plans facilitates goal attainment by increasing automatic responses to cues [13]. However, some evidence suggests that planning interventions may work, at least in part, because they

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Encourage participants to plan their own actions more frequently [14, 15]. Consequently, we investigated whether a change in frequency of action planning may mediate the effects of the planning intervention on fruit and vegetable consumption.

The effects of a self-efficacy intervention may be enhanced by addressing other cognitions, such as action planning. A combined planning and self-efficacy intervention may result in changes in both self-efficacy and use of the planning strategy. This combination may lead to more salient behavior change, as compared with a plain self-efficacy intervention. However, previous studies suggest that a combined intervention targeting the theory of planned behavior (TPB) components and action plans did not result in further improvement of healthy nutrition than an intervention addressing the TPB components only [16].

Web-based or e-mail-delivered interventions frequently use tailored feedback as a basis for the intervention. In health education, tailoring is defined as ‘any combination of information or change strategies intended to reach one specific person, based on characteristics that are unique to that person, related to the outcome of interest’ [17], (p. 5). The content of the intervention is tailored, depending on previous responses to a set of questions. For example, an intervention may include computer-generated nutrition information tailored to participants’ nutrition, intentions or self-efficacy, and it may affect individuals’ fruit and vegetable consumption [18].

Usually web- or e-mail-based interventions focus on educating the participants about necessary changes in their diet [19, 20]. Participants of educational web-based interventions reduced their fat and increased fruit and vegetable intake [for a review see 20]. However, participants’ cognitions are usually not targeted by the interventions directly.

The effects of nutrition education are usually studied directly after the intervention [19]. Follow-up data collection takes place within 3–10 weeks after the intervention [18, 20]. Although these interventions seem to be effective for weeks after the intervention, it is necessary to investigate whether the effects may be maintained (i.e. for at least 6 months).

Aims

The present study investigates the long-term effects of a self-efficacy intervention and a combined self-efficacy and action planning intervention on fruit and vegetable consumption. It was hypothesized that both interventions would result in changes in fruit and vegetable consumption at 6 months after the intervention, whereas no changes in fruit and vegetable consumption were expected in the control group. Additionally, it was hypothesized that (i) in the self-efficacy intervention group, change in self-efficacy would mediate the effects of the intervention on change in fruit and vegetable consumption and (ii) in the self-efficacy and action plan intervention group, changes in both self-efficacy and action plans would mediate the effects of the intervention on change in fruit and vegetable consumption.

Method

Participants

At Wave 1, the questionnaires were filled out by 285 individuals who (i) were adults, (ii) had a body mass index (BMI) of ≥18, (iii) were not vegetarians or vegans, (iv) provided a valid e-mail address and (v) had no metabolic or gastrointestinal diseases. (Overall, 402 individuals took part in Wave 1. The following participants were excluded: 47 children, 27 respondents with BMI <18, 35 respondents who were vegetarians or vegans, 22 individuals who refused to provide their e-mail address, 33 respondents who reported at least one metabolic or cardiovascular disease.) One month after Wave 1 data collection, participants were randomly assigned to (i) an experimental group with a self-efficacy treatment, (ii) an experimental group with a combined self-efficacy and planning treatment or (iii) a control group. Six months after the intervention, 200 participants (70.2%) filled out the follow-up questionnaire.

Respondents from the final sample were 18–60 years old (M = 28.98, SD = 9.78), 34% were men, and 26% were overweight or obese. Most of the respondents were single (63%); 5.6% had
completed primary education, 35.9% secondary education and 58.6% tertiary education. Almost half of the participants (45%) reported some chronic health condition. The most frequently reported health concerns were allergies (8.5%), hypertension, heart or circulation diseases (10.5%).

**Procedure**

Data were collected on-line. The time lag between receiving the intervention delivered by e-mail and follow-up measurement was 6 months. At Wave 1, the study was advertized on four Internet websites: a journalism-related website for youths, a health-related website, a lifestyle-related website for women and a website with cooking recipes. After clicking on the advertisement, the Internet users were linked to an invitation to take part in the study. The invitation informed about the originators and the aim of the study and assured confidentiality. Those who agreed to participate in the study were referred to a website that included questionnaire instructions and a link to a self-administered questionnaire. Provision of an e-mail address was not a pre-requisite for taking part in the study, but participants were invited to leave their e-mail address if they wanted to receive feedback about their results and to participate in an intervention and data collection at 6 months after the intervention (Wave 2).

Wave 1 data were collected for 30 days. Thirty days after closing on-line data collection, the experimenters sent an e-mail including either the intervention or the information for the control group. Sending the intervention lasted for 30 days. Six months after the intervention had been sent, participants received an invitation to fill out the second questionnaire (Wave 2) with the link to the website with a self-administered questionnaire.

In the final longitudinal dataset, 2.5% of data were missing. To impute missing data, multivariate regression with self-efficacy, action plans, fruits and vegetables entered as respective predictors was employed.

**Intervention**

All participants who provided their e-mail address were randomly assigned to (i) the self-efficacy intervention group, (ii) the self-efficacy and action plans intervention group or (iii) the control group. In the final sample that was analyzed (n = 200), there were 68, 73 and 59 participants of the respective groups. The study was introduced as an intervention targeting healthy nutrition, in particular consuming five portions of fruit and vegetables per day (portions were defined by means of examples). The intervention was individually tailored, that is, (i) the letter contained a personal salutation and (ii) participants received individual feedback about their self-efficacy scores.

The ‘self-efficacy intervention’ (sent to participants of the self-efficacy intervention group and the combined self-efficacy and action plan intervention group) consisted of three parts: (i) information on the importance of self-efficacy for goal pursuit and why it is necessary to enhance or maintain high self-efficacy, (ii) feedback regarding a participant’s results in a measure of self-efficacy compared with the average self-efficacy level in the total Wave 1 sample and (iii) information regarding ways to increase self-efficacy.

First, self-efficacy was defined, and participants were briefly informed about the studies targeting self-efficacy and nutrition that helped people to act as intended. This part concluded that one of the ways to better one’s nutrition is to build strong self-efficacy for dealing with barriers that arise when someone tries to act as intended.

Self-efficacy scores were trichotomized in participants of Wave 1, who received feedback about the average level of self-efficacy beliefs in the total sample. Next, they were informed whether their own scores were equal to, above or below the average scores. Enhancing feedback followed (‘It is very important to harbor optimistic self-beliefs’, ‘Even if it may seem a bit low, one can easily strengthen these beliefs in order to reach one’s own goals easier and faster’.).

In the following part of the intervention, self-efficacy beliefs were enhanced by verbal persuasion. Participants were asked to recollect an event in which they successfully adhered to and acted according to their intentions and to write down their recollections. For example, they were asked the following:
Please try to recollect a situation when you decided not to eat some less healthy food (e.g., fat or sweet snacks) and to eat or drink something healthy instead, (e.g., eat fruit or vegetables or drink water or herbal tea), or not to eat anything. At least sometimes you certainly managed to stick to your decision, although you craved this less healthy food. Try to recollect the circumstances in which this situation took place (Where was it? What type of food was it?). You may have felt some positive feelings that accompanied the successful achievement of your goal. In any case, you can be proud of yourself now and feel that you are successful in achieving what you intended to do and sticking to your decisions.

Finally, participants’ positive emotions were enhanced by supportive feedback that they were effective and successful: ‘This experience shows that you can be successful and act effectively, if you only wish. You are able to repeat this successful mastery experience in other situations, such as eating a healthy diet that includes five portions of fruit and vegetables per day’.

The ‘action plan intervention’ (sent to the combined self-efficacy and action plan intervention group) consisted of an introduction to action planning and a planning form. Respondents were instructed that they would be asked to form a plan regarding their healthy lifestyle, and that their plans should always include ‘the information about when, where, and how you will maintain your healthy lifestyle’. Later, they received information about what their action plans should include (‘If you make an action plan, you should always include details referring to what, when, where, and how you will act’). Participants were informed that planning is a successful strategy (‘There is a lot of research showing that action plans are powerful and useful if someone wants to change a behavior into a healthier one’).

Finally, they were asked to write down their action plans regarding healthy nutrition (i.e. when, where and how they will eat fruit and vegetables during the next week). They were also asked to plan how they would behave in a tempting situation, namely if someone offers them unhealthy food, or if they crave something unhealthy: ‘If I will be in situation ... (please, write down the circumstances), I plan to ... (please, write down how you will react)’.

The ‘control group’ message referred to the importance of maintaining a healthy nutrition. Participants received a letter that focused on the importance and value of seeking help from family or friends if they fail to act as intended or if they continue to eat an unhealthy diet.

**Measures**

‘Consumption of fruit and vegetables’ was measured at both waves by one item: ‘Within the last two weeks, how often have you eaten a portion of fruit and/or vegetables (excluding potatoes)’? Responses were given on a scale ranging from 1 to 7 (‘once per week or less’, ‘a few times per week’, ‘once a day’, ‘twice per day’, ‘three times per day’, ‘four times per day’ and ‘more than four’). On average, respondents declared eating fruit and vegetables twice a day (M = 3.66, SD = 0.92 at Wave 1; M = 3.90, SD = 1.13 at Wave 2).

‘Intention’ was measured with a single item, ‘Within the next months I intend to eat more portions of fruit and vegetables every day’. Responses were given on a scale from 1 (‘definitely not’) to 4 (‘exactly true’). At Wave 1, the majority (78%) of participants declared an intention to change their consumption. The average was 3.07 (SD = 0.84) at Wave 1 and 2.94 (SD = 1.11) at Wave 2.

‘Self-efficacy’ at both waves was measured with three items. The stem ‘It is important to stick to a healthy diet. How certain are you that you are able to maintain a healthy diet ...’ was followed by: (a) ... even if I would have to change various daily nutrition habits, (b) ... even if I would have to invest additional effort to convince others that I really want to stick to a healthy diet, (c) ... even if I would have to change my habits regarding grocery shopping’. Responses were given on a scale from 1 (‘definitely not’) to 4 (‘exactly true’). Cronbach’s alpha was 0.78 and 0.76 at Waves 1 and 2,
respectively. Mean item response at Wave 1 was 2.75 (SD = 0.89) and 3.01 (SD = 0.92) at Wave 2.

‘Action plans’ were measured with two items, ‘I have my own plan regarding which healthy foods I will eat tomorrow’, and ‘I have my own plan regarding how many portions of fruit/vegetables I will eat tomorrow’. Responses were given on a scale from 1 (‘definitely not’) to 6 (‘exactly true’). Mean item response at Wave 1 was 3.53 (SD = 1.99) and 3.76 (SD = 1.92) at Wave 2. The correlation between items was 0.68 at Wave 1 and 0.71 at Wave 2.

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**Results**

**Sample attrition, randomization checks and correlations**

For individuals who participated in Wave 1 only and those who took part in both waves, no between-group differences were found for fruit and vegetable consumption, $F(1, 275) = 0.27$, ns, intention, $F(1, 275) = 2.86$, ns, self-efficacy, $F(1, 275) = 0.02$, ns, action plans, $F(1, 275) = 0.27$, ns, age, $F(1, 275) = 1.14$, ns, BMI, $F(1, 249) = 3.86$, ns, or gender $\chi^2(1) = 5.11, P < 0.10$. Across variables under study, no differences were found between participants who refused to provide their e-mail at Wave 1 and those who provided their valid e-mail address.

Among participants who dropped out at Wave 2, we found no differences across three groups in fruit and vegetable consumption, $F(2, 73) = 0.79$, ns, self-efficacy $F(2, 73) = 1.90$, ns, action plans $F(2, 73) = 0.53$, ns, and age $F(2, 73) = 2.30$, ns.

Within the final sample, the three groups did not differ in age, $F(2, 197) = 1.40$, ns, gender, $\chi^2 = 2.12$, ns, and BMI, $F(2, 274) = 1.19$, ns. At Wave 1, participants of three study groups had equally strong intentions to eat fruit and vegetables, $F(2, 199) = 2.84$, ns. There were no differences for action plans $F(2, 198) = 1.08$, ns, self-efficacy $F(2, 198) = 0.84$, ns, or consumption of fruit and vegetables at Wave 1, $F(2, 198) = 0.83$, ns.

The correlations among variables under study are displayed in Table 1. Fruit and vegetable intake at Waves 1 and 2 was related to intention. Social-cognitive variables were moderately correlated across and within the waves.

**Effects of the interventions on fruit and vegetable consumption and cognitions**

The first hypothesis referred to effects of both interventions on fruit and vegetable consumption. Analysis of variance revealed a main effect of time, $F(1, 199) = 6.99, P < 0.01, \eta^2 = 0.03$, and a time $\times$ group interaction, $F(2, 198) = 8.43, P < 0.001, \eta^2 = 0.08$. The groups did not differ at Wave 1, $F(2, 198) = 0.72$, but significant differences were found at Wave 2, $F(2, 198) = 6.81, P < 0.001, \eta^2 = 0.07$. *Post hoc* tests revealed that the control group differed from both intervention groups ($P < 0.01$), whereas no differences were found between the intervention groups. Means for the groups are presented in Fig. 1.

After controlling for intention at Wave 1, we have obtained similar results, with a time $\times$ group interaction, $F(2, 196) = 8.29, P < 0.001, \eta^2 = 0.08$. Additionally, to test whether effects of the manipulation affected other cognitions, we tested effects of the interventions on intention. There was neither a time effect, $F(1, 199) = 3.58$, ns, nor a time $\times$ group interaction, $F(2, 198) = 1.36$, ns.

**Effects of change in cognitions on change in fruit and vegetable consumption**

The second hypothesis referred to the mediating role of change in respective cognitions in the relation between group assignment and change in fruit and vegetable consumption. To obtain scores of change in self-efficacy, action plans and fruit and vegetable consumption, the residualized-change approach was chosen [21]. Change in fruit and vegetable consumption was unrelated to age, gender and BMI.

To test this hypothesis, procedures recommended by Baron and Kenny [22] were used. The test for mediation consists of four steps that are analyzed using three regression equations: (i) the independent variable predicts the dependent variable, (ii) the independent variable predicts the mediator and (iii) the mediator variable, entered in the first step, predicts the dependent variable, whereas the
independent variable, entered in the second step, predicts the dependent variable. A decrease in the relation between the predictor variable and outcome variable in the third equation (compared with the first equation) would be indicative of mediation.

The first set of analyses referred to effects of the self-efficacy intervention and the mediating role of change in self-efficacy. Regression analyses revealed that change in fruit and vegetable consumption was predicted by condition (self-efficacy intervention versus control), $\beta = 0.34$, $P < 0.001$, $R^2 = 0.12$. Condition also explained change in self-efficacy, $\beta = 0.38$, $P < 0.001$, $R^2 = 0.14$. After controlling for self-efficacy change, $\beta = 0.37$, $P < 0.001$, the standardized regression coefficient for condition on consumption change was reduced, $\beta = 0.23$, $P < 0.05$. A Sobel test, $Z = -3.11$, $P < 0.01$, indicated that the differential effect of condition was accounted for by the change in self-efficacy in the self-efficacy intervention group.

### Table 1. Correlations among social-cognitive variables and nutrition for self-efficacy at Waves 1 and 2 for the self-efficacy intervention group, the self-efficacy and action plans intervention group and the control group

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<th>Variable</th>
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$^†P < 0.10$, $^*P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$. 

Improving fruit and vegetable consumption
Analyses also revealed that although condition (self-efficacy intervention versus control) explained change in planning, $\beta = 0.18$, $P < 0.05$, $R^2 = 0.03$, but after controlling for planning change, $\beta = 0.03$, ns, the regression coefficient for condition on consumption change was not reduced, $\beta = 0.35$, $P < 0.001$. Therefore, the differential effect of condition was not accounted for by the change in planning in the self-efficacy intervention group.

The second set of analyses referred to the effects of the combined self-efficacy and action plans intervention and the mediating role of change in self-efficacy and planning. Regression analyses revealed that change in fruit and vegetable consumption was predicted by condition (planning and self-efficacy intervention versus control), $\beta = 0.27$, $P < 0.01$, $R^2 = 0.07$. Condition also explained change in planning, $\beta = 0.21$, $P < 0.05$, $R^2 = 0.05$. After controlling for planning change, $\beta = 0.31$, $P < 0.001$, the standardized regression coefficient for condition on consumption change was reduced, $\beta = 0.20$, $P < 0.05$. A Sobel test, $Z = -2.02$, $P < 0.05$, indicated that the differential effect of condition was accounted for by the change in self-efficacy in the planning and self-efficacy intervention group.

Further analyses revealed that condition (self-efficacy and planning intervention versus control) explained change in self-efficacy, $\beta = 0.23$, $P < 0.05$, $R^2 = 0.05$, after controlling for self-efficacy change, $\beta = 0.31$, $P < 0.001$, the regression coefficient for condition on consumption change was reduced, $\beta = 0.22$, $P < 0.05$. A Sobel test, $Z = 2.55$, $P < 0.05$, indicated that the differential effect of condition was accounted for by the change in self-efficacy in the planning and self-efficacy intervention group.

**Discussion**

An intervention sent by e-mail targeting self-efficacy or self-efficacy and action plans resulted in an increase of fruit and vegetable consumption at 6 months after the intervention. This effect was mediated by change in respective cognitions. The initial guidance in self-efficacy or self-efficacy and planning had a longer effect on these cognitions and cognitions enabled intervention groups’ participants to change their fruit and vegetable consumption.

Self-efficacy change mediated the effects of the self-efficacy intervention on change in fruit and vegetable consumption, whereas changes in both self-efficacy and planning mediated the effects of the combined intervention (addressing self-efficacy and planning). The results support Bandura’s [4] suggestions and previous research [6], showing that an enhancement of self-efficacy by means of verbal persuasion and positive emotion may result in behavior change. The results are also in line with studies showing that planning interventions may work because they encourage a person to engage in more frequent use of strategy planning [14, 15].

The message on the importance of healthy nutrition resulted in no significant changes in cognitions or behavior in the control group. By contrast, both the plain self-efficacy intervention and the combined self-efficacy and action plan intervention led to more frequent fruit and vegetable consumption. However, the self-efficacy intervention caused a similar increase of fruit and vegetable consumption as observed in the combined self-efficacy and planning intervention group. There are
several possible explanations for this result. Compared with the self-efficacy intervention, the planning intervention was not tailored, which could reduce its effectiveness. The procedures used to deliver the intervention (i.e. an e-mail-delivered persuasion and a form to be filled out) may have a certain threshold of effectiveness. Overall, the effects of such an intervention may be small. To obtain larger effects, individual contact with an experimenter, a planning diary and self-efficacy-enhancing personal experience should be employed.

Effects of a planning intervention may be moderated by participants’ intention [10], whereas effects of self-efficacy on behavior may be mediated by intention [4, 23]. The majority of participants of the present study intended to change their fruit and vegetable consumption; therefore the results cannot be generalized to those individuals who do not intend to change their behaviors. It is also possible that as behavior becomes more routinized over longer time periods (i.e. 12 months), implementation intentions are better predictors of behavior than intentions [24], which may explain a lack of change in the effects of interventions on behavior after controlling for intentions.

Our study has several limitations. Fruit and vegetable consumption was measured by a single item. Self-report, single-item measures of health behaviors are seen as being sufficiently valid [25]. However, social cognitions may be related to the self-reported consumption of fruit and vegetables, while the relations between cognitions and nutrition biomarkers may be negligible [26]. Although reliability of data collection in the Internet might be questionable, studies that address effects of data collection modes showed that employment of an on-line questionnaire and an interview resulted in the same frequencies of health behaviors [27]. A lack of compatibility between measures employed in the study could reduce the amount of variance explained by some constructs (i.e. intention) [28]. An action planning intervention could aim more specifically at forming plans about consuming ‘five portions’ of fruit and vegetables per day, instead of just making plans about when, where and how to eat fruit and vegetables. Future research employing tailored interventions could take into account stages of health behavior change and target stage-specific cognitions, such as phase-specific self-efficacy [7, 29], and therefore further enhance the effectiveness of self-efficacy interventions. Finally, the residualized change score used in mediation analyses is sometimes criticized [30] as other approaches may provide more unique information on intraindividual change.

The present research contributes to the understanding of health behavior change processes. The self-efficacy intervention as well as the combined self-efficacy and action planning intervention affected behavior. An intervention delivered by e-mail is a relatively simple and inexpensive means of reaching large populations. Although the effects on fruit and vegetable consumption were similar, the cognitive pathways by which the two interventions affected nutrition behavior were different. Among participants of the self-efficacy intervention, change in self-efficacy predicted behavior change, whereas among those assigned to a combined self-efficacy and action plan intervention, change both in action planning and self-efficacy affected behavior change.

Conflict of interest statement

None declared.

References


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