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McCabe, Brianne E.; Plotnikoff, Ronald C.; Dewar, Deborah L.; Collins, Clare E.; Lubans, David R.; 'Social cognitive mediators of dietary behavior change in adolescent girls'.
Published in American Journal of Health Behavior Vol. 39, Issue 1, p. 51-61 (2015)

Available from: <http://dx.doi.org/10.5993/AJHB.39.1.6>

Accessed from: <http://hdl.handle.net/1959.13/1332240>

Change

Mediation of Dietary

Testing the Social Cognitive Mediators of Dietary Behavior Change in the NEAT Girls
Obesity Prevention Program

Abstract

Objectives: This study examined potential mediators of adolescent girls' dietary behavior change in the Nutrition and Enjoyable Activity for Teen Girls (NEAT Girls) intervention for obesity prevention.

Methods: Participants were 294 adolescent girls attending 12 secondary schools located in low-income communities of New South Wales, Australia. Hypothesized social cognitive mediators of dietary behavior change were assessed using valid and reliable scales.

Results: The intervention effects on dietary outcomes and hypothesized mediators were not statistically significant. However, changes in hypothesized mediators were associated with changes in key dietary behaviors.

Conclusions: Continued research is needed to examine effective strategies for improving dietary outcomes in youth, and explore alternative theoretical mechanisms of dietary behaviour change.

Key words: Dietary Change; Adolescents; Mediation; Intervention; Nutrition.

Introduction

The transition from childhood to adolescence is characterised by a marked deterioration in physical activity ¹ and dietary behaviors ². Few youth consume a diet that aligns with current guidelines especially with respect to fruit and vegetable consumption ³. For example, a national survey of Australian adolescents reported approximately 2% consume the recommended three servings per day of fruit and approximately 10% eat four or more serves of vegetables per day ⁴. The poor dietary intake exhibited by many adolescents is of concern given the increasing prevalence of obesity and other diet related health implications ⁵. Further, the development of healthy eating habits is critical at this age as unhealthy habits can transfer into poor adult diets, compounding the risk for diet related diseases ⁶.

Health behavior theories are helpful in interpreting dietary behaviors among youth ⁷ and evidence suggests that theoretically-based interventions are more effective in changing behavior than non-theoretical approaches ^{8,9}. Bandura's Social Cognitive Theory (SCT) ¹⁰ provides a useful framework for explaining why people may acquire and maintain health behaviors across a range of population groups ¹¹. The core of this theory is that human behavior is the product of a dynamic interplay of personal, environmental and behavioral factors. The term 'reciprocal determinism' is used to describe how these factors may affect or be affected by the others. Bandura's ¹² more recent commentary of the SCT (Figure 1) describes a core set of determinants of health behavior and the mechanisms through which these determinants are specified. These determinants include intentions (proximal goals), self-efficacy, outcome expectation, and perceived impediments and facilitators to change. While there has been a multitude of theories used to guide research and practice in health promotion, SCT has been used extensively in

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adolescent health behavior research to guide intervention development. Further, there is considerable evidence supporting SCT constructs to explain adolescent physical activity behaviors ¹³.

(insert Figure 1 around here)

In SCT, intentions are hypothesized to be the direct antecedent to behavior and can be considered proximal goals to perform a particular behavior (e.g., *aiming* to participate in physical activity on most days of the week is essentially the same as *intending* to perform a particular behavior. Goals, when highly valued, enhance motivation to adopt healthy eating behaviors. While goals can be proximal or distal, it is the proximal or short-term goals which are more effective in enacting behavior change ¹².

Self-efficacy is considered to be a central determinant in SCT because it influences health behavior both directly and indirectly through other influences. Self-efficacy refers to an individual's belief in their ability to perform a specific behavior such as, healthy eating. Self-efficacy is task and context specific, with an individual's sense of efficacy being tied to specific behaviors and situations ¹⁴. In the current study we postulate that self-efficacy for healthy eating is positively related to adolescent girls' healthy dietary behaviors ⁷.

Outcome expectations refer to the anticipated outcomes of healthy eating, such as the potential health benefits ¹¹. The anticipated outcomes can be social, physical and self-evaluative and are dependent on the individuals' self-efficacy beliefs which serve as incentives for food choices ¹⁵. Outcome expectations may be influenced by outcome expectancies which are concerned with personal value placed on the perceived benefits of a healthy behavior (e.g., maintaining a healthy weight through healthy eating is important to me/not important to me).

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Socio-structural factors can also facilitate or impede health behavior change. In terms of dietary behavior, adolescents consume most of their meals and a majority of their snacks at home¹⁶. The family or home environment has two major influences; the food available for consumption and influential attitudes, preferences and values surrounding food by family members⁵. Although parents have little influence over what adolescents eat away from the home, they may provide an important influence in the home environment^{5, 17}.

The aim of this study was to examine hypothesized social cognitive mediators of dietary behavior change in adolescent girls following a 12-month school-based physical activity and dietary intervention to prevent obesity. Schools were located in low-income Australian communities.

Method

Intervention Components

The NEAT Girls study involved a 12-month group randomized controlled trial (RCT) to prevent obesity. The intervention included strategies which targeted psychological, behavioral and environmental influences of dietary behavior based on constructs from the SCT^{18, 19}. Each participant received a NEAT Girls nutrition handbook which provided key health messages based on current Australian dietary guidelines for adolescents, and included 10 weeks of home challenges designed to promote healthy eating. The nutrition messages targeted increases in fruit and vegetable consumption, daily breakfast, eating evening meals at a dinner table, monitoring portion size, drinking water, and reducing sweetened beverages and energy-dense snacks.

Three practical nutrition workshops were delivered in the school food laboratories by Accredited Practicing Dietitians. Workshops reinforced the key health messages for healthy eating that were promoted in the handbook, and focussed on providing dietary

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information and strategies designed to develop lifetime nutrition skills to facilitate the maintenance of healthy weight. Tasks included the energy balance concept pertaining to kilojoule intake and energy expenditure, interpreting food labels, modifying recipes to reduce energy density of meals and snacks, appropriate portion sizes and the preparation of inexpensive healthy snacks and meals. Participants also engaged in three interactive seminars that were delivered by a member of the research team. Seminars focussed on reaffirming key nutrition recommendations and behavioral strategies to support student directed implementation. Other dietary-focussed intervention strategies included four parent newsletters and text messaging for social support.

Participants

Eligible secondary schools were located in the Hunter Region and Central Coast areas of NSW with a Socio-Economic Indexes for Areas (SEIFA) index of ≤ 5 (bottom 50%). Among 26 eligible schools, 12 schools consented to participate in the study. Participants were adolescent girls in Grade 8 identified by their physical education teacher as disengaged in physical education lessons and currently not participating in individual/organised sport.

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Sample size

The original sample size calculation for the RCT based on the primary end point of 12-months and was based on change in body mass index (BMI) – the study’s primary outcome. A sample of 24 girls from 12 schools (N = 294) was required to detect a group difference of one BMI unit assuming an alpha level of 0.05, power of 80% power and a 20% dropout ²⁰. This sample size is adequately powered to detect small to medium-sized mediation effects using a product-of-coefficients test ²¹.

Outcomes

All measurements were completed by trained research assistants on school premises. Questionnaires were completed by participants in exam-like conditions.

Dietary behavior

Dietary behavior was assessed using the Australian Eating Surveys (AES), which is a 120-item semi-quantitative Food Frequency Questionnaire (FFQ) for dietary intake. The AES has been previously tested for reliability and validity ²² and has shown to be suitable for Australian youth 9-16 years ²³. The Australian Bureau of Statistics and unpublished data from the 1995 Australian National Nutrition Survey were used to generate portion sizes for individual food items. Participants were asked questions based on the frequency of their food consumption over the previous six months; their intake of fruit and vegetables, with specific focus on seasonal fruit; and their total number of daily serves of various food items. Finally questions on food related behaviors, including frequency of eating take-away food and eating while watching TV, were asked.

Misreporting was defined using the methods described by Field et al., ^{24, 25} with cases reporting <500kcal/day (2,090kJ) and >5000kcal/day (20,900kJ) per day removed from the dataset (24 removed at baseline and 18 removed at post-test). The following FFQ

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outcomes were selected as dependent variables in the regression models as they represented the key dietary messages from the NEAT Girls intervention: i) proportion of total energy intake from fruit, ii) proportion of total energy intake from vegetables, iii) proportion of total energy intake from sugar sweetened beverages and, iv) total fat intake in grams ²⁴.

Social cognitive theory measures

Intention: Using a four-point Likert-type scale (*1 = not at all true for me; 4 = very true for me*), five items assessed intentions to adopt healthy eating behaviors. A common stem “*In the next three months do you ...*” provided a time referent to direct participants to regard their intentions for the short-term future. For example, ‘*... do you intend to eat healthier portion sizes during meals e.g., not eating until you feel full?*’ ¹¹.

Self-efficacy: Participants were asked to rate their confidence (*1 = strongly disagree; 6 = strongly agree*) in personal ability to choose/eat healthy foods whenever a choice is provided (e.g., *I find it difficult to choose healthy meals or snacks when I am eating out with friends*) ¹¹.

Outcome expectations and expectancies: This five-item scale measured the anticipated outcomes of healthy eating such as the physical and cognitive benefits. Participants rated their expectation statements on a six-point Likert-type scale (*1 = strongly disagree; 6 = strongly agree; e.g., Healthy eating can help me to feel more energetic throughout the day*). The expectancies scale provided five corresponding personal evaluations of the importance (*1 = not important at all; 4 = very important*) for each expectation item (e.g., ‘*How important is feeling more energetic to you?*’) ¹¹.

Home environment: The home dietary environment scale examined an individual’s mental representation of their home environment that may influence their dietary

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behavior. Specifically, items examined the provision of healthy snacks, drinks and the availability of fruit and vegetables. Using a six-point Likert-type scale (*1 = strongly disagree; 6 = strongly agree*), participants were asked to indicate their level of agreement/disagreement with each item (*e.g., At home fruit is always available to eat-including fresh, canned or dried fruits*)¹¹.

Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 20.0 (2010 SPSS Inc., IBM Company Armonk, NY) and the INDIRECT add on for SPSS²⁶. It has been suggested that if intra-class correlation coefficients (ICC) are small (i.e., ICC < .05) and there is no meaningful difference among groups, the data may be analysed at the individual level^{27, 28}. Due to the relatively small number of clusters and the low ICC values (all values were < 0.033), the analyses were not adjusted for the clustered nature of the data. A product-of-coefficient test was used to assess single and multiple mediator models because it has good statistical power in small samples and can be used to identify significant mediation effects even in the absence of a significant intervention effect²⁹. Single mediator models were tested for each of the dietary outcomes that aligned with the NEAT Girls behavioral messages (i.e., proportion of total energy intake from fruit, vegetables and sugar sweetened beverages and total fat intake). Each model included treatment (i.e., intervention or control) as the independent variable, baseline mediator and dietary outcome as covariates, 12-month dietary mediator and 12-month dietary outcome as the dependent variable. The INDIRECT calculates the action theory (A coefficient), conceptual theory (B coefficient), direct effect (C') and significance of the mediated effect (AB) simultaneously. Figure 2 depicts the pathways and coefficients tested. The action theory test involved regressing the potential mediators onto the treatment condition (A coefficient), controlling for baseline. The direct effect of the intervention on dietary

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outcomes was estimated by regressing the posttest dietary scores onto treatment (C' coefficient) with adjustment for baseline dietary scores and potential mediators. This model also provided the conceptual theory test which represents the association between changes in potential mediators (B coefficient) and changes in dietary outcomes. Finally, the significance of the product-of-coefficients (AB) was determined using the asymmetric bias-corrected bootstrap confidence intervals. For the mediator effects to be considered statistically significant, the 95% confidence intervals for the product-of coefficients must not include zero. Multiple mediator models that included all of the hypothesized mediators were calculated for each of the four dietary outcomes. Alpha levels were set at $p < 0.05$ for all analyses.

(insert Figure 2 around here)

Results

Participants at baseline were 357 adolescent girls (mean age = 13.2 ± 0.5 years) from 12 secondary schools (see Table 1), with 63 unavailable for 12-month assessment; 153 (85.5%) and 141 (79.2%) girls were retained in the control and intervention groups, respectively. The girls who dropped out of the study had higher baseline BMI (mean = 23.81 ± 4.52 vs 22.39 ± 4.56) than those who completed the study ($p = 0.03$). FFQ results were obtained from 327 and 271 girls at baseline and 12-month, respectively. As reported previously^{18, 30}, there were no statistically significant differences between intervention and control groups at baseline.

There were no intervention effects for the key dietary behaviors i.e., energy intake from fruit, energy from vegetables, proportion of energy from fats and proportion of energy from sugared beverages.

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(insert Table 1 around here)

Action theory test

There were no statistical significant action theory test results for any of the theoretical mediators (Tables 2-5). However, the effect on nutrition home environment approached statistical significance ($\beta = -0.161$, $SE = 0.090$, $p = 0.071$). Intervention effects were not significant for intention to consume low-sugared beverage options, low-fat options, vegetables and fruit.

(insert Tables 2-5 around here)

Conceptual theory test

Changes in the proportion of energy from fruit (Tables 2-5) was associated with changes in self-efficacy ($\beta = 2.076$, $SE = 0.413$, $p = 0.001$). Changes in nutrition home environment approached statistical significance ($\beta = 0.965$, $SE = 0.512$, $p = 0.060$). Changes in the proportion of energy from vegetables (Table 2) was associated with changes in intention to consume vegetables ($\beta = 1.292$, $SE = 0.381$, $p = 0.001$). Changes in self-efficacy approached statistical significance ($\beta = 0.666$, $SE = 0.376$, $p = 0.078$). Changes in proportion of energy from fat (Table 3) was associated with changes in intention to consume low fat options ($\beta = -5.938$, $SE = 2.447$, $p = 0.016$). None of the mediators were associated with fat intake. There were no statistically significant conceptual theory test results for the proportion of energy from sugared beverages.

Mediated effects

The product of coefficients (i.e., AB) and 95% confidence intervals are reported in Tables 2-5. Changes in nutrition home environment mediated the intervention effect on

proportion of energy from fruit ($AB = -0.158$, 95 % CI, -0.488 to 0.001). None of the other SCT constructs mediated the effects of the intervention on dietary intake.

Multiple Mediator Model Analysis

In the multiple mediator models explaining energy from fruit, there were no statistically significant action theory test results. There were significant conceptual theory test results for self-efficacy ($\beta = 1.114$, $SE = 0.528$, $p = 0.036$). In the models explaining proportion of energy from vegetables there were no statistically significant action theory results, but adolescents' nutrition home environment approached significance ($\beta = -0.157$, $SE = 0.091$, $p = 0.086$). Statistically significant conceptual theory results were found for intention to consume vegetables ($\beta = 1.560$, $SE = 0.473$, $p = 0.001$). In the models explaining fat intake there were no statistically significant action theory test results. Adolescents nutrition home environment approached significance ($\beta = -0.161$, $SE = 0.090$, $p = 0.073$). Statistically significant conceptual theory results were found for adolescents' intention to consume low fat options ($\beta = -7.366$, $SE = 2.750$, $p = 0.008$). In the models for energy from sugared beverages there were no statistically significant results for the action theory or conceptual theory tests. None of the SCT constructs mediated the intervention effect on dietary outcomes in any of the multiple mediator models.

Discussion

The primary aim of this paper was to explore the mediators of dietary behavior change following an obesity prevention program in adolescent girls attending schools in low-income communities. The intervention effects on dietary behavior were small and not statistically significant. A product-of-coefficients test was used to examine potential mechanisms of dietary behavior change, and this method can be used to identify

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mediators even if intervention effects are not significant²⁹. Although none of the action theory results were significant, there were a number of significant conceptual theory test results. These findings suggest that the intervention was not successful in changing adolescent girls' key dietary behaviors, yet significant conceptual theory test results demonstrated that specific social cognitive constructs predicted behavior change in this cohort.

Nutrition home environment satisfied the criteria for mediation; however changes were not in the hypothesized direction. Over the 12-month study period, girls in the intervention reported comparatively lower scores of the nutrition home environment scale at post-test. It is unlikely that the NEAT Girls intervention had a negative impact on the availability of healthy foods in participants' homes. Rather it is suggested that due to participant's heightened awareness and increased understanding of healthy eating following the intervention, they were more aware of the unhealthy foods available in their homes. Similar results were found in the Program X pilot study³¹, whereby participants in the intervention group perceived their home nutrition environment to be less healthy at post-test assessment. It is possible that both groups may have not been aware of the availability of healthy foods in their homes at baseline. However, after participating in an intervention focussed on the importance of healthy eating, the intervention group may have increased their awareness of the availability such foods in their households. Similarly, Gustafson et al.,³² found that women from low-income backgrounds became more aware of their environment and the accessibility of fruit and vegetables after participating in a dietary intervention.

Although the impact of the NEAT Girls intervention on girls' food perceptions in the home environment was not in the hypothesized direction, this is not necessarily a negative

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result. The changes in the adolescent girls' perception of their environment suggest that their knowledge and awareness increased, which may have positive implications for future behavior. With this increased knowledge of healthy eating, participants may be more likely to make positive long-term dietary behavior changes ³³.

The amount of family support and food availability in the home environment is considered to be an important barrier/facilitator to healthy eating in adolescents ³⁴. Although the NEAT Girls intervention was delivered in schools and targeted adolescent girls, strategies also included home-based challenges and newsletters to engage parents and target the home environment. However, the absence of an intervention effect on dietary behaviors suggest that the NEAT Girls intervention was not enough to positively influence parents and the provision of healthy foods at home. The challenges of engaging parents and positively impacting the home environment during school-based nutrition interventions have been reported previously ³⁵. Yet there are also accounts of success when intervention strategies have included parental involvement. For example a Belgian school-based intervention that combined computer tailored feedback, school environmental changes and parental support was found to have a positive effect on adolescents' dietary behaviors and physical activity ³⁶. The study found that by including a parental support component, adolescent girls significantly decreased their proportion of energy from fat, compared to an intervention treatment without parental support ³⁶. The intervention strategy of providing parents with regular newsletters is parallel with the current study; however parents were also given a CD of the physical activity and nutrition intervention to complete at home. By directly involving parents in their child's health promotion intervention, this is found to be a positive impact on adolescent health behaviors.

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Significant associations were found between changes in the mediating variables and participants' dietary behavior. A change in self-efficacy was positively associated with changes in fruit intake, providing evidence for the importance of this SCT construct. Similar to the current study, Chin, Paw, Singh, Brug & Van Mechelen ³⁷, and Reynolds, Yaroch & Franklin ³⁸, also found that changes in self-efficacy were consistently related to positive fruit and vegetable intake behaviors. This finding suggests that increasing an individual's self-efficacy for fruit consumption through education and social support has the potential to increase intake. Although changes in self-efficacy were associated with changes in fruit intake there was no relationship between changes in self-efficacy and vegetable consumption. It is important to note that self-efficacy relates to one's ability to execute a behavior under personal control ¹⁴, and adolescents have greater control over the snacks they eat (e.g., fruit) rather than what they are served for dinner (e.g., vegetables) ³⁹.

The intervention did not have a significant impact on participants' intentions to eat healthily. This is a common finding from many dietary interventions, with findings showing limited or null results for changes in dietary behavior commonly found [7]. A ceiling effect is a possible explanation for this finding, as participants' reported relatively high intentions to eat healthily at baseline, thus reducing the potential for change over time. SCT proposes that goals/intentions are the direct antecedent of behavior. It appears that the NEAT Girls intervention was not successful in convincing adolescent girls of the importance of changing these behaviors. Although changes in intentions are considered to be a prerequisite for behavioral change, unless they are accompanied by improvements in self-efficacy and social support, it is unlikely that intentions will translate into behavior ³⁴. Previous studies have noted the discord between intentions and actual dietary intake ⁴⁰. Self-regulation strategies to keep the individual motivated to continue the behavior

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have been offered as a possible adherence mechanism for adolescents to continue to consume healthy diets ⁴¹. For example, for individuals intending to decrease their consumption of sugar sweetened beverages and foods, setting goals such as cleaning their teeth immediately after dinner could reduce the temptation to consume sugar sweetened beverages or foods following the evening meal ³⁴. Accurate assessment of food intake in children and adolescents is an essential prerequisite for monitoring the nutritional status as well as for conducting epidemiological and clinical research between diet and health. The measurement of energy and nutrient intakes in children and adolescents is particularly challenging due to the of respondents' understanding, honesty and observer considerations which surface during testing ⁴². While cognitive abilities should be fully developed by adolescence, issues of motivation and body image may hinder willingness to report accurately ⁴³.

There are a number of strengths in this study, including the use of a randomised controlled trial and the unique study population. Cluster RCTs are considered to be the gold standard for evaluating the efficacy of school-based interventions ⁴⁴ and the NEAT Girls trial adhered to the Consolidated Standards of Reporting Trials (CONSORT) statement ⁴⁵ to reduce sources of potential bias. Few studies have examined the dietary behaviors of adolescent girls from low-income communities in Australia ¹⁸. Further, this study employed valid and reliable assessment tools. Despite these strengths, there were some limitations that should be noted. First, although dietary intake was assessed using a FFQ which was validated in this target population on a contemporary food list, it's limited sensitivity to detect small changes in energy intake ³⁰ may explain the weak associations between social cognitive constructs and dietary intake ⁴⁶. It is possible that participants in the NEAT Girls made small changes in dietary intake, but these were not detected by the FFQ. Although FFQs are commonly used with adolescents to measure dietary intake,

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they have been found to overestimate nutrient intake, particularly among adolescent girls⁴⁷. Second, participants in the NEAT Girls study were not blinded to treatment conditions, which may introduce the possibility of respondent bias. Finally, not all intervention components were delivered as intended and few participants completed the home challenges, which were considered to be an integral strategy for changing the home environment and increasing social support from parents.

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(Bandura, 2004)

Fig. 1: Structural pathways of influence on behavior

Fig. 2: Hypothesized pathways and coefficients included in a single mediator model

Table 1: Characteristics of the study population (N = 294)

Characteristics	Control		NEAT Girls		Total	
	(<i>n</i> = 153)		(<i>n</i> = 141)		(<i>N</i> = 294)	
<i>Demographics</i>	Mean	SD	Mean	SD	Mean	SD
Age (years)	13.20	0.45	13.15	0.44	13.18	0.45
Participants born in Australia, <i>n</i> (%)	174	97.2%	175	98.3%	349	97.8%
English language spoken at home, <i>n</i> (%)	176	98.3%	176	98.9%	352	98.6%
Cultural background ^a						
Australian, <i>n</i> (%)	153	85.5%	152	85.4%	305	85.4%
European, <i>n</i> (%)	18	10.1%	18	10.1%	36	10.1%
Other, <i>n</i> (%)	8	4.6%	7	3.9%	15	4.2%
<i>Anthropometrics</i>						
Weight (kg)	58.37	13.78	58.41	14.15	58.39	13.95
Height (m)	1.61	0.07	1.60	0.06	1.60	0.07
BMI (kg/m ²)	23.37	4.68	23.30	4.71	22.64	4.58
BMI <i>z</i> -score ^b	0.81	1.17	0.76	1.16	0.80	1.14

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BMI category ^b						
Underweight, <i>n</i> (%)	1	0.6%	1	0.6%	2	0.6%
Healthy weight, <i>n</i> (%)	99	55.3%	103	57.9%	202	56.6%
Overweight, <i>n</i> (%)	50	27.9%	43	24.2%	93	26.1%
Obese, <i>n</i> (%)	29	16.2%	31	17.4%	60	16.8%

Abbreviations: SD, standard deviation; BMI, body mass index; SEP, socio-economic position.

^aone participant did not report their cultural background.

^bBMI z-score and categories based on ‘LMS’ method.

Table 2: Action theory test, conceptual theory test and significance of the mediated effect for proportion of energy from fruit

Hypothesized mediators	Intervention effect		Action theory test		Conceptual theory test		Significance of mediated effect	
	C'(SE)	p value	A (SE)	p value	B (SE)	p value	AB	95% CI ^a
Intention to eat fruit	0.245 (0.706)	0.728	-0.101 (0.085)	0.239	2.174 (0.522)	0.239	-0.212	-0.687, 0.101
Self-efficacy for healthy eating	0.721 (0.687)	0.916	0.046 (0.105)	0.651	2.076 (0.413)	< 0. 001	0.1063	-0.344, 0.643
Home environment for healthy eating	0.071 (0.721)	0.922	-0.161 (0.089)	0.071	0.965 (0.512)	0.060	-0.158	-0.488, -0.001
Outcome expectancies for healthy eating	0.064 (0.732)	0.931	-0.052 (0.055)	0.348	0.844 (0.837)	0.314	-0.045	-0.436, 0.037

Note. C' = unstandardized regression coefficient of the intervention predicting dietary intake foods accounting for effect of the mediator; A = unstandardized regression coefficient of treatment condition predicting hypothesized dietary mediators; B = unstandardized regression coefficient of the hypothesized mediators predicting dietary intake with treatment condition included in the model; SE = standard error; 95% CI = 95% confidence interval; AB = product-of-coefficients estimate;

^aBias-corrected bootstrap 95% confidence intervals for the product-of-coefficients.

Table 3: Action theory test, conceptual theory test and significance of the mediated effect for proportion of energy from vegetables

Hypothesized mediators	Intervention effect		Action theory test		Conceptual theory test		Significance of mediated effect	
	C' (SE)	<i>p</i> value	A (SE)	<i>p</i> value	B (SE)	<i>p</i> value	AB	95% CI ^a
Intention to eat vegetables	0.406 (0.611)	0.508	0.023 (0.102)	0.822	1.292 (0.381)	< 0.001	0.027	-0.293, 0.273
Self-efficacy for healthy eating	0.435 (0.626)	0.488	0.027 (0.106)	0.780	0.666 (0.376)	0.078	0.019	-0.124, 0.303
Home environment for healthy eating	0.415 (0.634)	0.513	-0.170 (0.089)	0.057	0.639 0(.450)	0.157	-0.109	-0.451, 0.005
Outcome expectancies for healthy eating	0.275 (0.639)	0.668	-0.066 (0.055)	0.241	-.093 (0.728)	0.899	0.016	-0.125, 0.230

Note. C' = unstandardized regression coefficient of the intervention predicting dietary intake foods accounting for effect of the mediator; A = unstandardized regression coefficient of treatment condition predicting hypothesized dietary mediators; B =

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unstandardized regression coefficient of the hypothesized mediators predicting dietary intake with treatment condition included in the model; SE = standard error; 95% CI = 95% confidence interval; AB = product-of-coefficients estimate;

^aBias-corrected bootstrap 95% confidence intervals for the product-of-coefficients.

Table 4: Action theory test, conceptual theory test and significance of the mediated effect for fat intake

	Intervention effect		Action theory test		Conceptual theory test		Significance of mediated effect	
	C'(SE)	<i>p</i> value	A (SE)	<i>p</i> value	B (SE)	<i>p</i> value	AB	95% CI ^a
Hypothesized mediators								
Intention to consume low-fat options	-2.679 (3.684)	0.468	-0.016 (0.095)	0.867	-5.938 (2.447)	0.016	0.805	-1.007, 1.627
Self-efficacy for healthy eating	-2.968 (3.756)	0.430	0.064 (0.105)	0.542	-1.424 (2.266)	0.531	-0.072	-1.285, 0.259
Home environment for healthy eating	-3.115 (3.785)	0.411	-0.173 (0.088)	0.050	-0.125 (2.712)	0.644	0.208	-0.482, 1.706
Outcome expectancies for healthy eating	-.2030 (3.764)	0.590	-0.069 (0.056)	0.218	3.530 (4.251)	0.407	-0.210	-1.657, 0.221

Note. C' = unstandardized regression coefficient of the intervention predicting dietary intake foods accounting for effect of the mediator; A = unstandardized regression coefficient of treatment condition predicting hypothesized dietary mediators; B =

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unstandardized regression coefficient of the hypothesized mediators predicting dietary intake with treatment condition included in the model; SE = standard error; 95% CI = 95% confidence interval; AB = product-of-coefficients estimate;

^aBias-corrected bootstrap 95% confidence intervals for the product-of-coefficients.

Table 5: Action theory test, conceptual theory test and significance of the mediated effect for energy from sugared beverages

Hypothesized mediators	Intervention effect		Action theory test		Conceptual theory test		Significance of mediated effect	
	C' (SE)	<i>p</i> value	A (SE)	<i>p</i> value	B (SE)	<i>p</i> value	AB	95% CI ^a
Intention to consume low-sugar options	-0.394 (0.772)	0.611	0.109 (0.100)	0.275	-0.138 (0.490)	0.780	-0.012	-0.270, 0.085
Self-efficacy for healthy eating	-0.332 (0.771)	0.667	0.039 (0.106)	0.713	0.154 (0.462)	0.740	0.009	-0.066, 0.161
Home environment for healthy eating	-0.391 (0.770)	0.612	-0.165 (0.089)	0.064	0.555 (0.546)	0.311	-0.087	-0.415, 0.026
Outcome expectancies for healthy eating	-0.423 (0.772)	0.584	-0.054 (0.056)	0.332	0.603 (0.877)	0.492	-0.030	-0.292, 0.046

Note. C' = unstandardized regression coefficient of the intervention predicting dietary intake foods accounting for effect of the mediator; A = unstandardized regression coefficient of treatment condition predicting hypothesized dietary mediators; B =

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unstandardized regression coefficient of the hypothesized mediators predicting dietary intake with treatment condition included in the model; SE = standard error; 95% CI = 95% confidence interval; AB = product-of-coefficients estimate;

^aBoot strapped bias corrected 95% confidence intervals of the product of coefficients.