Abstract

Objective: This study aimed to identify whether discretionary food consumption declined in an intervention primarily focused on promoting fruit and vegetable consumption. We also aimed to identify potential mediators explaining intervention effects on discretionary food consumption.

Design: Secondary analysis of data from the ShopSmart study, a randomised controlled trial involving a 6-month intervention promoting fruit and vegetable consumption. Linear regression models examined intervention effects on discretionary food consumption at intervention completion (T2). A half-longitudinal mediator analyses was performed to examine the potential mediating effect of personal and environmental factors on the association between the intervention effects and discretionary food consumption. Indirect (mediated) effects were tested by the product of coefficients method with bootstrapped standard errors using Andrew Hayes' PROCESS macro for SPSS.

Setting: Women were recruited via the Coles FlyBuys loyalty card database in socioeconomically disadvantaged suburbs of Melbourne, Australia.

Subjects: Analyses included 225 women (116 intervention and 109 control).

Results: Compared with controls, intervention participants consumed fewer discretionary foods at T2, after adjusting for key confounders (B = -0.194, 95% CI: -0.378 to -0.010; p = 0.039). While some mediators were associated with the outcome (taste, outcome expectancies, self-efficacy, time constraints), there was no evidence that they mediated intervention effects.

Conclusions: This study demonstrated that a behavioural intervention promoting fruit and vegetable consumption amongst socioeconomically disadvantaged participants was effective in reducing discretionary food intake. Although specific mediators were not identified, researchers should continue searching for mechanisms by which interventions have an effect to guide future program design.

Keywords

Nutrition intervention, randomized controlled trial, mediators, socioeconomic disadvantage, discretionary foods

Introduction

Poor diet quality is one of the leading risk factors for noncommunicable diseases (NCDs), such as cardiovascular disease, cancer, chronic respiratory disease and diabetes, which kill 41 million people globally each year [1]. Socioeconomic position (SEP) is closely linked with NCDs, specifically, in high income countries NCD rates are higher in disadvantaged and marginalised people than in groups of higher SEP [2]. Socially disadvantaged people are more likely to become ill and die prematurely than people of higher social positions, in part because they are at greater risk of being exposed to unhealthy behaviours such as dietary practices that are not aligned with recommendations [1]. Despite the convincing evidence to date regarding the health benefits associated with healthy eating, alarmingly, the average diet quality of the western population continues to remain poor [3, 4]. In fact, in Australia approximately 35% of energy consumption comes from discretionary food intake [5], and US data indicates that 86% of the population consume more than the recommended limit of discretionary choices [4]. Unhealthy discretionary items include sweet biscuits, cakes, confectionary, chocolate, ice cream and other ice confections, processed meats and sausages, pastries, pies, fried foods, potato chips, crisps, fatty and/or salty snack foods, sugar-sweetened soft drinks and cordials, and alcoholic drinks [6].

A range of interventions have been shown to successfully promote fruit and vegetable consumption [7]. For example, trials targeted at adults living on a low income have reported effects ranging from approximately +0.42 to +1.1 servings per day of fruits and vegetables [8-12]. However, those studies have not reported whether such programs concomitantly reduce discretionary food consumption, in the absence of an explicit focus on restricting such foods [7]. At best, they may simply aim to reduce calories from fat~~[8, 10]~~. For example, two interventions [8, 10] aimed at promoting fruit and vegetable consumption also focused on reducing fat intake, primarily through encouraging recipe modification and choosing lower fat versions of foods. While neither study reported on discretionary food intake specifically, both found positive intervention effects on both increased fruit and vegetable consumption and reduced intakes of calories from fat.

Of relevance, programs focussing on weight loss as an outcome commonly emphasise calorie-restriction. While these may achieve weight loss (or minimise weight gain) during the treatment period, this is commonly followed by regain of some, if not all, of the lost weight [13]. Some studies have even shown that one- to two- thirds of dieters regain more weight than

they lost on their diets [14]. One possible reason is that too great an emphasis is placed on *outcome* motivators (e.g. weight loss), with insufficient attention to *process* motivators which are key to influencing behaviour [13, 15]. Process motivators are the factors that elicit and sustain attention to and persistence in an activity (e.g. increase intrinsic motivation for participating in the process of behaviour change such as fun, taste, control, social interaction, and pride)[13]. To achieve behaviour change, it has been suggested that the activities required for the behaviour change process are rewarding [13]. Hence, programs that promote consumption of healthy foods by encouraging self-efficacy (e.g. label reading, meal planning, cooking, budgeting etc.), meal enjoyment, social interaction and goal setting, whilst drawing minimal attention to restricting unhealthy foods are a potentially promising approach for achieving success. Such an approach is similar to that of the theory based *stealth interventions*, which are designed to make the process of behaviour change rewarding, easy, and desirable rather than a sacrifice or burden, as "diets" are often perceived to be [13].

Potential mechanisms by which programs that promote healthy food consumption may result in subsequent decreases in (and displacement of) unhealthy foods include increased preferences for healthier foods [16, 17]; greater skills and confidence in food preparation and cooking; and/or reduced environmental constraints related to procuring, preparing and eating nutritious produce [18]. However, few studies have examined these potential mechanisms and the potential to influence changes in discretionary food consumption indirectly through nutrition promotion[13].

The aim of this study was to identify whether discretionary food consumption declined in an intervention whose primary focus was to promote fruit and vegetable consumption. Of note, in the original study ("ShopSmart") vegetable consumption increased among socioeconomically disadvantaged women[19]. In this secondary analysis, ~~W~~we also aimed to identify potential mechanisms (mediators) explaining any intervention effects on discretionary food consumption, drawing on past research of determinants for food choice and eating behaviours informed by social cognitive theory [15, 20] to guide mediator selection. Social cognitive theory[15, 20] posits that behaviours are learned and this learning is influenced by the interaction of personal and environmental, as well as behavioral factors. In this study we focus on both personal factors (self-efficacy, taste preferences, and outcome expectancies) and environmental factors (time, cost and availability constraints), given their established links with eating behaviours [15, 20]. Exploring the mechanisms that drive food choice provides

an opportunity to better understand the reasons for intervention successes and failures, with the potential to design programs that achieve positive food consumption behaviours.

Methods

The ShopSmart study was a randomised controlled trial targeted at women of low socioeconomic position, aimed at testing the effectiveness of a skill-building intervention promoting fruit and vegetable consumption (www.isrctn.com, ISRCTN48771770) [19, 21]. The findings presented here are additional, opportunistic analyses of the ShopSmart intervention data using secondary trial outcomes (mediators) and an additional trial outcome (discretionary food intake). Women were the focus, since they are primarily responsible for food purchasing and preparation in households [22]. The trial comprised a 3 month retrospective baseline data collection phase (involving retrieval of data for a 3 month retrospective period (after participants registered and consented to the study, but before the intervention began)), followed by a 6 month intervention period and a further 6 month no-intervention follow-up period. The intervention development was guided by social cognitive theory [15] to ensure a strong theoretical, empirical, and practical foundation.

Women were recruited via the Coles FlyBuys loyalty card database from one of two catchment areas (randomly selected disadvantaged neighbourhoods serviced by a Coles store and within 25 km of the main research site) (see Ball et al., 2013 or 2016 for further details [19, 21]). Two hundred and forty-eight women returned baseline surveys and were randomly assigned to either the behavioural intervention (n = 124) or control (n = 124) conditions by using a computer-generated block randomization sequence produced and implemented by an independent statistician that involved blocks of 2 and 4 in varying combinations. Only women with complete data for all reported variables (including survey questionnaires regarding food shopping or dietary behaviours) at baseline and intervention completion [time (T) 2] were included in this analyses. Hence, the complete case sample included 225 women (116 intervention and 109 control). See **Figure 1** for ShopSmart participant recruitment and flow through the study.

Intervention

Women in the intervention arm received a set of eight educational and skill-building newsletters and behaviour change resource packages (sent fortnightly for the first two months and monthly for the remaining 4 months of the intervention). They were also invited to take

part in a dietitian-led supermarket tour, which provided practical experience and skills in selecting fresh produce, as well as label reading to identify healthier food items. Resources were informed by social cognitive theory [15] and designed to specifically address disadvantaged women's needs. They focused primarily on affordability and nutrition-related attitudes and skills. ShopSmart intervention details are described in full elsewhere [21].

Data collection and outcome measures

Diet was measured using a food frequency questionnaire (FFQ) composed of items assessing usual frequency of intake, previously developed for use with Australian adults in the 1995 National Nutrition Survey[23] and other Australian population-based surveys[24, 25]. Discretionary food consumption was assessed by self-reported mailed surveys completed pre-intervention (T1), intervention completion (T2), and 6 months post-intervention (T3). Total discretionary foods was made up of the sum of 9 individual items (i.e. potato crisps, hot chips, chocolates, cakes, pies, fast food, pizza, alcohol and soft drink) Respondents were asked "about how often have you eaten the following a. potato crisps (or salty snack foods), b. hot chips (or roast potatoes, potato wedges), c. chocolate (or lollies), d. cakes (or doughnuts, sweet biscuits), e. pies (or pastries, sausage rolls), f. fast foods, g. pizza?", with 9 response options ranging from "never or less than once/month" to "6 or more times/day". As these questions did not include portion size, each occasion of eating was assumed to represent **a single serve** equivalent to a single serve of discretionary items based on the Australian Dietary Guidelines [6]. For example, a single serve of discretionary foods that provides approximately 600kJ is; 2 scoops of regular ice cream, or 2 slices processed meats, or 30g salty crackers, or 40g plain cake, or 25g chocolate, or 1/3 commercial meat pie, or 12 hot chips [6]. Alcohol consumption was assessed using a combination of two questions, "on average how often did you drink beer, wine and/or spirits" and "on days when you were drinking alcohol, about how many glasses of beer, wine and/or spirits altogether did you usually drink?", which allowed for the calculation of number of alcoholic glasses per day. Based on the Australian Dietary Guidelines, two standard drinks was equivalent to a single discretionary serve (e.g. approximately 600kJ) [26]. Finally, for soft drink consumption (e.g. regular (sugar-sweetened) carbonated soft drink) respondents were asked "about how much full-calorie soft drink do you usually drink each day?", with 10 response options ranging from "I don't drink soft drink" to "6 or more serves/day". One can of full-calorie soft-drink (375mL) was equivalent to a single discretionary serve [6].

Sociodemographic characteristics assessed included age, country of birth, relationship status, highest attained level of education, smoking status, whether they had children, and BMI. These measures were collected in self-reported surveys completed at T1. The control group completed assessments only, and at the conclusion of the study were offered all of the printed intervention materials.

Mediator selection

The eleven ShopSmart survey questions, and response options, utilised for assessing food shopping and dietary behaviours that allowed for mediator analysis are provided in **Table 1**. The mediators selected were constructs, represented by the items described in Table 1, selected based on past research of determinants of food choice and eating behaviours[27, 28], which align with social cognitive theory[15]. They were categorised as personal or environmental constructs or both, consistent with theory and past research [29].

Insert Table 1 here

Statistical analysis

Descriptive analyses were performed on baseline characteristics of the original ShopSmart cohort (n = 248) and the total eligible sub-sample (n = 225), including the intervention (n = 116) and control group (n = 109). Wilcoxon signed rank tests were used to explore the changes in dietary intake (servings per day of discretionary items) from baseline to ~~post-~~ intervention completion (6 months post-baseline) for the intervention and control group. These analyses were performed to establish whether the ShopSmart program (primarily aimed at promoting fruit and vegetable consumption) was associated with changes in the measure of total discretionary items and its sub-components (i.e. potato crisps, hot chips, chocolates, cakes, pies, fast food, pizza, alcohol and soft drink).

Linear regression models examined intervention effects on self-reported total discretionary food consumption at T2. Because of the skewed distribution of the dependent variable, log transformation was performed (log normal). When modelling a log-transformed outcome, regression coefficients and confidence intervals can be exponentiated (i.e., e^b) and subsequently interpreted as proportional differences in the geometric mean (approximately the median) of the outcome. All of the models controlled for baseline levels of the outcome and for the following covariates (determined *a priori*): catchment area (one of two

neighbourhoods), age (years), country of birth (Australia, other), relationship status (married/de facto, separated/divorced/widowed, never married), highest attained level of education (low (less than year 12), medium (year 12/trade/diploma), high (tertiary)), smoking status (never, former, current), children (yes, no), and BMI (kg/m^2).

A half-longitudinal mediator analysis[30] was performed to examine the potential mediating effects of personal and environmental factors (T2) on the association between the intervention effects and ~~on~~ total discretionary food consumption (T2). This analysis allowed for a better understanding of the explanatory pathways/mechanisms by which the intervention led to the dietary outcome. The half-longitudinal approach to mediation is typically used when there is no temporal separation between measurement of the mediator and the outcome variable[30]. Although we had three time points of data available, the half-longitudinal analysis was the preferred method (rather than a full longitudinal analysis) since the outcome of interest was discretionary food consumption at intervention completion (T2), rather than six months post-intervention (T3). Indirect (mediated) effects were tested by the product of coefficients method with bootstrapped standard errors using Andrew Hayes' PROCESS macro for SPSS [31]. The proposed mediation model can be seen in **Figure 2**, which includes the exposure/independent variable (IV) (skill-building intervention group), the mediators (M), and the outcome/dependent variable (DV) (discretionary food intake.) As seen in Figure 2, *a* represents the relationship of IV to M, and *b* represents the relationship of M to DV adjusting for IV. There is a direct effect (*c'*) relating IV to DV adjusting for M, and a mediated effect where IV indirectly affects DV through M. Finally, the model controlled for the covariates listed above, as well as baseline levels of the mediators.

Statistical significance was set at $P < 0.05$ (2-tailed), and all statistical analyses were conducted using SPSS software [32].

Insert Figure 2 here

Results

Descriptives

Baseline characteristics of the ShopSmart cohort and the eligible sub-sample (total cohort, intervention and control group) are displayed in **Table 2**.

Insert Table 2 here

From baseline to intervention completion amongst intervention group participants, noticeable improvements were observed for intake of total discretionary foods, and individual discretionary food items (potato crisps, chocolates, and cakes)($p < 0.05$). In contrast, as expected, no obvious improvements in any discretionary food were found amongst control group participants ($p > 0.05$), other than for cake ($p = 0.001$) (**Table 3**).

Insert Table 3 here

Linear regression analysis

Linear regression analysis showed that compared with controls, intervention participants consumed fewer discretionary foods at intervention completion (T2) (B = -0.194, 95% CI: -0.378 to -0.010 servings/d; $p = 0.039$) after controlling for baseline levels of discretionary foods and covariates (catchment area, age, country of birth, marital status, highest attained level of education, smoking status, children, and BMI). The natural exponentiation of this coefficient equals 0.82 (95% CI: 0.69 to 0.99), indicating that the intervention group had an approximately 18% lower median for discretionary serves at T2, compared to the control group.

Mediator analysis

Four out of the eleven potential mediator variables were found to be associated with the outcome, independent of intervention group, including food tastes/preferences ("I like to drink water") (95% CI: 0.11 to 0.51; $p = 0.003$), outcome expectancies ("When food shopping how much do you consider your own health) (95% CI: -0.38 to 0.07; $p = 0.004$), self-efficacy ("How confident do you feel about preparing and cooking fruit and vegetables that you have not cooked with before") (95% CI: 0.04 to 0.17; $p = 0.002$), and time constraints ("I feel that vegetables are time-consuming to prepare") (95% CI: -0.36 to -0.09; $p = 0.011$). However, there was no evidence that they mediated intervention effects ($p > 0.05$). This is largely explained by the fact that there were no intervention effects observed for any of the mediators selected (**Table 4**).

Insert Table 4 here

Discussion

This study demonstrated that an intervention focused on promoting fruit and vegetables amongst socioeconomically disadvantaged participants was effective in reducing intakes of unhealthy discretionary items, even in the absence of a specific focus on limiting such foods. On average, the intervention group reduced their discretionary food intake by 0.3 serves per day at intervention completion, which is equivalent to approximately 180 kilojoules (kJ) per day. This was primarily due to a decline in consumption of potato crisps, chocolates, and cakes. Although this reduction in energy intake may appear small, other studies have shown the importance of similar daily declines [33]. For example, Hall et al., 2011 reported that for every change of energy intake of 100 kJ per day will lead to an eventual bodyweight change of about 1 kg [34]. Hence, our findings are of likely clinical significance when considering that modest weight losses of 5% to 10% of body weight can contribute to important health benefits including improved glucose tolerance, hyperlipidaemia, and blood pressure in overweight and obese adults [35]. Moreover, unhealthy dietary patterns have been associated with increased risk of chronic diseases, including coronary heart disease, type 2 diabetes, metabolic syndrome, some types of cancers [36], depression [37], and a lower intake of essential nutrients [38]. Thus, even small reductions in discretionary serves is likely to be associated with a number of health benefits.

Food choice is a complex behaviour as demonstrated by the consistently poor quality diets of the nation [3]. The positive findings of this study provide us with an alternative perspective on successful program design, such as stealth interventions [13] where emphasis is placed on incentives for the process of behaviour change rather than outcomes. For example, the ShopSmart study promoted fruit and vegetable consumption by encouraging self-efficacy (e.g. label reading, meal planning, cooking, budgeting etc.), meal enjoyment, social interaction and goal setting, with minimal focus on restricting unhealthy foods [21]. These design features make the behaviour change process rewarding and desirable rather than a sacrifice or burden, as “diets” are often perceived to be [13].

One limitation of this study was the use of self-report FFQ items. These items have been widely used in other population-based studies, but were not validated as a complete FFQ against other dietary assessment tools. This may have resulted in socially desirable under-reporting of discretionary food intake. However, given the intervention did not focus explicitly on reducing discretionary foods, it seems unlikely that this completely accounts for

the reduction in reported intakes observed in the intervention compared with control group. This study failed to identify mediators on the explanatory pathway linking the intervention to a reduction in discretionary food consumption. Given the intervention was focused on fruit and vegetables, it is possible that the ShopSmart survey did not include measures of mediators relating to the intervention-discretionary foods effect. Additionally, some mediator measures lacked variation in responses (e.g. included only three response options), which may have reduced the ability to identify mediating effects. Moreover, due to the half-longitudinal analysis performed, the examined relationship between the mediators and outcome were actually cross-sectional. Purposefully designed measures focused on discretionary foods (e.g., confidence for, or environmental barriers to, reducing discretionary foods) may have helped highlight the important pathways. Future studies may also benefit from including additional measures of potential mediating factors, such as those relating to household values or social factors e.g. relationships of individuals that can constrain or facilitate food choice decisions. Early family cuisine, upbringing and family dynamics can result in the development of food roles and eating identities that lead to persistent patterns of food choices [39].

Strengths of this study include the RCT design and low attrition rates, which demonstrates that the ShopSmart intervention effectively attracted and retained women of low socioeconomic position, whom are a commonly difficult group to engage [40]. Robust analyses of mediators were performed, and a range of covariates were included in both the mediator model and linear regression analysis.

Although specific mediators were not identified, researchers and public health professionals should continue searching for mechanisms by which interventions have an effect to guide future program design. A better understanding of why some interventions/programs do or do not work will help to inform future program decision making. Importantly, this study is one of few to demonstrate that an intervention focused on promoting fruit and vegetables was effective in reducing intakes of discretionary items, even in the absence of a specific focus on limiting such foods. Hence, programs such as stealth interventions[13], which emphasise incentives for the process of behaviour change rather than outcomes, may encompass the necessary features for achieving program success. Maintaining a holistic view of food choice decisions and food behaviours is likely essential [41]. Food behaviours are complex and cannot be detached or extracted from many other aspects of people's lives, in addition to structure

(e.g. social institutions and other environments) and individual agency. Without considering all these aspects, future programs are likely to be insufficient to produce desired outcomes.

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Table 1 ShopSmart survey questions, with their proposed constructs and response options, that were examined as potential mediators

Survey Question	Relevant Construct [15, 38, 40]	Number of response options	Response Options
"I like the taste of full-calorie soft drinks too much to cut down on drinking these"	Personal: food tastes/preferences	3	"Agree" to "Disagree"
"I like to drink water"	Personal: food tastes/preferences	3	"Agree" to "Disagree"
"I feel confident that I can eat fruit or vegetables as snacks"	Personal: self-efficacy	3	"Agree" to "Disagree"
"When food shopping how much do you consider your own health"	Personal: outcome expectancies (health)	4	"Not at all" to "Very much"
"How confident do you feel about preparing and cooking fruit and vegetables that you have not cooked with before"	Personal: self-efficacy	7	"Extremely confident" to "Not at all confident"
"I feel that I have enough knowledge about how to prepare/cook vegetables"	Personal: self-efficacy	3	"Agree" to "Disagree"
"I feel that vegetables are time-consuming to prepare"	Environmental / Personal: time constraints	3	"Agree" to "Disagree"
"I feel that fruit is too expensive"	Environmental / Personal: cost/affordability	3	"Agree" to "Disagree"

“I feel that vegetables are too expensive”	Environmental / Personal: cost/affordability	3	“Agree” to “Disagree”
“I feel that fruit is not always available”	Environmental: availability	3	“Agree” to “Disagree”
“I feel that vegetables are not always available”	Environmental: availability	3	“Agree” to “Disagree”

Table 2 Baseline characteristics of the original ShopSmart cohort and the eligible sub-sample (total cohort, intervention and control group)

	Original ShopSmart Cohort (n = 248)	**Eligible sub-sample**		
		total cohort (n = 225)	intervention group (n = 116)	control group (n = 109)
Age, mean (SD)	43.11 (10.46)	43.60 (10.42)	43.71 (10.49)	43.48 (10.39)
Catchment area, % (n)				
Dandenong	28.6 (71)	27.1 (61)	23.3(27)	31.2 (34)
Broadmeadows	71.4 (177)	72.9 (164)	76.7 (89)	68.8 (75)
Born in Australia, % (n)	69.4 (172)	69.8 (157)	69.0 (80)	70.6 (77)
Marital status, % (n)				
Married/de facto	57.7 (143)	58.2 (131)	56.9 (66)	59.6 (65)
Separated/divorced/widowed	22.2 (55)	23.1 (52)	19.8 (23)	26.6 (29)
Never married	20.2 (50)	18.7 (42)	23.3 (27)	13.8 (15)
Highest education level, % (n)				
Low (less than year 12)	32.8 (81)	32.4 (73)	36.2 (42)	28.4 (31)
Medium (year 12/trade/diploma)	53.6 (133)	54.2 (122)	56.0 (65)	52.3 (57)
High (tertiary)	13.8 (34)	13.3 (30)	7.8 (9)	19.3 (21)
Children (yes), % (n)	55.2 (137)	55.7 (123)	55.2 (64)	54.1 (59)
Smoking status, % (n)				
Never smoked	52.8 (131)	52.9 (119)	56.0 (65)	49.5 (54)
Former smoker	20.6 (51)	20.9 (47)	21.6 (25)	20.2 (22)
Current smoker	26.7 (66)	26.2 (59)	22.4 (26)	30.3 (33)
BMI, mean (SD)	28.64 (7.75)	28.77 (7.93)	29.18 (8.47)	28.24 (7.33)

Standard Deviation (SD)

Table 3 Change in discretionary item consumption (serves per day) from baseline to intervention completion (6 months post-baseline) for intervention and control group. Wilcoxon singed rank tests performed.

		Intervention Group (n = 116)			Control Group (n = 109)		
		Serves per day			Serves per day		
		Mean (SD)	Median (IQR)	*p*	Mean (SD)	Median (IQR)	*p*
Total discretionary items~~, mean (SD)~~	Baseline	1.37 (0.96)	1.16 (1.29)	**0.0005**	1.18 (0.84)	1.03 (1.01)	0.248
	Intervention completion	1.07 (0.90)	0.83 (1.09)		1.13 (0.80)	0.93 (1.07)	
Potato crisps~~, mean (SD)~~	Baseline	0.21 (0.31)	0.07 (0.07)	**0.011**	0.17 (0.21)	0.07 (0.07)	0.964
	Intervention completion	0.16 (0.28)	0.07 (0.07)		0.18 (0.25)	0.07 (0.07)	
Hot chips~~, mean (SD)~~	Baseline	0.14 (0.15)	0.07 (0.07)	0.143	0.13 (0.14)	0.07 (0.07)	0.907
	Intervention completion	0.13 (0.17)	0.07 (0.07)		0.12 (0.14)	0.07 (0.07)	
Chocolates~~, mean (SD)~~	Baseline	0.40 (0.40)	0.43 (0.72)	**< 0.0005**	0.33 (0.37)	0.14 (0.36)	0.121
	Intervention completion	0.27 (0.34)	0.14 (0.36)		0.30 (0.40)	0.14 (0.36)	
Cakes~~, mean (SD)~~	Baseline	0.27 (0.30)	0.14 (0.36)	**0.001**	0.24 (0.33)	0.14 (0.36)	**0.001**
	Intervention completion	0.19 (0.23)	0.07 (0.36)		0.16 (0.16)	0.14 (0.07)	
Pies~~, mean (SD)~~	Baseline	0.04 (0.06)	0.07 (0.07)	0.298	0.04 (0.06)	0.00 (0.07)	0.673
	Intervention completion	0.04 (0.06)	0.00 (0.07)		0.04 (0.06)	0.00 (0.07)	
Fast food~~, mean (SD)~~	Baseline	0.06 (0.09)	0.07 (0.07)	0.664	0.06 (0.12)	0.07 (0.07)	0.887
	Intervention completion	0.06 (0.08)	0.07 (0.07)		0.06 (0.10)	0.07 (0.07)	
Pizza~~, mean (SD)~~	Baseline	0.06 (0.05)	0.07 (0.07)	0.652	0.06 (0.11)	0.07 (0.07)	0.905
	Intervention completion	0.06 (0.09)	0.07 (0.07)		0.05 (0.05)	0.07 (0.07)	
Alcohol~~, mean (SD)~~	Baseline	0.06 (0.19)	0.00 (0.03)	0.865	0.10 (0.24)	0.00 (0.07)	0.309
	Intervention completion	0.05 (0.12)	0.00 (0.05)		0.12 (0.28)	0.02 (0.07)	
Soft drink~~, mean (SD)~~	Baseline	0.13 (0.31)	0.02 (0.05)	0.540	0.06 (0.18)	0.00 (0.03)	0.054
	Intervention completion	0.11 (0.28)	0.02 (0.12)		0.09 (0.23)	0.02 (0.05)	

Standard Deviation (SD), Interquartile Range (IQR)

Table 4 Results of mediator analyses (n = 225)

Mediators at T2	IV → M		M → DV		Direct Effect IV → DV		Indirect Effect IV→ M → DV
	***a* (95% CI)**	***p***	***b* (95% CI)**	***p***	***c'* (95% CI)**	***p***	***a* * *b* (95% CI)**
I like the taste of full-calorie soft drinks too much to cut down on drinking these	0.06 (-0.13, 0.24)	0.56	0.03 (-0.11, 0.17)	0.67	-0.19 (-0.38, -0.00)	**0.048**	0.00 (-0.01, 0.02)
I like to drink water	0.01 (-0.11, 0.14)	0.81	0.31 (0.11, 0.51)	**0.003**	-0.19 (-0.37, -0.01)	**0.04**	0.00 (-0.04, 0.05)
I feel confident that I can eat fruit or vegetables as snacks	-0.08 (-0.22, 0.06)	0.28	0.02 (-0.16, 0.21)	0.81	-0.19 (-0.38, -0.00)	**0.049**	-0.00 (-0.02, 0.02)
When food shopping how much do you consider your own health	-0.12 (-0.29, 0.05)	0.16	-0.22 (-0.38, 0.07)	**0.004**	-0.21 (-0.40, -0.03),	**0.03**	0.03 (-0.01, 0.08)
How confident do you feel about preparing and cooking fruit and vegetables that you have not cooked with before	-0.25 (-0.63, 0.14)	0.21	0.11 (0.04, 0.17)	**0.002**	-0.16 (-0.34, 0.03)	0.10	-0.03 (-0.08, 0.01)
I feel that I have enough knowledge about how to prepare/cook vegetables	-0.13 (-0.28, 0.02)	0.10	0.02 (-0.14, 0.19)	0.78	-0.18 (-0.37, 0.01)	0.06	-0.00 (-0.26, 0.02)
I feel that vegetables are time-consuming to prepare	0.03 (-0.15, 0.21)	0.75	-0.22 (-0.36, -0.09)	**0.01**	-0.17 (-0.35, 0.02)	0.07	-0.01 (-0.06, 0.04)
I feel that fruit is too expensive	-0.02 (-0.20, 0.17)	0.87	-0.03 (-0.16, 0.11)	0.70	-0.20 (-0.39, -0.01)	**0.04**	0.00 (-0.01, 0.01)
I feel that vegetables are too expensive	0.04 (-0.14, 0.24)	0.61	-0.00 (-0.14, 0.13)	0.95	-0.18 (-0.37, 0.01)	0.06	0.00 (-0.02, 0.01)
I feel that fruit is not always available	-0.05 (-0.27, 0.16)	0.61	-0.08 (-0.20, 0.04)	0.20	-0.18 (-0.37, 0.01)	0.06	0.00 (-0.02, 0.03)
I feel that vegetables are not always available	-0.12 (-0.32, 0.92)	0.27	-0.11 (-0.23, 0.01)	0.07	-0.19 (-0.38, -0.01)	**0.04**	0.01 (-0.01, 0.05)

1. Independent variable/exposure/intervention (IV), mediator (M), dependent variable/outcome/discretionary foods (DV), Confidence Intervals (CI)

2. As seen in Figure 2, *a* represents the relationship of IV to M, and *b* represents the relationship of M to DV adjusting for IV. There is a direct effect (*c'*) relating IV to DV adjusting for M, and a mediated effect where IV indirectly affects DV through M.

3. Models controlled for baseline levels of the outcome and baseline levels of the mediator, as well as the following covariates: catchment area, age, country of birth, marital status, highest attained level of education, smoking status, children, and BMI.

Legend for figures

Figure 1 ShopSmart participant recruitment and flow through the study.

Figure 2 Mediator model for examining potential mediating effects of personal factors (at T2) of intervention effects and on total discretionary food consumption (at T2).

Mediators (M), Dependant variable (DV), Independent variable (IV)