Research Article

The Role of Social Support and Self-efficacy for Planning Fruit and Vegetable Intake

Guangyu Zhou, PhD[1]; Yiqun Gan, PhD[2]; Kyra Hamilton, PhD[3,4]; Ralf Schwarzer, PhD[5,6]

ABSTRACT

Objective: The aim of the current study was to examine the joint effect of self-efficacy, action planning, and received social support on fruit and vegetable intake.

Design: The study used a longitudinal design with 3 waves of data collection.

Setting: Major university campus in Beijing, China.

Participants: Young adults (n = 286).

Variables Measured: Age, gender, body mass index, dietary self-efficacy, and baseline behavior were measured at time 1. Two weeks after time 1, received social support and action planning were assessed (time 2); 4 weeks after time 1, subsequent fruit and vegetable consumption was measured (time 3).

Analysis: In a path analysis, action planning at time 2 was specified as a mediator between self-efficacy at time 1 and fruit and vegetable intake at time 3, controlling for age, gender, body mass index, and baseline behavior. In addition, in a conditional process analysis, received social support at time 2 was specified as a moderator of the self-efficacy–planning relationship.

Results: Action planning mediated between self-efficacy and subsequent dietary behavior, and received social support moderated between self-efficacy and planning supporting a compensation effect. Action planning served as a proximal predictor of fruit and vegetable intake, and planning one's consumption was facilitated by dietary self-efficacy.

Conclusions and Implications: Through the identification of social cognitive factors influencing dietary planning, interventions can target self-efficacy and received social support to test the efficacy of these mechanisms in increasing individuals' ability to ensure they consume adequate amounts of fruits and vegetables.

Key Words: dietary self-efficacy, action planning, received social support, fruit and vegetable intake (*J Nutr Educ Behav*. 2017;49:100-106.)

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INTRODUCTION

Consuming a nutritionally balanced diet that includes an adequate amount of fruits and vegetables protects overall health and is associated with a reduced risk of some noncommunicable diseases including cardiovascular disease and certain cancers.[1-4] An adequate consumption is considered to be at least 400 g/d of fruits and vegetables, which is often equated to be at least 5 portions.[5] Globally, however, fruit and vegetable intake is much lower than this recommendation,[6,7] which suggests that current interventions aimed at improving dietary decisions are not effective or are at best only marginally effective in encouraging individuals' healthy food choices.

A major criticism of the design of many health promotion programs is the neglect of behavioral theory as a basis to inform the development of the intervention and an evidence base for their effectiveness. The literature reinforces the notion that health promotion interventions underpinned by behavioral theory and supported by robust evaluation are more likely to result in behavioral change. Accordingly, social cognitive factors are likely to be critical in individuals' decisions to consume adequate amounts of fruits and vegetables. It is therefore important for interventions grounded in sound behavioral theory to be adopted to modify individuals' dietary decisions.

To ensure effective acceptance and adoption of interventions to improve

[1]Department of Health Promotion, Education, and Behavior & South Carolina SmartState Center for Healthcare Quality (CHQ), Arnold School of Public Health, University of South Carolina, Columbia, SC
[2]School of Psychological and Cognitive Sciences and Beijing Key Laboratory of Behavior and Mental Health, Department of Psychology, Peking University, Beijing, China
[3]School of Applied Psychology, Griffith University, Brisbane, Queensland, Australia
[4]School of Psychology and Speech Pathology, Curtin University, Perth, Western Australia, Australia
[5]Department of Psychology, Free University of Berlin, Berlin, Germany
[6]Department of Clinical, Health, and Rehabilitation Psychology, University of Social Sciences and Humanities, Warsaw, Poland
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Address for correspondence: Yiqun Gan, PhD, Beijing Key Laboratory of Behavior and Mental Health, Department of Psychology, Peking University, Beijing 100871, China; Phone: (86-10) 62757271; Fax: (86-10) 63268050; E-mail: ygan@pku.edu.cn

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fruit and vegetable intake, it is important first to isolate the mechanisms that guide the health behavior. Future investigations can then test the extent to which the mechanisms magnify or diminish motivations toward behavioral engagement. Social cognitive mechanisms of behavior change often serve as a backdrop toward understanding human behavior; in trying to move knowledge forward, researchers have become focused on investigating the more complex relationships within the social cognitive components.[8] In relation to fruit and vegetable intake, reviews documented the facilitating roles of dietary self-efficacy, action planning, and social support.[8-10] Comparatively little research, however, investigated how these processes operate in concert with or independent of each other to explain behavioral engagement, and even fewer used designs to test the sequence of effects accurately. Studies are therefore needed that examine the joint effects of these 3 social-cognitive variables on health behavior, specifically in this study on fruit and vegetable intake, using longitudinal research designs.

Dietary Self-efficacy, Action Planning, and Social Support for Fruit and Vegetable Intake

Perceived self-efficacy is defined as the belief in one's capabilities to perform an action required to achieve a certain outcome; it can be characterized as being prospective, competence based, and action related.[11] Self-efficacy beliefs can affect which tasks people choose to complete, how much effort they expend on their tasks, the extent to which they persevere in the face of obstacles, and how they evaluate their successes and failures.[11] Thus, dietary self-efficacy reflects the optimistic self-beliefs people hold in the face of temptations or obstacles, to stick to their healthy dietary behaviors. It is an essential personal resource that enables individuals, including those at risk of poor diets, to initiate and sustain healthy eating behavior.[12] Studies using longitudinal survey designs have shown that participants with higher levels of dietary self-efficacy also report higher levels of fruit and vegetable intake.[13] Interventions designed to improve dietary self-efficacy have also been found to facilitate fruit and vegetable consumption.[14]

Whereas self-efficacy is a belief in one's ability to perform a specific action required to attain a desired outcome, planning is a self-regulatory or self-management skill that is hypothesized to be a proximal predictor for health behavior change. Action planning pertains to making detailed plans of when, where, and how to initiate an action.[15] It aims to create new contingencies between (external) situational cues and behavioral responses (eg, in a school dining hall at lunch time, I will eat a piece of fruit).[16,17] Over the past decade there has been a surge in intervention studies to enhance planning.[18-20] Evidence overall supports the effectiveness of planning interventions,[21] with meta-analytic research showing a notable medium effect size for planning interventions on health behaviors.[22] More specifically, recent reviews on intervention studies documented the effects of action planning on dietary behavior, including fruit and vegetable intake.[9]

Although extant literature in general supported the role of planning on behavior, considerable heterogeneity in effects across studies existed and some studies evidenced no effect.[21] This suggests that the role of planning on behavior is complex and further research is needed that examines the mechanisms by which planning formation leads to behavioral engagement.[21] It may be that individuals with a high level of self-efficacy might be more likely to form specific plans to initiate a novel behavior and that optimistic self-beliefs can instigate the execution of those plans. The health action process approach explicitly specifies planning as a mediator between self-efficacy and behavior.[23] Whereas some studies confirmed this hypothesized pathway in the context of nutrition behavior, these studies were limited either because the study design had only 2 time points[24] or because the measures assessed self-management and not action planning.[25] Thus, it seems both timely and important for providing evidence in support of theoretical propositions that research investigates the mediating role of action planning between self-efficacy and fruit and vegetable intake using a longitudinal research design that accurately specifies the sequential nature of the proposed effects.

Social support is another important social cognitive variable that has been shown to influence fruit and vegetable intake positively.[10] It refers to the function and quality of social relationships that involve interactive processes between providers and receivers. Perceived social support is the recipient's anticipated available support from his or her social network if needed, whereas received social support reflects the actual resources provided by significant others (eg, family members, friends).[26] Received dietary support, in particular, has been found to be a predictor for fruit and vegetable intake.[13,27] What is less known is how this construct might interact with other important social cognitive factors to influence behavior. Specifically, the mechanisms that reflect the interplay of received social support with self-efficacy and action planning in terms of dietary behavior are not well understood and warrant further investigation.

Social cognitive theory may help to explain these more complex relationships; it suggests various possible interactions between self-efficacy and social support on health behaviors.[11] On the one hand, they could strengthen one another—the synergistic hypothesis. This synergistic interaction was confirmed in a dietary study: Individuals with higher self-efficacy profited more from support when forming intentions that then were translated into more fruit and vegetable intake.[13] On the other hand, one factor could take over the role of the other—the compensation hypothesis. This compensation interaction posits that both resources could compensate for lacks in the respective other.[11,28] A study that tested this compensation hypothesis in the context of physical exercise found that high self-efficacy could compensate for low social support on action control.[29] Alternative explanations were given for the findings: Those who were supported in their exercise might depend less on their own abilities to overcome barriers for exercising; or, low-supported persons might initiate exercise because of their firm self-efficacious beliefs. Thus, further studies are needed to understand this complex relationship better and provide an evidence base that explains the interactive role between self-efficacy and social support on health behavior.

Hypotheses of the Current Study

The aim of the current study was to investigate the roles of dietary self-efficacy, action planning, and received social support for fruit and vegetable intake in young adults. First, in line with dual-phase models of health behavior[23] and previous research reviewing the potential roles of planning on behavior,[21] the effect of self-efficacy on behavior was assumed to be mediated via planning. Second, drawing on social cognitive theory[11] and previous literature,[28,30] social support and self-efficacy might either synergize or compensate for one another to predict individuals' planning for their fruit and vegetable intake. Specifically, both received social support and self-efficacy combined need to be present for dietary planning (synergistic effect)[30]; or one single resource is sufficient, which would reflect a compensatory effect of one for the other.[28] The former hypothesis pertains to a simple mediation effect. It was expected that making dietary plans would serve as a mediator between self-efficacy and the behavioral outcome. The latter hypothesis addressed the conditional effect that was expected when received social support comes into the equation as a putative moderator of the self-efficacy–planning relationship, because the effect of self-efficacy on planning may depend on levels of received social support.

METHODS

Participants and Procedure

Participants (N = 286) were young adults recruited from a major university in China. Students who reported adhering to a vegan diet were excluded from participating. The sample was composed of women (61.9%; n = 177) and men (38.1%; n = 109), aged 17–46 years (mean, 23.6 years; SD, 4.4 years). As an incentive to participate, participants were offered 20 *yuan* (equivalent to US $3) for the completion of all 3 questionnaires.

The study was approved by the human research ethics committee at Peking University. A longitudinal design with 3 waves of data collection, each spaced 2 weeks apart, was conducted. Before the commencement of class, participants from 2 courses were invited to partake in what was advertised as a study on health behavior. An information sheet outlining the purpose of the study was provided and all questionnaires were conducted face-to-face. The time 1 (T1) questionnaire assessed dietary self-efficacy and fruit and vegetable intake in the previous week as well as demographic variables. The time 2 (T2) questionnaire assessed received social support and action planning. Fruit and vegetable intake during the previous week was measured again at time 3 (T3). Consent was gained through completion of the T1 questionnaire, and consent to contact participants for the T2 and T3 follow-up was given through the provision of contact details. Data across each time point were able to be de-identified and matched using a unique code identifier created by the participant.

Measures

Dietary self-efficacy. At T1, 6 items assessed dietary self-efficacy. Three of the items measured action self-efficacy (eg, I am certain that I can eat at least 5 portions/d of fruit and vegetables even if it is difficult to get starting at the very beginning, scored totally disagree [1] to totally agree [5]). Three of the items measured coping self-efficacy (eg, I am certain that I can eat at least 5 portions/d of fruit and vegetables even if I meet several obstacles to prevent me from achieving the goal, scored totally disagree [1] to totally agree [5]). The measure was validated in previous studies.[12,24] Cronbach α for the current study was .74.

Received social support. Received social support at T2 was measured by 3 items developed from the Berlin Social Support Scales[31] and adapted to the target behavior of fruit and vegetable intake. Participants were asked to rate the frequency with which they received support for fruit and vegetable intake from their family, friends, and acquaintances in the past week (eg, My friends in school gave me encouragement to stick to 5 portions of fruit and vegetables/d, scored totally disagree [1] to totally agree [5]). Cronbach α for the current study was .80.

Action planning. Action planning at T2 was assessed with 3 items regarding the location, time, and social context of fruit and vegetable intake. The wording of the 3 items was, I have already planned [when/where/with whom] to eat fruits and vegetables, scored totally disagree [1] to totally agree [5]. The measure was validated in previous studies.[14,32] Cronbach α for the current study was .79.

Fruit and vegetable intake. At T1 and T3, 2 items measured fruit and vegetable intake (eg, During the past week, how many portions of fruit/vegetables did you eat per day?). To assist participants in responding accurately, examples of what constituted 1 portion size were provided. Such self-report items of food consumption were validated against food-frequency questionnaires and dietary biomarkers.[33]

Data Analysis

Data analyses were performed on the complete case data set (n = 156, after list-wise deletion of missing values) with Hayes' SPSS Process macro.[34] In addition, the findings were replicated on the basis of the initial total sample of 286 participants, using MPLUS 7.4 (Muthén & Muthén, Los Angeles, CA) accounting for missing values by full information maximum likelihood.[35] Because results did not differ between these 2 methods, findings on the complete case data set are reported.

First, to account for any attrition effects, chi-square tests of independence were performed on the categorical variables (gender and ethnicity), and independent-sample *t* tests and MANOVA were performed on the continuous variables (age, body mass index, self-efficacy, and baseline behavior).

Second, a mediation analysis was performed using the SPSS PROCESS[34] macro 2.16 (Hayes, Columbus, OH) (model 4). Action planning at T2 was specified as a mediator between self-efficacy at T1 and fruit and vegetable intake at T3, controlling for age, gender, body mass index, and baseline behavior (T1 fruit and vegetable intake). Bias-corrected bootstrapping with 5,000 resamples was chosen to establish 95% confidence intervals (CIs) for direct, indirect, and total effects.

Third, a conditional process analysis was performed to explore possible moderation of the former mediation model (model 7). Moderated mediation was tested with action planning at T2 as

a mediator between self-efficacy at T1 and fruit and vegetable intake at T3, whereas social support at T2 served as a moderator between self-efficacy and action planning. To probe the interaction between self-efficacy and social support, a simple slope test was used, and an extension of the Johnson–Neyman technique[36] was applied to test the significance of the indirect effect within the observed range of values of the moderator (social support) until the value of the moderator was identified, and for which the conditional indirect effect was statistically significant at $\alpha = .05$.

RESULTS

Attrition Analysis

Of a total of 286 participants who completed the baseline assessment, a sub-sample of 156 (55%) completed the third wave of data collection. The only significant difference between returning students and those who dropped out was for gender, with greater attrition evident for men compared with women (60.55% vs 36.16%; χ^2 (1 degree of freedom) = 16.19; $P < .01$). The final sample at T3 consisted of 156 participants aged 17 to 46 years (mean, 23.6 years; SD, 4.4 years), 72.4% of whom were women.

Descriptive Analysis

The table presents the means, SDs, and inter-correlations among all variables included in the model. Average fruit and vegetable intake per day was 4.3 portions (SD, 2.75) at T1 and 4.6 portions (SD 2.16) at T3; 67.5% (57.1% at T3) of the sample did not consume the recommended amount of 5 portions/d of fruits and vegetables. There were no significant changes in fruit and vegetable consumption from T1 to T3 ($t_{165} = 0.14$; $P > .05$). Self-efficacy at T1 and action planning at T2 were significantly related to each other ($r = .18$; $P < .05$). Action planning at T2 was significantly correlated with fruit and vegetable intake at T3 ($r = .21$; $P < .01$). The association between received social support and action planning at T2 was significant ($r = .27$; $P < .01$). There were no significant relationships among age, gender, body mass index, and fruit and vegetable intake (all P's $< .01$).

Mediation Analysis

Self-efficacy at T1 predicted action planning at T2 ($\beta = .19$; $P < .05$), which in turn predicted fruit and vegetable intake at T3 ($\beta = .30$; $P < .01$). After controlling for fruit and vegetable intake at T1 and action planning at T2, there was no significant association between self-efficacy at T1 and fruit and vegetable intake at T3 ($\beta = -.13$; $P > .05$) (Figure 1). The indirect effect of self-efficacy at T1 on fruit and vegetable intake at T3 via action planning at T2 was $\beta = .06$ (95% CI, 0.01–0.15). Controlling for baseline behavior (fruits and vegetables at T1), 10% of variance in fruit and vegetable intake at T3 was explained.

Conditional Process Analysis

To explore further the putative moderator of received social support in this mediation chain, the researchers conducted a conditional process analysis (Figure 2). In a first step, action planning at T2 was regressed on self-efficacy at T1, received social support at T2, and the interaction between self-efficacy and received social support. Results indicated that self-efficacy and received social support predicted action planning with $\beta = .80$, $P < .01$ and $\beta = .82$, $P < .01$, respectively. An interaction of self-efficacy and received social support also emerged as a significant predictor of action planning with $\beta = -.18$, $P < .05$. In a second step, fruit and vegetable intake at T3 was regressed on fruit and vegetable intake at T1, action planning at T2, and self-efficacy at T1. Action planning emerged as the strongest predictor of fruit and vegetable intake at T3 ($\beta = .30$; $P < .01$), followed by baseline behavior ($\beta = .20$, $P < .05$). No significant relationship between self-efficacy and T3 fruit and vegetable consumption emerged ($\beta = -.15$; $P > .05$). The path from self-efficacy to dietary behavior was mediated via action planning with an indirect effect of $\beta = .07$ (95% CI, 0.02–0.18) when there was a medium level of received social support. The indirect effect of self-efficacy on behavior was higher among participants with 1 SD received social support below the mean ($\beta = .13$; 95% CI, 0.03–0.31) than among those with 1 SD received social support above the mean ($\beta = .01$; 95% CI, –0.07–0.10). Together, these variables accounted for 13% and 10% of the variances in action planning at T2 and fruit and vegetable intake at T3, respectively.

Figure 3 illustrates the interaction between self-efficacy and received social support. A higher level of self-efficacy corresponded with a higher level of action planning regardless of levels of received social support. However, the effect size of self-efficacy on action planning decreased to nonsignificant as received social support increased. The Johnson–Neyman technique showed that the cutoff point at which self-efficacy no longer predicted action

Table. Descriptive Analysis for Target Behavior of Fruit and Vegetable Intake: Bivariate Correlations, Means, and SD

Key variables	1	2	3	4	5	6	7	Mean	SD
1. Dietary self-efficacy (time 1)								3.38	0.74
2. Received social support (time 2)	–.06							3.17	1.05
3. Action planning (time 2)	.18*	.27**						3.27	0.80
4. Fruit and vegetable intake (time 3)	–.04	.07	.21**					4.59	2.16
5. Fruit and vegetable intake (time 1)	–.05	.01	.03	.21**				4.29	2.75
6. Age (time 1)	–.02	.05	.06	–.01	.04			23.64	4.44
7. Gender (time 1)	.01	.01	–.10	–.10	–.05	–.14*		–	–
8. Body mass index (time 1)	–.10	.12	.05	–.05	–.08	.07	.29**	21.46	3.77

*$P < .05$; **$P < .01$.

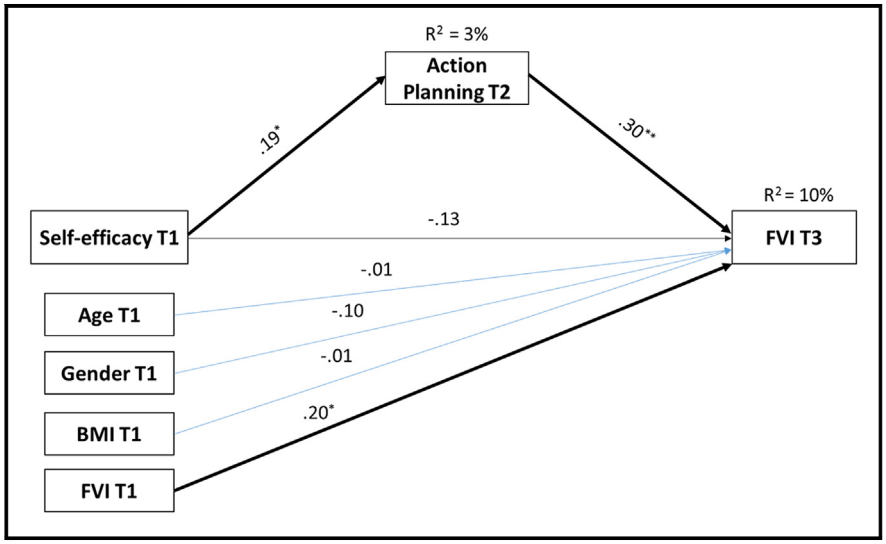

Figure 1. Mediation analysis of effect of self-efficacy on fruit and vegetable intake via action planning, controlling for baseline behavior. Unstandardized solution, bootstrapped with 5,000 resamples (n = 156), controlling for age, sex, and body mass index. *$P < .05$; **$P < .01$. BMI indicates body mass index; FVI, fruit and vegetable intake; T, time.

planning was reached when the received social support score was 3.5 on a scale from 1 to 5.

DISCUSSION

The current study examined possible social cognitive mechanisms involved in consuming fruits and vegetables, testing self-efficacy, action planning, and received social support as joint predictors in a moderated mediation framework and using a longitudinal design. Although self-efficacy was theorized to be a pivotal determinant of health behavior in social cognitive theory,[11,23] such a role in the context of healthy eating behaviors is not well established. In the current study, no direct effect of self-efficacy on fruit and vegetable intake was observed. A systematic review found that nearly 34% of included studies showed no significant associations between self-efficacy and fruit and vegetable consumption.[10] To elucidate the mechanisms under which self-efficacy may predict fruit and vegetable intake, the current study focused on the interplay of self-efficacy and received social support on action planning and the mediator of action planning between self-efficacy and subsequent behavior.

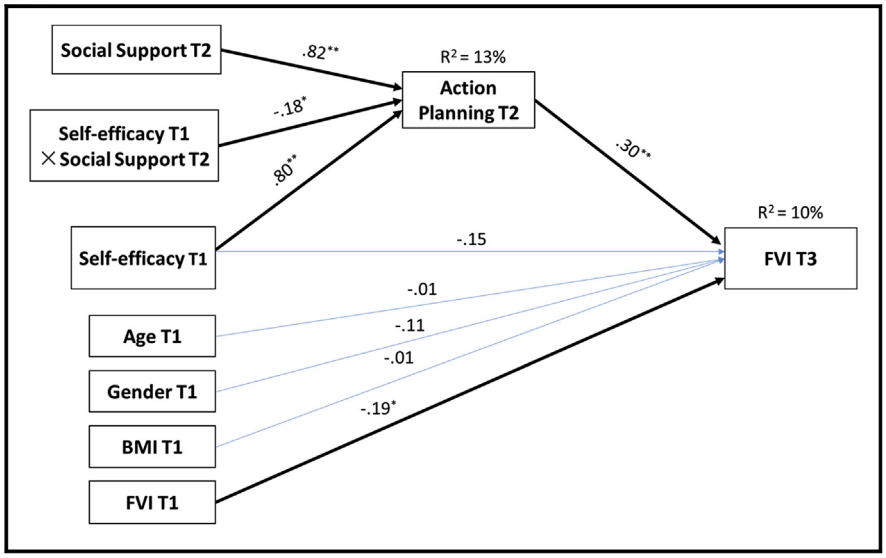

Figure 2. Moderation analysis of effect of received social support and dietary self-efficacy on fruit and vegetable intake via action planning, controlling for baseline behavior. Unstandardized solution, bootstrapped with 5,000 resamples (n = 156), controlling for age, sex, and body mass index. *$P < .05$; **$P < .01$. BMI indicates body mass index; FVI, fruit and vegetable intake; T, time.

First, in line with dual-phase models of health behavior[23] and previous planning literature,[21] the current study examined the chain of dietary self-efficacy leading to action planning and to fruit and vegetable intake. The findings of the current study add to the extant literature on the mediating role of planning and provide emerging evidence that the effect of self-efficacy on healthy eating behavior is mediated via action planning. This implies that people who hold optimistic self-beliefs engage more in action planning for their fruit and vegetable intake and thus are more likely to adhere to the 5 portions/d regime. The results were in line with a previous study applying a latent true change model that demonstrated how changes in self-efficacy predicted changes in planning which in turn corresponded to changes in fruit and vegetable intake.[24] Also congruent with the results were findings from an intervention study demonstrating that treatment effects on fruit and vegetable change were mediated by self-efficacy and planning.[25] In support of the researchers' first aim, the findings of the current study suggest that being confident about one's ability to consume recommended amounts of fruits and vegetables daily may facilitate the generation of specific plans regarding when, where, and with whom to eat such healthy foods, which in turn facilitates actual behavior.

In addition to self-efficacy, received social support was also found to facilitate self-regulation, specifically for making plans, in this nutrition context.[37] Thus, action planning as a specific self-regulatory skill may benefit from individual optimistic self-beliefs as well as received social support. Previous studies found a synergistic effect of social support and self-efficacy on nutritional behavior, but a compensatory effect on physical exercise.[13,29] Exploring whether these 2 resources have a more synergistic or compensatory role on fruit and vegetable intake constituted the second aim of the current study. Results showed that

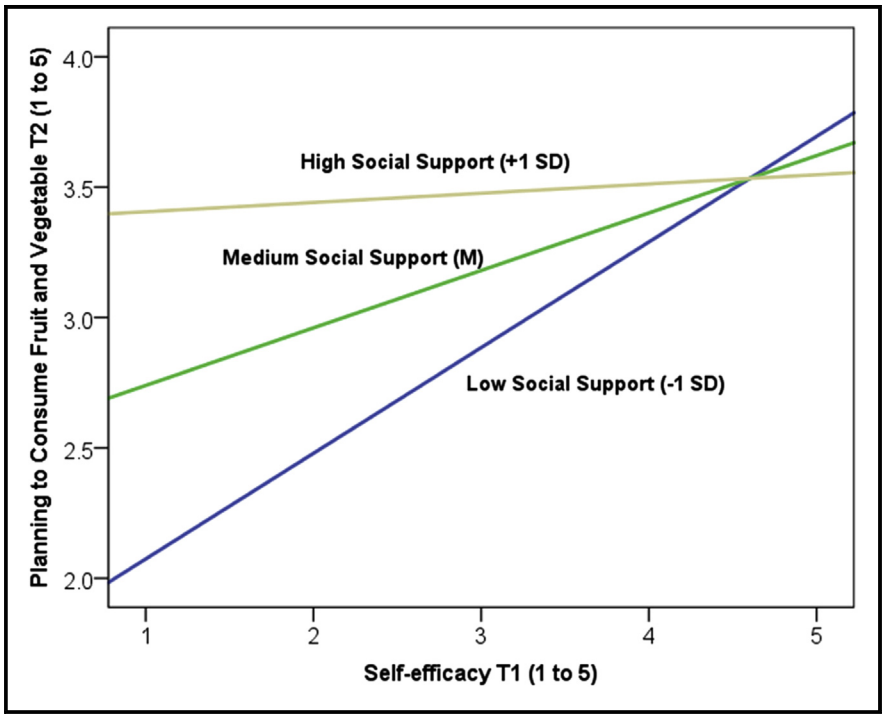

Figure 3. Interaction between dietary self-efficacy at time 1 (T1) and received social support at time 2 (T2) on action planning at T2. M indicates mean.

received social support interacted with self-efficacy on action plans, which in turn predicted fruit and vegetable intake. This supports a compensatory effect. Findings indicated that the positive association between self-efficacy and action planning was more pronounced among participants with lower levels of received social support. This implies that when self-efficacy is low, received social support can compensate for it when it comes to making action plans. Furthermore, for individuals with lower self-efficacy, low received social support is detrimental to translating optimistic self-beliefs into action plans; yet, for those with higher self-efficacy, received social support makes no difference with regard to their plans.

To evaluate these results and their implications for future research and practice, some limitations of the current study need to be mentioned. First, the measurement of fruit and vegetable intake was self-reported, which may have resulted in bias in that individuals may have overestimated (or underestimated) the number of portions consumed in the previous week. Despite such a potential bias, dietary self-reports were validated against objective assessment such as biomarkers.[33] Second, although a strength of the study was the use of a longitudinal design, it did not allow for causal inference. However, the 3-wave study design had temporal order, which strengthened the support for the mediational findings. To confirm the putative causal chains further, experimental intervention designs are needed. Third, the sample recruited in the current study was composed of university students, which may have limited the generalization of the findings. Nevertheless, this research contributes to the investigation of action planning as a mediator between self-efficacy and fruit and vegetable intake, and demonstrates the compensatory effect of received social support and self-efficacy on action planning. The findings of the current study add to the emerging literature investigating the joint effect of self-efficacy, planning, and social support on people's dietary behavior and provide novel implications for planning interventions that may account for equivocal findings in support of such interventions.[21,38] By identifying social cognitive factors influencing dietary planning, interventions can target self-efficacy and received social support to test the efficacy of these mechanisms in increasing individuals' ability to ensure they consume adequate amounts of fruits and vegetables.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The findings from the current study have implications for future interventions to facilitate healthy eating behavior. In particular, developing simple action plans may assist in promoting the adequate consumption of fruits and vegetables. In addition, it may be important for researchers designing healthy eating planning interventions first to identify individuals who are low self-efficacious and receive less social support and to improve at least 1 of these 2 coping resources before implementing the intervention on such individuals. Advantages of planning interventions include low cost and response burden.[21] Given the often limited financial resources to develop health interventions, understanding better the mechanisms by which planning formation leads to action is an important line of investigation. Although the current study was conducted in healthy adults, it is possible that the findings could also translate to the clinical context. An online weight management intervention program designed to focus on self-regulatory skills and nurse social support suggested an effective solution to weight reduction for obese patients.[39] Future interventions can then draw on this knowledge to develop more effective planning interventions for health behavior change for both healthy persons and patients.

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CONFLICT OF INTEREST

The authors have not stated any conflicts of interest.