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Planning and self-efficacy can increase fruit and vegetable consumption: a randomized controlled trial

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Abstract Fruit and vegetable consumption represents a nutritional goal to prevent obesity and chronic illness. To change dietary behaviors, people must be motivated to do so, and they must translate their motivation into actual behavior. The present experiment aims at the psychological mechanisms that support such changes, with a particular focus on dietary self-efficacy and planning skills. A randomized controlled trial compared a theory-based psychological intervention with a health education session in 114 participants. Dependent variables were fruit and vegetable consumption, intention to consume more fruit and vegetables, planning to consume more, and dietary self-efficacy, assessed before the intervention, 1 week afterwards, and at 6-week follow up. Significant group by time interactions for all four dependent variables documented superior treatment effects for the psychological intervention group, with substantially higher scores at posttest and follow-up for the experimental group, although all students benefited from participation. To identify the contribution of the main intervention ingredients (self-efficacy and planning), regression analyses yielded mediator effects for these two factors. A social-cognitive intervention to improve fruit and vegetable consumption was superior to a knowledge-based education session. Self-efficacy and planning seem to play a major role in the mechanisms that facilitate dietary changes.

Keywords Fruit and vegetable consumption · Self-efficacy · Intentions · Planning · Dietary changes

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Introduction

Changing dietary behaviors requires not only basic knowledge about nutrition, but also motivational and volitional factors that guide self-regulatory processes (Lippke and Ziegelmann 2008). The present study was designed to make a contribution to the understanding of psychological mechanisms that contribute to intention formation and actual behavior change when it comes to eating a diet rich in fruit and vegetables.

Current situation of fruit and vegetable consumption in Thailand

Some of the world's most widespread and debilitating nutritional disorders are caused by diets lacking in fiber, vitamins and minerals. Therefore, the World Health Organization (WHO) recommends consuming at least 400 grams of vegetables and fruits per day—or five servings of 80 grams each (WHO 2003). The Health Information System Development Office (HISO) of Thailand showed that a substantial number of Thai citizens consumed less than the recommended amount of fruits and vegetables, despite a major government effort launching nutrition messages that focused on the benefits of fruit and vegetable consumption. In every age group, fruit and vegetables

consumption was about half of what was recommended. The results showed that average consumption per day was at 268 grams in men and 283 grams in women (HISO 2006). The Physical Activity Division, Ministry of Public Health (MOPH 2000a) investigated health behaviors and physical activity practices among employees of the Ministry of Public Health. Almost half of the participants, especially civil servants with higher education and socio-economic status, consumed only about two servings of fruit and vegetables per day (or approximately 135 g/day). This was in congruence with research by Satheannoppakao et al. (2009) in community-dwelling men and women participating in the Thailand National Health Examination Survey III.

Fruit and vegetable consumption in college students

College years are a period of significant change in the lifestyle of young adults (Ha and Caine-Bish 2009). Food patterns established during this time are likely to be maintained for life and may have a long-lasting influence on college students' future health and the health of their future families (Betts et al. 1997; Brown et al. 2005). Chung and Hoerr (2005) reported that only about 60% of young men met the minimum recommendation of three servings of fruit and vegetables. Many students are occupied with busy lifestyles, spending time in classes, social activities, peer groups, and other irregularly organized activities, and their dietary behaviors are based on rituals, convenience, and social influence. Additionally, young adults are often ambivalent about their future health and the role that nutrition plays (Betts et al. 1995). Due to the absence of chronic medical conditions in this age group, little attention has been paid to the diets of 18- to 24-year-olds. Finding a way to motivate young adults to consume more fruit and vegetables would represent a way to avoid the development of body weight problems and chronic illness.

Psychological mechanisms in health behavior change

Poor dietary habits are difficult to change, and various psychosocial factors are associated with such changes (De Bruijn 2010; Shaikh et al. 2008). To adhere to the recommendations, one has to form an explicit behavioral intention. However, intentions often fail to be translated into corresponding behaviors (Gutiérrez-Doña et al. 2009; Renner et al. 2008, 2010).

Therefore, intentions need to be supplemented by other, more proximal factors that might facilitate the translation of intentions into action (Wiedemann et al. in press). Some facilitators have been identified, such as perceived self-efficacy and planning. However, it is not fully understood how these two factors interplay with intentions and behaviors. Previous studies have specified self-efficacy and planning as mediators between intentions and behaviors (e.g., Gutiérrez-Doña et al. 2009; Renner et al. 2008, 2010; Wiedemann et al. in press). In line with such findings, the present study was based on the Health Action Process Approach (HAPA; Schwarzer 2008; Schwarzer et al. 2011). This theory describes the motivational and volitional phases of health behavior change and focuses on self-efficacy and planning skills as key elements of self-regulation. It assumes, among others, that the intention-behavior gap can be bridged by volitional factors, in particular by different kinds of perceived self-efficacy as well as planning. In the following sections, we describe this multiple mediation that constitutes a key characteristic of HAPA.

Planning as a mediator

Good intentions are more likely to be translated into action when people plan when, where, and how to perform the desired behavior. Planning has been found to mediate the intention-behavior relation (Schwarzer 2008; Sniehotta 2009; Wiedemann et al. 2011a) because it includes specific situation parameters ("when", "where") and a sequence of action ("how"). People tend to remember better their intentions when specified in a when, where, and how manner (for an overview and meta-analysis, see Gollwitzer and Sheeran 2006). This has important implications for health-behavior interventions. Planning can be promoted effectively among individuals with self-regulatory deficits. Hunter et al. (2010) provided evidence of a mediating effect of food planning on fruit and vegetables consumption among women. Several randomized controlled trials have documented the evidence in favor of such planning interventions in the context of dietary changes (e.g., Chapman et al. 2009; Luszczynska et al. 2007).

Self-efficacy as a mediator

Perceived self-efficacy reflects optimistic self-beliefs when overcoming temptations or adopting a novel course of action. Different challenges have to be met during the course of dietary behavior change. Self-efficacy beliefs are required to master these tasks successfully. Perceived self-efficacy has been found to be important at all points in the health behavior change process including dietary changes (Bandura 1997; Franko et al. 2008; Neumark-Sztainer et al. 2003). People harboring self-doubts might either fail to translate intentions into plans, or they might fail to act upon their plans. Self-efficacy facilitates goal achievement

because it instigates planning and behavioral initiative. Also, self-efficacious people feel more confident about trying a novel or difficult behavior, and they invest more effort in maintaining a desired behavior when barriers arise. Self-efficacy has been found to be consistently associated with consumption of fruit and vegetables (Brug et al. 1995). Persons with high levels of dietary self-efficacy consume more fruit and vegetables than others (Luszczynska et al. 2007). A study on eating behaviors among adolescents also found that self-efficacy operated as a mediator in fruit consumption (Ball et al. 2009).

Aims

To improve fruit and vegetables consumption, we have developed a theory-guided intervention that was mainly based on two components: cultivating self-efficacy and developing action planning skills. The study was designed as a randomized controlled trial to examine the effects of the intervention in comparison to an active control group. It was expected that the intervention group not only scores higher in intentions, self-efficacy, and planning, but also reports higher levels of fruit and vegetables consumption later on.

Moreover, to explain such a desired outcome, the possible gain in fruit and vegetables consumption needed to be traced back to the main intervention ingredients self-efficacy and planning. Thus, these two variables were specified as mediators between the intervention and fruit and vegetables consumption.

Method

Participants and procedure

Full time undergraduate students (N = 764) of Chiang Mai University, Thailand, attending the five sections of the General Psychology course in the second semester of the academic year 2009, were invited to participate in a health promotion program. Exclusion criteria were being vegetarian or having received any other kind of nutrition education in the last 6 months. This left 121 eligible students out of 149 who were interested in the study. They were assigned to one of two conditions using random sampling numbers without replacement: a self-efficacy and planning intervention (intervention group, $n = 61$) or a health education session (active control group, $n = 60$). Five students dropped out, and two were lost in the follow-up, resulting in a final data set of 114 participants (see Fig. 1). Age ranged from 18 to 25 years. Those in the intervention group had a mean age of 20.1 years (SD = 1.4), those in the active control group had a mean age of 20.3 years (SD = 1.2).

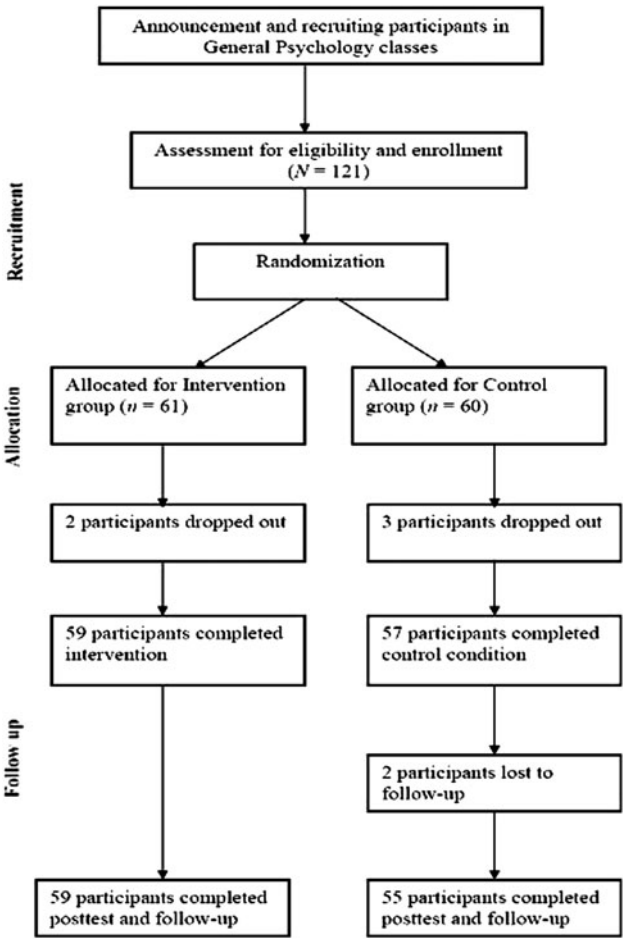

Fig. 1 Study flowchart with numbers of participants who attended the intervention and control conditions

After giving informed consent, participants took the Time 1 (T1) baseline assessments. One and six weeks later, respectively, participants were invited to the Time 2 (T2) posttest and Time 3 (T3) follow-up assessments. To prevent attrition, eight gift vouchers were offered in a sweepstakes as an incentive to those who completed either the intervention or health education program, and who also responded to all questionnaires at three points in time. This 500 baht (equivalent to 16.32 US Dollars) voucher was a good incentive, because average income of students per month is approximately 4,000 baht. Additional small tokens, such as booklets on healthy nutrition and weight management, were given to those who completed the program.

Intervention and control conditions

The study was a two-group randomized controlled trial comparing a theory-based psychological intervention with

a nutrition education session (control group). The intervention group received a training program including general health and nutrition education plus psychological program focusing on self-efficacy enhancement and planning skills, whereas the active control group received only the general health and nutrition education lesson. The goal was to consume five servings of fruit and vegetables per day as recommended, and participants were made conscious of their deficits in fruit and vegetables consumption. The study took place on a weekend and started for both groups with a 2.5 h overview of nutrition information based on Thailand's nutrition guidelines (MOPH 2000b), presented by a trained lecturer in the field of nutrition from a vocational college. Afterwards, participants in the control group received handouts about general nutrition guidelines and they were asked to continue reading on their own at home. The intervention group then received a psychological program that addressed self-efficacy and strategic planning. Self-efficacy enhancement was stimulated by recalling mastery experience, by modeling, and by persuasion (Bandura 1997). Two kinds of planning skills were practiced; action planning and coping planning. Participants received prepared action planning sheets and were asked to generate a detailed plan of when, where, and how they intended to consume fruit and vegetables. They were also asked to specify which particular kind of fruit and vegetables they planned to consume at certain occasions. Moreover, they received prepared coping planning sheets that required them to imagine situations where barriers might emerge that would prevent them from acting as previously planned. In discussion groups, students shared their experience with intentions and barriers, and they learned how to recover from setbacks. Nutrition calendars were introduced to help them practice how to make a weekly plan and a general nutrition planner. Handouts to assist future planning were also provided so that participants could generate action plans (such as to plan which fruit and vegetables to eat, when, how, and which amount) and coping plans (such as to anticipate possible barriers, find coping strategies, and how to get back on track after being derailed).

Measures

All measures had been validated in previous studies (Luszczynska et al. 2007; Schwarzer 2008). They were translated into Thai by the first author in collaboration with a professional interpreter. Linguistic equivalence was attained by back translations.

Fruit and vegetables intake was measured by two items: "How many servings of fruit (e.g., bananas, pineapples) have you eaten on average per day? Think of your consumption in the previous week," and "How many portions of vegetables (e.g., cabbage, lettuce) have you eaten on average per day? "Think of your consumption in the previous week" (open-ended response format). Correlation between the two items was $r = .80$.

Intention to consume fruit and vegetables was measured by two items: "How many servings of fruit (e.g., bananas, pineapples) do you intend to eat every day?" and "How many portions of vegetables (e.g., cabbage, lettuce) do you intend to eat every day?" (open-ended response format). Correlation between the two items was $r = .88$.

Planning to change nutrition habits was measured by three items for action planning (e.g., "I have concrete plans when, where, and how to eat which kind of fruit and vegetables.") and three items for coping planning (e.g., "I have concrete plans…what to do in difficult situations to stick to my intentions." Cronbach's alpha was .80 for action planning, and .80 for coping planning. All items had a 6-point scale response format.

Perceived dietary self-efficacy was measured by two items with a 6-point scale response format: ''I am confident that I can eat five servings of fruit and vegetables a day,'' and "I am confident that I can eat enough fruit and vegetables daily, even when there are no attractive shopping opportunities." Correlation between the two items was $r = .38$.

Data analysis

To examine intervention effects, repeated measures analyses of variance were computed with fruit and vegetables intake, intention, planning, and self-efficacy as dependent variables at three points in time, and groups as the between-subjects factor. To examine the mediator effects, multiple mediation analyses were computed using the SPSS macro "Indirect", that includes multiple regression procedures and also accounts for the inclusion of covariates (Hayes 2009). Mediation exists when a predictor affects a dependent variable indirectly through at least one intervening variable, or mediator (Preacher and Hayes 2008). We use baseline behaviors, sex, and body weight as covariates.

Results

Means, standard deviations, and group comparison statistics for all variables are summarized in Table 1.

To examine the intervention effects at posttest and follow-up, repeated measures ANOVA was computed. For the dependent variable *fruit and vegetables consumption*, a main effect for time emerged, $F(2,224) = 51.05$, $P < .001$, $\eta^2 = .31$, and an interaction between group and time,

Table 1 Means and standard deviations (SD) of all study variables in both groups, and comparison between groups

Variable/group	Time 1					Time 2					Time 3				
	M	SD	*t*	*p*	*d*	*M*	SD	*t*	*p*	*d*	*M*	SD	*t*	*p*	*d*
Fruit and vegetable consumption			0.6	0.55	0.11			2.83	<.01	0.53			2.63	<.01	0.49
Intervention	3.61	2.03				4.8	1.75				4.9	1.56			
Active control	3.38	2.04				3.95	1.46				4.18	1.35			
Intention			−.85	0.4	0.16			0.62	0.54	0.11			3.36	<.01	0.63
Intervention	5.75	1.83				6.68	1.17				6.92	1.18			
Active control	6.02	1.59				6.55	1.12				6.2	1.1			
Planning			0.52	0.61	0.1			3.5	<.01	0.64			7.06	<.001	1.32
Intervention	3.07	0.73				3.42	0.55				3.68	0.5			
Active control	3	0.67				3.07	0.54				3.08	0.4			
Self-efficacy			1.05	0.3	0.2			2.73	<.01	0.51			6.31	<.001	1.2
Intervention	3.55	0.84				3.89	0.59				4.24	0.55			
Active control	3.39	0.78				3.54	0.77				3.56	0.58			

$F(2,224) = 4.36$, $P = .014$, $\eta^2 = .04$. There was also a main effect of intervention groups, $F(1,112) = 4.09$, $P = .046$, $\eta^2 = .04$ (see Fig. 2).

For the dependent variable *intention*, a main effect for time emerged, $F(2,224) = 32.68$, $P < .001$, $\eta^2 = .23$, and an interaction between group and time, $F(2,224) = 12.18$, $P < .001$), $\eta^2 = .10$. There was no main effect of group, $F(1,112) = .71$, $P = .40$ (see Fig. 3).

For the dependent variable *planning*, a main effect for group emerged, $F(1,112) = 12.42$, $P = .001$, $\eta^2 = .10$, a main effect for time, $F(2,224) = 35.26$, $P < .001$, $\eta^2 = .24$, and an interaction between group and time, $F(2,224) = 20.67$, $P < .001$, $\eta^2 = .16$ (see Fig. 4).

For the dependent variable *self-efficacy*, a main effect for group emerged, $F(1,112) = 12.49$, $P = .001$, $\eta^2 = .10$, a main effect for time, $F(2,224) = 27.21$, $P < .001$,

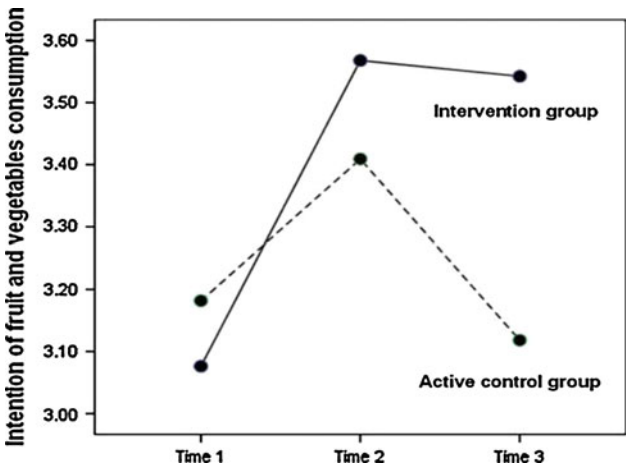

Fig. 3 Level of intention of fruit and vegetable consumption in the two experimental conditions at three points in time

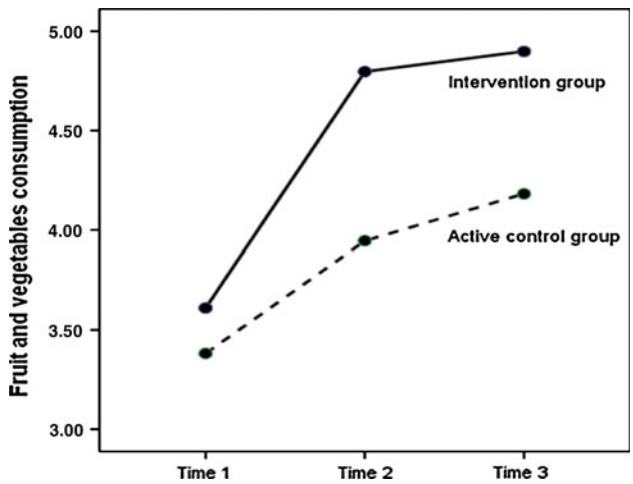

Fig. 2 Level of fruit and vegetable consumption in the two experimental conditions at three points in time

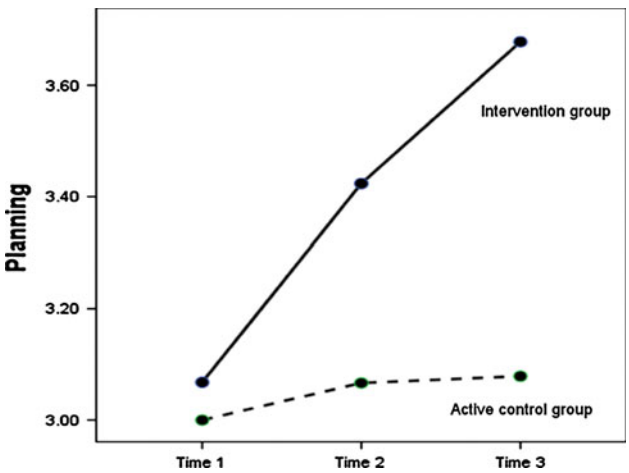

Fig. 4 Level of planning for fruit and vegetable consumption in the two experimental conditions at three points in time

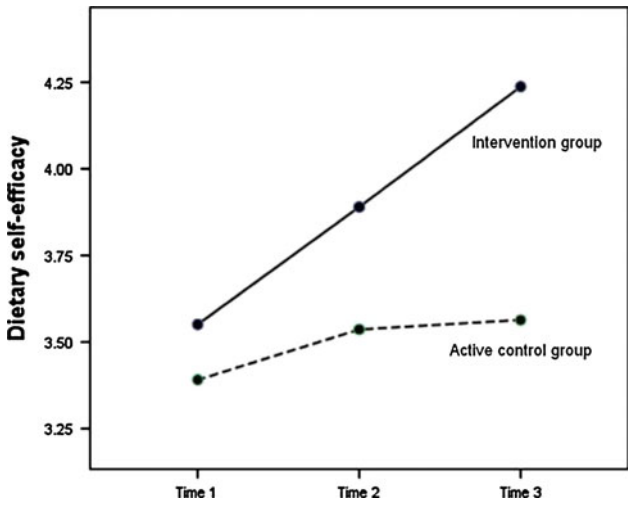

Fig. 5 Level of perceived self-efficacy for fruit and vegetable consumption in the two experimental conditions at three points in time

$\eta^2 = .20$, and an interaction between group and time, $F(2,224) = 9.87$, $P < .001$, $\eta^2 = .08$ (see Fig. 5).

Pairwise comparisons

Post-hoc tests revealed that the groups did not differ significantly on any of the dependent variables at baseline, all *P*s > .05. Significant differences between the two groups for *fruit and vegetables consumption* were found at posttest and follow-up, $t = 2.83$, $P < .01$ at T2 and $t = 2.63$, $P = .01$ at T3. The intervention group demonstrated an increase in fruit and vegetables consumption from baseline to 1 week after the intervention. The mean fruit and vegetables consumption of the intervention group was 3.61, SD = 2.03, at T1, and 4.80, SD = 1.75 at T2, $t = -9.20$, $P < .001$, but no differences between scores at T2 and T3. The active control group also showed an increase of fruit and vegetables consumption from T1, $M = 3.38$, SD = 2.04, to T2, $M = 3.95$, SD = 1.46, and $t = -3.74$, $P < .001$, but there was no difference between T2 and T3.

For the *intention* of fruit and vegetables consumption, the intervention and the active control groups were not different at both baseline and posttest assessments, but differences were found at follow-up, $t = 3.36$, $P = .001$. The intervention group showed an increase in intention of fruit and vegetables consumption from baseline to 1 week after the intervention. Intention means of the intervention group were 5.75, SD = 1.83, at T1 and 6.68, SD = 1.17, at T2, $t = -6.53$, $P < .001$, and there was also a difference between T2, 6.68, SD = 1.17, and T3, 6.92, SD = 1.18, $t = -2.29$, $P < .05$. The active control group showed a difference in intentions from T1, 6.02, SD = 1.59, to T2, 6.55, SD = 1.12, $t = -4.45$, $P < .001$, but a decrease from T2, 6.55, SD = 1.12, to T3, 6.20, SD = 1.10, $t = 3.04$, $P < .01$.

For *planning* for fruit and vegetables consumption, differences between the intervention and the active control groups were found on posttest and follow-up assessments, $t = 3.50$, $P < .01$ and $t = 7.06$, $P < .001$, respectively. The intervention group indicated an increase in planning for fruit and vegetables consumption from baseline to posttest and from posttest to follow-up 6 weeks after the intervention. Planning means of the intervention group were 3.07, SD = .73, at T1 and 3.42, SD = .55, at T2, $t = -6.75$, $P < .001$, and $M = 3.68$, SD = .50, $t = -5.23$, $P < .001$, at T3. For the active control group there was no difference in planning at all points in time.

For *dietary self-efficacy,* differences between the intervention and the active control groups were found at posttest and follow-up assessments, $t = 2.73$, $P < .01$, and $t = 6.31$, $P < .001$, respectively. The intervention group indicated an increase in dietary self-efficacy from baseline to posttest and from posttest to follow-up 6 weeks after the intervention. Dietary self-efficacy means of the intervention group were 3.55, SD = .84, at T1 and 3.89, SD = .59, at T2, $t = -4.92$, $P < .001$, and 4.24, SD = .55, $t = -4.47$, $P < .001$, at T3. For the active control group there was an increase in dietary self-efficacy from baseline to posttest. Dietary self-efficacy means of the active control group were 3.39, SD = .78, at T1 and 3.54, SD = .77, at T2, $t = -2.13$, $P < .05$. There was no difference in dietary self-efficacy between T2, 3.54, SD = .77, and T3, 3.56, SD = .58, $t = -.36$, $P = .72$.

Mediation analyses

So far, it has been documented that there were substantial treatment effects on all outcome variables (see d values in Table 1). The following analysis addresses the question of whether the key intervention ingredients, planning and self-efficacy, were instrumental in the change of fruit and vegetables consumption. For this purpose, planning and self-efficacy at posttest and follow-up were considered to serve as putative mediators between the interventions and the primary behavioral outcome, fruit and vegetables consumption. Mediation analyses, partly controlling for demographics and baseline behavior, were conducted. The only substantial mediator effects emerged when using changes in coping planning (T3–T2) as well as Time 3 self-efficacy as mediators, whereas action planning did not mediate. Group membership predicted coping planning, .61, $P < .01$, and self-efficacy, .99, $P < .01$, and subsequently, T3 fruit and vegetables consumption was predicted by these two mediators, coping planning, .13, $P < .05$, and self-efficacy, .23, $P < .01$, controlling for sex, .09, $P > .05$, body weight, −.11, $P > .05$, and baseline

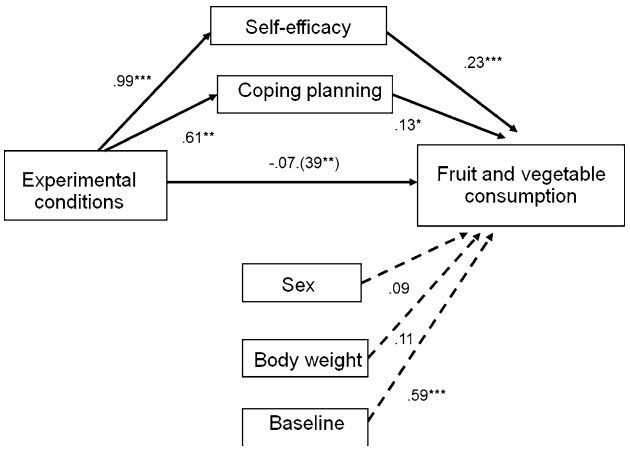

Fig. 6 Model with two mediators (self-efficacy and planning) and three covariates (sex, body weight, and baseline dietary behavior)

fruit and vegetables consumption, .59, $P < .01$. Overall, 63% of the behavior variance was accounted for by the entire model (see Fig. 6).

Discussion

This study examined whether a theory-guided psychological nutrition intervention would make a difference on Thai university students' fruit and vegetable consumption. One hundred and fourteen university students were randomly assigned to a psychological intervention or an active control group. The intervention program was based on the HAPA (Schwarzer 2008) with a particular focus on perceived self-efficacy and dietary planning skills. Repeated measures analysis comparing these two groups at pretest, posttest, and follow-up yielded significant time by group interactions for all four dependent variables: fruit and vegetables consumption, intentions, planning, and self-efficacy.

It was found that participants receiving the intervention consumed significantly more fruit and vegetables than participants in the control condition. This effect remained stable from posttest to follow-up assessment. The same kind of effect emerged for the social-cognitive predictors of dietary behaviors, namely intention, planning, and self-efficacy. A further question was whether these variables simply constitute multiple outcomes of the intervention, or whether they might reflect the ingredients of the intervention package and would, thus, operate as causal agents for behavior change. To examine the mechanisms of behavior change we applied multiple mediation analyses by specifying a path model where planning and self-efficacy served as mediators between group membership and later fruit and vegetables consumption. Such an analysis is likely to shed light on the way these variables might have operated in the study (Hayes 2009; MacKinnon 2008; Reuter et al. 2008). Although we did not intend to make cross-cultural comparisons, it is of note that the present findings tend to replicate findings from very different cultures, contributing to their external validity. Similar results confirming the role of self-efficacy and planning have been found in Germany (Richert et al. 2010), Costa Rica (Gutiérrez-Doña et al. 2009), and South Korea (Renner et al. 2008). There are also congruent findings from two randomized controlled trials by Kellar and Abraham (2005) as well as Gratton et al. (2007) both of which demonstrated an increase in fruit and vegetables consumption in the intervention groups over the control groups. Particularly, the intervention study of Gratton et al. (2007), emphasized the importance of the implementation intention about how, when and why the participants could reach five portions a day. Similarly, Stadler et al. (2010) compared two brief interventions; one with and one without self-regulation. The group with an added self-regulation training, on top of an information intervention, increased its effectiveness for long-term behavior change whereas participants in the information-only group returned to baseline levels. It has also been found that the number of actually generated plans in an intervention plays a role for subsequent behavior (Wiedemann et al. in press). Fruit and vegetable consumption increased with higher number of plans, and was significantly larger in groups that formed four or five plans as compared to controls who did not plan.

Due to the overall experimental findings as well as the mediation analyses, one can conclude that the ingredients of the psychological nutrition intervention have had a favorable impact on subsequent dietary behaviors, although we cannot specify whether a single ingredient has been crucial or whether the package as a whole was necessary to attain the goal. It is obvious that self-efficacy in conjunction with planning is able to support sustaining behavior change, which replicates previous findings that such kinds of interventions facilitate changes in health behaviors (Armitage 2004; Luszczynska et al. 2007; Sniehotta et al. 2005).

There are some limitations in this study. First, the participants were undergraduate students from a Thai University and thus might not be representative for a larger population of young adults in this country or beyond. Second, the intervention package included mainly two components, namely self-efficacy and planning. The effects of these two components cannot be disentangled, and one cannot judge whether one of them would have been sufficient to achieve the present results. To identify the specific effects of each of these ingredients, one could design a randomized controlled trial with more groups, providing interventions with one component only. Third, all assessments were self-reported, and no objective

measures (such as body weight or endocrinological measures) were available. Fourth, we did not consider stages of change. It is possible that most participants were intenders, which means that they were highly motivated to change their diet, which is why they participated in the study in the first place. In this case, the empirical findings apply only to individuals at this stage, but not to others who were non-intenders (e.g., contemplators). To account for such moderating effects, one has to assess the stages of change and also look for stage transitions (Wiedemann et al. 2011b, in press). Moreover, stage effects would then suggest stage-matched interventions (de Vet et al. 2008).

Nevertheless, the use of a randomized controlled trial and the theory-guided intervention design have elucidated the mechanisms of dietary change processes, using fruit and vegetables consumption in Thailand as an example. The findings replicate similar studies in different populations and, thus, make a contribution to our cumulative knowledge on psychological components in dietary changes.

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