Influence of price discounts and skill-building strategies on purchase and consumption of healthy food and beverages: outcomes of the Supermarket Healthy Eating for Life randomized controlled trial[1–3]

Kylie Ball, Sarah A McNaughton, Ha ND Le, Lisa Gold, Cliona Ni Mhurchu, Gavin Abbott, Christina Pollard, and David Crawford

ABSTRACT

Background: Fiscal strategies are increasingly considered upstream nutrition promotion measures. However, few trials have investigated the effectiveness or cost effectiveness of pricing manipulations on diet in real-world settings.

Objective: We assessed the effects on fruit, vegetable, and beverage purchasing and consumption of a 20% price-reduction intervention, a tailored skills-based behavior-change intervention, and a combined intervention compared with a control condition.

Design: The Supermarket Healthy Eating for Life trial was a randomized controlled trial conducted over 3 mo [baseline (time 1) to postintervention (time 2) with a 6-mo follow-up (time 3)]. Female primary household shoppers in Melbourne, Australia, were randomly assigned to a *1*) skill-building (n = 160), *2*) price-reduction (n = 161), *3*) combined skill-building and price-reduction (n = 160), or *4*) control (n = 161) group. Supermarket transaction data and surveys were used to measure the following study outcomes: fruit, vegetable, and beverage purchases and self-reported fruit and vegetable consumption at each time point.

Results: At 3 mo (time 2), price reduction–alone participants purchased more total vegetables and frozen vegetables than did controls. Price reduction–alone and price reduction–plus–skill-building participants purchased more fruit than did controls. Relative to controls, in the price-reduction group, total vegetable consumption increased by 233 g/wk (3.1 servings or 15% more than at baseline), and fruit purchases increased by 364 g/wk (2.4 servings; 35% more than at baseline). Increases were not maintained 6 mo postintervention (time 3). Price reduction–alone participants showed a tendency for a slight increase in fruit consumption at time 2 (P = 0.09) that was maintained at time 3 (P = 0.014). No intervention improved purchases of bottled water or low-calorie beverages.

Conclusions: A 20% price reduction in fruit and vegetables resulted in increased purchasing per household of 35% for fruit and 15% for vegetables over the price-reduction period. These findings show that price modifications can directly increase produce purchases. The Supermarket Healthy Eating for Life trial was registered at Current Controlled Trials Registration as ISRCTN39432901. *Am J Clin Nutr* 2015;101:1055–64.

Keywords: behavior change, fruit and vegetables, price discounts, skills, randomized controlled trial

INTRODUCTION

The 2012 burden of disease study showed that 14 of the top 20 leading causes of death worldwide were linked to nutrition, with inadequate intake of fruit and vegetables among risk factors (1). Intakes of energy-dense, nutrient-poor foods and beverages are also high in many countries, posing additional risks to nutritional quality and health (2) and highlighting the need for initiatives to improve diet.

Individuals from socioeconomically disadvantaged backgrounds tend to have lower intakes of fruit and vegetables and higher intakes of energy-dense, nutrient-poor foods than do their more-advantaged counterparts (3–5). Nutrition-promotion interventions inclusive of individuals experiencing socioeconomic disadvantages are required (6). Women remain primarily responsible for food selection and preparation (7, 8) and, as household food gatekeepers, represent important targets for nutrition interventions.

Fiscal and pricing intervention strategies are currently of much interest to policymakers (9), but there remains insufficient evidence of their impact on diet in real-world settings. A number of modeling or experimental laboratory-based analyses of fiscal effects have been undertaken (see reference 10–14 for reviews), but there remains a dearth of evidence from randomized controlled trials of the effects of pricing manipulations on food purchasing and consumption in real-world settings such as

[1] From the Centre for Physical Activity and Nutrition Research (KB, SAM, GA, and DC) and Deakin Health Economics (HNDL and LG), Deakin University, Burwood, Australia; the National Institute for Health Innovation, University of Auckland, Auckland, New Zealand (CNM); and the School of Public Health, Curtin University, Perth, Australia (CP).

[2] The Supermarket Healthy Eating for Life study was supported by a National Health & Medical Research Council Project Grant (594767). KB is supported by a National Health & Medical Research Council Principal Research Fellowship (1042442). SM is supported by an Australian Research Council Future Fellowship (FT100100581). LG is supported by a National Health & Medical Research Council Early Career Fellowship (1035100). The contents of this manuscript are solely the responsibility of the authors and do not reflect the views of the funding bodies.

[3] Address correspondence to K Ball, Centre for Physical Activity and Nutrition Research, Deakin University, 221 Burwood Highway, Burwood 3125, Australia. E-mail: kylie.ball@deakin.edu.au.

Received July 27, 2014. Accepted for publication March 4, 2015.

First published online April 15, 2015; doi: 10.3945/ajcn.114.096735.

supermarkets. Nonetheless, the limited existing evidence suggests such approaches are promising (e.g., see references 15–17).

Although upstream approaches are appealing because they have the potential for broad reach, cognitive and behavioral factors are also well-established determinants of diet (18). Only 2 randomized controlled trials examined the effects on diet of combining price reduction and individually targeted nutrition-education behavior-change approaches in real-world settings where people shop for food. One study, which was conducted in 4 Dutch supermarkets (19), showed that a 50% price discount increased fruit and vegetable purchasing over 6 mo, but nutrition education alone had no impact. The study was based on only a small sample (n = 151) and focused only on selected fruit and vegetables. Despite the large magnitude of the discount, intervention effects were not maintained 3 mo postdiscount. The New Zealand Supermarket Healthy Options Project (SHOP) (17) showed positive effects of price discounts on the purchase of healthier foods both immediately postintervention and at 12-mo follow-up but no effects of nutrition education. However, the educational component of that study focused primarily on the product substitution of healthier options. Additional investigations of theoretically grounded behavioral approaches to modifying diet, alone and in combination with promising fiscal approaches, are warranted.

The SHELf (Supermarket Healthy Eating for Life) study was a randomized controlled trial conducted in partnership with the National Heart Foundation of Australia and Coles supermarkets, which is a major supermarket retailer in Australia. In this article, we report on main trial outcomes assessing the effects on fruit, vegetable, and beverage purchasing and consumption of a price reduction intervention, a skills-based behavior-change intervention, and a combined intervention compared with a control condition.

METHODS

Trial design and ethics

The SHELf trial protocol was described in full elsewhere (20). In brief, the SHELf trial had a parallel 4-arm trial design with a 1:1:1:1 participant allocation ratio. A 3-mo retrospective baseline data-collection phase (involving retrospective retrieval of electronic sales data on participant registration in the study) was followed by a 3-mo intervention period and an additional 6-mo no-intervention follow-up period. The trial, which took place between May 2011 and November 2012, was approved by and followed ethical standards in accordance with the Deakin University Faculty of Health Human Ethics Advisory Group (approval HEAG-H 12/10), and all participants provided written informed consent.

Participants and recruitment

Women were targeted for this intervention because of their role as key nutrition gatekeepers (21, 22). The study was powered on the basis of data from a large community-based dietary study of women (23) to detect an increase in vegetable consumption of ≥0.5 servings/d (in Australia, a standard serving is equivalent to 75 g vegetables), which the assumption of an SD of 1.1 servings. To detect an increase of this magnitude, with α = 0.05, the sample size required was 76 per group, thereby totaling 304 for 80% power or 408 for 90% power. The inflation of our estimate to adjust for attrition and loss to follow-up (conservatively estimated at ∼10% at each of 3 measurement waves) and account for potential design effects on the basis of sampling within catchment areas (conservatively estimated at 1.1 or an inflation of 10%), our total minimum sample size was

$$304 \div 0.70 \times 1.1 = 478\ (80\%\text{power})\ \text{or}\ 641\ (90\%\text{power}) \quad (1)$$

Coles supermarkets in Melbourne, Victoria, Australia, were the setting for recruitment. Coles is the second largest grocery chain in Australia with ∼740 stores nationally. To include participants from low as well as high socioeconomic backgrounds, we used the Socioeconomic Index for Areas (SEIFA) indicator of relative advantage and disadvantage (24) to identify recruitment supermarkets. This index is an indicator of the socioeconomic conditions of people living in an area on the basis of aggregated social and economic information from the population census (such as the proportion of low-income households or of people with a tertiary education). The SEIFA was used to randomly select one advantaged and one disadvantaged neighborhood that were serviced by a Coles store and (for logistical reasons) were within 25 km of the main research site (Deakin University). Women who shopped regularly (at least once every 2 wk) at either of the target stores or any other Coles store within a 5-km radius of these stores were identified by Coles and Loyalty Pacific Pty Ltd. (FlyBuys) staff and composed the sampling pool from which a random sample of 5000 was drawn for a recruitment mailing to participants' home addresses. At the same time, a media release that targeted local newspapers was undertaken in catchment areas to encourage additional participation.

Women were required to either hold or be willing to obtain a Coles store loyalty (FlyBuys) card, which was provided to shoppers at no cost, and use this card when they shopped at Coles supermarkets over the 9-mo study period. Additional eligibility criteria were that women were aged between 18 and 60 y; the main household shopper; able to speak, read, and write English and provide written informed consent to participate; willing to give information about total household income; willing to have their Coles sales data collected and analyzed; and the only woman in their household taking part in the study.

An initial mailing of 3000 recruitment invitations resulted in a higher than anticipated response rate, and a subsequent intended mailing of 2000 additional packs was cancelled because the target sample size had already been exceeded. Because of the higher than anticipated interest in the study, with 700 registrations of interest received, enrollment was continued until sufficient participants were enrolled to achieve the higher power level of 90%. Participant recruitment and flow through the study are presented in **Figure 1**.

A total of 642 women were randomly assigned to one of 4 conditions by using a computer-generated block-randomization sequence produced and implemented by an independent statistician that involved blocks of 4 and 8 in varying combinations stratified by supermarket catchment area (low compared with high SEIFA). Allocation concealment was enabled via the secure storage of the randomization sequence separately from the participant database, which was accessible only by the data manager and statistician. Eligible participants were added to the database by the research fellows and assistants who were blinded

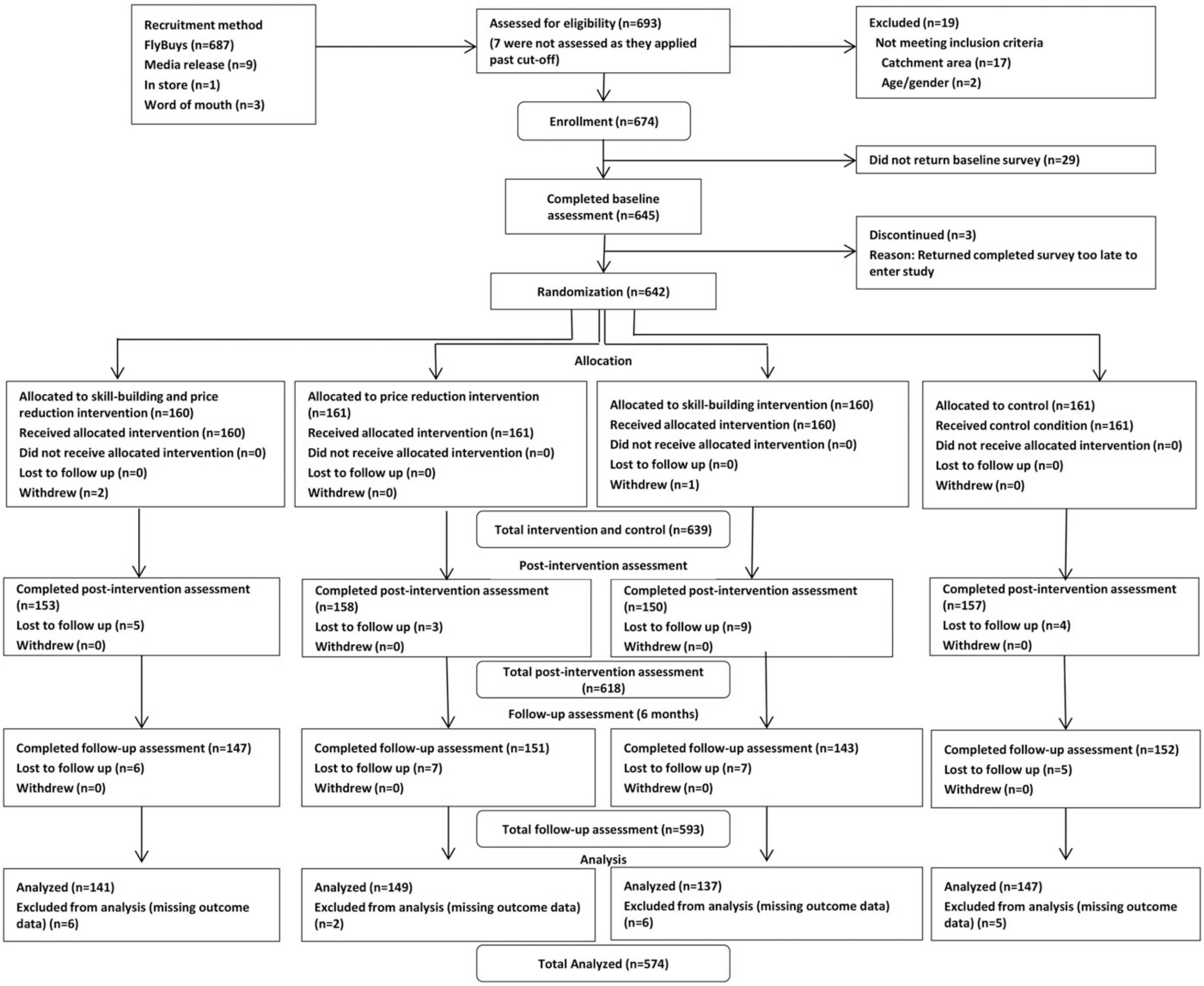

FIGURE 1 Participant recruitment and flow through the SHELf study. SHELf, Supermarket Healthy Eating for Life.

to the allocation sequence. Only after the baseline survey had been completed and returned with signed consent did the data manager allocate participants to study arms (price reduction: n = 161; skill building: n = 160; combined price reduction and skill building: n = 160; control: n = 161).

Intervention

Details of the 3-mo intervention are described in full elsewhere (20). Briefly, participants in the price-reduction intervention arm received a 20% price discount on target items, which was applied at the checkout on swiping their FlyBuys card at any Coles store for a 3-mo period. Participants were sent a list of discounted items (all fruit and vegetables, including fresh, tinned, and frozen, and diet or low-calorie carbonated beverages or water) at the start of the intervention and midway through the intervention period. This discount was applied over and above any other usual store discounts. Low-calorie carbonated beverages were included in the discount because carbonated beverages are among the most popular and affordable beverage for Australian consumers with average prices per liter below those of other nonalcoholic beverages.

The skills-based behavior-change intervention was informed by an intervention mapping approach (25) to ensure a strong theoretical, empirical, and practical foundation. The intervention was guided by social ecological (26) and social cognitive (27) theories. Participants in this arm received a set of 8 mailed skill-building newsletters and accompanying behavior-change and supplementary resources (including activities such as budgeting worksheets, goal-setting, and self-monitoring exercises) and 2 recipes per newsletter as well as links to additional online recipes and resources. In addition, participants in skill-building intervention arms were provided with the opportunity to participate in a free, online, web-based forum, which was active during the intervention period, to enable women to interact, share ideas, and support one another. The forum contained facilitated discussion boards on topics coinciding with those presented in the skill-building materials. The forum also enabled women to interact with an accredited practicing dietitian (equivalent to a registered dietitian in the United States) who answered questions and added posts regularly to reinforce key intervention messages and provided additional social support. All skill-building materials, including the forum, were pilot tested and tailored according to whether women reported caring for children under the age of 12 y (e.g., women with children received child-friendly food shopping and cooking tips and suggestions).

Incentives

To promote retention, all participants were provided with rewards for participating in the study. These rewards included a Coles shopping voucher worth 20 Australian dollars (A$; A$1 = US$0.93 in 2014) on each of 3 survey completions and a FlyBuys 1000-points bonus (equivalent to ∼A$15 value) on completion of the study. In addition, participants received small gifts throughout the study including water bottles, shopping bags, spice packs, and tea bags.

Data collection and outcome measures

Data collection, which involved self-report surveys and the collection of supermarket transaction data, took place at the following 3 time points: baseline (time 1); immediately post-intervention (3-mo postbaseline; time 2); and 6 mo post-intervention (9 mo postbaseline; time 3). The primary outcomes on which sample-size calculations were based were vegetable purchasing and consumption immediately postintervention. Other outcomes measures were purchases and the consumption of fruit, high-calorie carbonated sugar-sweetened beverages, low-calorie carbonated diet beverages, and water. Purchasing outcomes were assessed by using electronic sales (transaction) data, which were collected continuously across the 3-mo pre-intervention, 3-mo intervention, and 6-mo follow-up periods. These data were provided by Coles supermarkets for study participants shopping at any Coles store via their FlyBuys cards. Purchases of all fruit and vegetable items, which were expressed as grams per week, included fresh, frozen, canned, and dried fruit and vegetables. Beverage purchases, which were expressed as milliliters per week, included sugar-sweetened high-calorie carbonated beverages, low-calorie carbonated beverages, and water.

Fruit and vegetable consumption (servings/d) was assessed by using self-report questions adapted from the 1995 National Nutrition Survey and previously validated against food-record data (28). Carbonated sugar-sweetened beverages, diet beverages, and water consumption were assessed by using a modified version of a validated measure (29), which asked respondents to record how many servings of each beverage they usually drank each day (one serving was defined in the survey as 125 mL or 0.5 glasses). Participants also provided information in self-report baseline surveys on key sociodemographic characteristics including age, country of birth, marital status, highest education qualification, household income, and number of children living at home.

Statistical analysis

Data from participants who actively withdrew from the study after commencement (n = 3) were excluded from analyses. Participants who were lost to follow-up, i.e., subjects who did not complete time 2 (n = 21) or time 3 (n = 25) surveys or were missing data on main outcomes [purchasing (i.e., no transactions recorded) or consumption of fruit, vegetables, or target beverages] at any time point (n = 19), were also excluded. This resulted in the exclusion of data from 68 participants (10.6% of subjects who were randomly assigned). These exclusions meant that analyses were not strictly intention to treat. This approach was in line with revised Consolidated Standards of Reporting Trials guidelines, which have dropped the requirement for intention-to-treat analyses in favor of a clear description of exactly who was included in the analyses (30) because of the potential bias and criticisms leveled at approaches to impute missing outcome data required for an intention-to-treat analysis.

Descriptive statistics were used to examine participants' sociodemographic characteristics and food purchasing and consumption at baseline. Linear regression models were used to examine intervention effects on food-purchasing and consumption outcomes at times 2 and 3. Because of the skewed distributions of several outcome variables, bootstrapping with 1000 resamples was used to produce more-robust SEs. All models controlled for the baseline of the outcome and for the following a priori–determined covariates: participant catchment area, age, country of birth, marital status, household income, and number of children living at home. Statistical significance was set at $P < 0.05$ (2 tailed). All statistical analyses were conducted with Stata software (release 12; StataCorp LP).

For the economic analyses of programs costs, costs were measured in 2012 A$ by using project team records and Coles electronic sales data. Staff time was calculated by using the average Australian hourly wage rate of A$38 (31) including 27.3% on costs to reflect superannuation, work cover, and leave entitlements. Material costs were valued at market price. Household costs of purchased fruit, vegetables, water, and low-calorie beverages were valued at market price by using Coles sales data. Overhead costs, which were additional costs of building, equipment, and support services used by program staff, were estimated as 30% of the total program cost. No discount factor was applied for this <1-y program. Program costs were allocated to women who received the intervention and completed survey questionnaires.

RESULTS

Baseline sociodemographic characteristics of the 574 study participants who were included in analyses according to the intervention arm to which they were randomly assigned are shown in **Table 1**. Groups were not compared statistically on baseline values in line with Consolidated Standards of Reporting Trials guidelines (30). The sample was close to evenly split according to catchment area (44% from low–socioeconomic status and 55% from high–socioeconomic status areas) and educational level (50% tertiary educated). The majority (71%) of women were married, and 53% of women had at least one child living at home.

Participants who were excluded from the analysis (n = 68) did not significantly differ from those who were included in the study on baseline demographic characteristics other than age; subjects who were excluded from the analysis were younger (mean ± SD: 39.6 ± 10.9 y) than subjects whose data were included (43.7 ± 9.9 y). **Table 2** presents baseline values for the purchasing and consumption outcomes. At baseline, participants who were excluded from compared with those included in the analysis reported lower intakes of vegetables (mean ± SD: 2.1 ± 1.2 compared

TABLE 1
Baseline sociodemographic characteristics of participants in the SHELf study (n = 574)[1]

		Intervention arm			
	Whole sample (n = 574)	Control (n = 147)	Price reduction (n = 149)	Behavior change (n = 137)	Price reduction + behavior change (n = 141)
Age,[2] y	43.7 ± 9.9	43.6 ± 9.6	42.9 ± 10.2	44.4 ± 9.9	43.8 ± 10.0
Catchment area, n (%)					
Low SES	255 (44.4)	62 (42.2)	69 (46.3)	60 (43.8)	64 (45.4)
High SES	319 (55.6)	85 (57.8)	80 (53.7)	77 (56.2)	77 (54.6)
Country of birth, n (%)					
Australia	410 (71.4)	108 (73.5)	112 (75.2)	92 (67.2)	98 (69.5)
Other	164 (28.6)	39 (26.5)	37 (24.8)	45 (32.8)	43 (30.5)
Education, n (%)					
Did not finish high school	67 (11.7)	15 (10.2)	19 (12.8)	14 (10.2)	19 (13.6)
Year 12 or equivalent	219 (38.2)	60 (40.8)	50 (33.6)	52 (38.0)	57 (40.7)
Tertiary	287 (50.1)	72 (49.0)	80 (53.7)	71 (51.8)	64 (45.7)
Marital status, n (%)					
Married/de facto	410 (71.4)	111 (75.5)	102 (68.5)	95 (69.3)	102 (72.3)
Previously married	74 (12.9)	14 (9.5)	19 (12.8)	24 (17.5)	17 (12.1)
Never married	90 (15.7)	22 (15.0)	28 (18.8)	18 (13.1)	22 (15.6)
Household annual income (A$), n (%)					
$0–51,999	138 (24.0)	35 (23.8)	41 (27.5)	27 (19.7)	35 (24.8)
$52,000–103,999	144 (25.1)	41 (27.9)	39 (26.2)	37 (27.0)	27 (19.2)
>$104,000	153 (26.7)	41 (27.9)	36 (24.2)	41 (29.9)	35 (24.8)
Undisclosed	139 (24.2)	30 (20.4)	33 (22.2)	32 (23.4)	44 (31.2)
Children at home, n (%)					
None	270 (47.0)	64 (43.5)	78 (52.4)	60 (43.8)	68 (48.2)
1	113 (19.7)	31 (21.1)	19 (12.8)	29 (21.2)	34 (24.1)
2	122 (21.3)	32 (21.8)	29 (19.5)	34 (24.8)	27 (19.2)
≥3	69 (12.0)	20 (13.6)	23 (15.4)	14 (10.2)	12 (8.5)

[1]A$, Australian dollars; SES, socioeconomic status; SHELf, Supermarket Healthy Eating for Life.
[2]All values are means ± SDs.

with 2.5 ± 1.2 servings/d, respectively) and tap water (4.4 ± 3.0 compared with 5.5 ± 3.1 servings/d, respectively) and purchased fewer total vegetables overall (1124.3 ± 1289.5 compared with 1611.7 ± 1477.6 g/wk, respectively), fresh vegetables (846.3 ± 1039.3 compared with 1275.2 ± 1261.4 g/wk, respectively), total fruit (621.6 ± 790.6 compared with 1048.4 ± 1189.4 g/wk, respectively), fresh fruit (541.7 ± 716.3 compared with 901.7 ± 1096.5 g/wk, respectively), dried fruit (20.0 ± 46.6 compared with 39.3 ± 77.6 g/wk, respectively), canned fruit (50.6 ± 117.8 compared with 88.8 ± 171.0 g/wk, respectively), and diet beverages (159.6 ± 340.2 compared with 513.6 ± 1324.7 mL/wk, respectively) and more nondiet beverages (1302.2 ± 2496.1 compared with 691.7 ± 1416.0 mL/wk, respectively).

Transaction data indicated that participants purchased, on average, 1611.7 g total vegetables/wk (230 g/d) at baseline, of which the majority (1275.2 g) were fresh vegetables. Participants also purchased 1048.4 g fruit/wk (of which 900 g was fresh fruit) and just under 700 mL carbonated sugar-sweetened beverages/wk, 513 mL carbonated diet beverages/wk, and 362 mL bottled water/wk. Self-report data showed that the average daily consumption of fruit (1.9 servings) and vegetables (2.5 servings) was below recommended intakes (2 and 5 standard servings, respectively). Participants reported the consumption of on average of 5.5 servings (2.25 glasses) of tap water daily with lower reported consumption of other beverages.

Intervention effects on the purchasing and consumption of fruit, vegetables, and beverages, which were adjusted for key covariates, are presented in **Table 3**. Participants in the price-reduction intervention alone purchased more total vegetables and frozen vegetables than did controls at time 2; however, these increases were not maintained over the 6-mo postintervention (time 3). Compared with controls, participants in the combined price-reduction and skill-building intervention and price-reduction intervention alone also purchased significantly more total and fresh fruit during the intervention (time 2); however, these increases were not maintained over the 6-mo postintervention (time 3). The magnitudes of increase in fruit and vegetable quantities purchased from baseline to time 2 were generally ∼2–3 servings/wk (**Figures 2** and **3**). For example, relative to the control group, total fruit purchases increased by 364 g/wk (2.4 servings) in the price-reduction intervention arm, which was a 35% increase from baseline (or a 21% increase relative to the control group at time 2), and vegetables increased by 233 g/wk (3.1 servings), which was a 15% increase from baseline (a 12% increase relative to the control group at time 2). The behavior-change intervention had no significant effect on purchases of fruit or vegetables at time 2 or 3.

None of the intervention arms showed desired effects on purchases of either sugar-sweetened or low-calorie beverages or bottled water. There was an increase in the purchasing of sugar-sweetened beverages observed in the behavior change–alone group at time 3 only.

TABLE 2
Baseline fruit, vegetable, and beverage purchasing and consumption in participants in the SHELf study (n = 574)[1]

		Intervention arm			
	Whole sample (n = 574)	Control (n = 147)	Price reduction (n = 149)	Behavior change (n = 137)	Price reduction + behavior change (n = 141)
Purchase quantity					
Vegetables, g/wk					
Total	1611.7 ± 1477.6	1673.4 ± 1584.1	1524.7 ± 1412.4	1601.5 ± 1339.8	1649.0 ± 1566.2
Fresh	1275.2 ± 1261.4	1374.9 ± 1397.7	1195.0 ± 1192.6	1265.2 ± 1182.2	1265.9 ± 1263.5
Frozen	128.5 ± 205.5	119.8 ± 196.1	134.1 ± 242.7	152.2 ± 218.3	108.8 ± 152.0
Dried	4.8 ± 31.9	4.0 ± 16.0	3.7 ± 27.2	2.8 ± 12.4	8.7 ± 54.3
Canned	203.1 ± 393.9	174.8 ± 240.3	191.9 ± 249.3	181.2 ± 212.6	265.7 ± 678.0
Fruit, g/wk					
Total	1048.4 ± 1189.4	1146.5 ± 1428.7	1049.1 ± 1230.0	996.7 ± 1086.2	995.5 ± 948.8
Fresh	901.7 ± 1096.5	1002.2 ± 1321.1	919.0 ± 1157.8	825.8 ± 947.9	852.5 ± 890.0
Frozen	18.5 ± 73.4	24.8 ± 124.0	16.2 ± 43.9	21.2 ± 54.5	11.8 ± 31.5
Dried	39.3 ± 77.6	43.6 ± 91.5	33.4 ± 63.1	42.6 ± 84.4	37.7 ± 68.7
Canned	88.8 ± 171.0	75.8 ± 150.4	80.4 ± 160.0	107.1 ± 213.0	93.5 ± 156.1
Bottled water, mL/wk	361.9 ± 957.6	360.1 ± 803.5	267.5 ± 663.9	269.9 ± 660.5	552.8 ± 1461.4
Sugar-sweetened beverage, mL/wk	691.7 ± 1416.0	808.0 ± 1956.5	654.3 ± 1131.2	587.4 ± 1109.4	711.2 ± 1280.2
Diet beverage, mL/wk	513.6 ± 1324.8	485.8 ± 1361.0	346.1 ± 998.2	666.6 ± 1254.5	571.1 ± 1616.2
Self-reported consumption, servings/d					
Vegetables	2.5 ± 1.2	2.5 ± 1.2	2.4 ± 1.3	2.6 ± 1.1	2.5 ± 1.1
Fruit	1.9 ± 1.1	2.0 ± 1.2	1.8 ± 1.2	1.8 ± 1.0	1.9 ± 1.1
Tap water	5.5 ± 3.1	5.5 ± 3.1	5.8 ± 3.0	5.4 ± 3.0	5.2 ± 3.2
Bottled water	0.8 ± 1.8	0.9 ± 1.9	0.7 ± 1.5	0.9 ± 2.0	0.9 ± 1.6
Sugar-sweetened beverage	0.1 ± 0.5	0.1 ± 0.5	0.2 ± 0.6	0.2 ± 0.5	0.1 ± 0.3
Diet beverage	0.3 ± 0.8	0.3 ± 0.8	0.3 ± 0.8	0.4 ± 0.9	0.2 ± 0.4

[1]All values are means ± SDs. SHELf, Supermarket Healthy Eating for Life.

Intervention effects on self-reported consumption of fruit, vegetables, and beverages are shown in Table 3. The price-reduction intervention arm showed an increase in self-reported fruit consumption that approached significance at time 2 (P = 0.09) and was significant at time 3. Unexpectedly, participants in the price-reduction and behavior-change intervention arms reported slight increases in the consumption of sugar-sweetened beverages at time 2 (both arms) and time 3 (behavior-change arm only). The magnitude of increase was small (≤0.1 servings/d). No other intervention effects on self-reported consumption were observed.

Supplementary analyses were conducted to determine whether intervention effects were moderated by socioeconomic position (by testing 3-way interaction terms, intervention by time by educational level/household income). Results (data not shown) indicated no strong evidence of moderation by education or income (i.e., intervention effects were consistent across women with low and high education for all 19 outcomes at times 2 and 3 and across low- and high-income women for all time 2 outcomes and all but 3 time 3 outcomes).

The total cost of providing the SHELf price-reduction intervention was A$23,577 or A$158/household. This amount comprised the cost of the offered discount on purchased fruit, vegetables, water, or low-calorie carbonated beverages (A $6996), intervention materials (A$335), staffing cost (A$10,805), and overheads (A$5441). The cost of running the SHELf skill-building intervention was A$24,156 or A$176/household. This amount included A$9326 for facilitating and distributing intervention materials, A$9256 for managing the online forum as well as supervising the intervention, and A$5574 for overheads costs. The SHELf combined price-reduction and skill-building intervention cost was A$37,321 or A$265/household including A$9915 for intervention materials, A$12,012 for staffing costs, a A$6781 price discount on healthier purchases, and A$8613 for overheads costs. The cost effectiveness was calculated for the period of the active price reduction only because of the lack of sustained effects. Compared with the control group, the price-reduction intervention cost an additional A$4 per increased serving of vegetables purchased per week or an additional A$5 per increased serving of fruit purchased per week. The combined price-reduction and skill-building intervention cost an additional A$12 per increased serving of fruit purchased per week than for the control group.

DISCUSSION

This trial showed that a 20% price reduction had a positive impact on increased purchasing of fruit and vegetables over the time the discount was maintained. Impacts of the discount on self-reported consumption were not so marked, although fruit consumption also increased. With the exception of fruit consumption, increases were not maintained over the 6 mo after the withdrawal of the discount. These findings are at odds with those of the SHOP study, which showed that effects on healthy food purchases in a 12.5% price-discount condition were sustained 6 mo postintervention, although this effect was attenuated by approximately one-half. Compared with that study's 6-mo intervention, the current trial's shorter (3-mo) duration may explain the lack of maintenance. It was also possible that customers did not use their FlyBuys card as often once the discount was

TABLE 3
Adjusted effects of SHELf price reduction, behavior change, and combined intervention on consumption and purchase quantity outcomes compared with control group (n = 574)[1]

	Price reduction		Behavior change		Price reduction + behavior change	
	B (95% CI)	*P*	*B* (95% CI)	*P*	*B* (95% CI)	*P*
Purchase quantity (transaction data)						
Total vegetables (g/wk)						
Time 2	232.7 (3.8, 461.6)	0.046	−70.1 (−289.6, 149.3)	0.531	137.6 (−90.3, 365.6)	0.237
Time 3	19.1 (−224.0, 262.2)	0.878	−69.5 (−327.3, 188.2)	0.597	−44.3 (−304.5, 215.9)	0.739
Fresh vegetables (g/wk)						
Time 2	188.7 (−12.8, 390.2)	0.066	−37.3 (−235.3, 160.7)	0.712	123.5 (−71.8, 318.8)	0.215
Time 3	13.0 (−202.7, 228.7)	0.906	−69.7 (−95.7, 156.2)	0.545	−2.5 (−224.6, 219.6)	0.982
Frozen vegetables (g/wk)						
Time 2	44.9 (6.5, 83.3)	0.022	13.2 (−15.1, 41.5)	0.360	32.0 (−1.0, 65.1)	0.058
Time 3	8.1 (−26.3, 42.5)	0.644	10.5 (−21.5, 42.5)	0.521	2.5 (−29.2, 34.2)	0.877
Dried vegetables (g/wk)						
Time 2	−1.5 (−6.8, 3.9)	0.593	0.7 (−4.1, 5.5)	0.776	2.1 (−5.1, 9.3)	0.566
Time 3	1.2 (−4.71, 7.1)	0.690	4.4 (−1.2, 9.9)	0.126	−0.6 (−5.3, 4.0)	0.791
Canned vegetables (g/wk)						
Time 2	19.6 (−33.7, 72.9)	0.470	−31.0 (−76.2, 14.3)	0.180	16.7 (−34.8, 68.3)	0.525
Time 3	24.0 (−23.2, 71.1)	0.319	3.7 (−41.4, 48.8)	0.873	15.9 (−33.5, 65.3)	0.528
Total fruit (g/wk)						
Time 2	363.9 (95.2, 632.5)	0.008	72.2 (−180.3, 324.7)	0.575	279.9 (26.7, 533.1)	0.030
Time 3	169.8 (−57.6, 397.3)	0.140	43.2 (−200.7, 287.2)	0.728	75.8 (−159.0, 310.7)	0.527
Fresh fruit (g/wk)						
Time 2	313.2 (64.0, 562.4)	0.014	110.8 (−132.8, 272.2)	0.373	272.2 (31.1, 513.3)	0.027
Time 3	169.9 (−51.1, 391.0)	0.132	75.2 (−161.6, 312.0)	0.534	106.0 (−121.7, 333.7)	0.362
Frozen fruit (g/wk)						
Time 2	12.1 (−7.8, 32.1)	0.234	−7.3 (−20.8, 6.3)	0.294	0.7 (−10.4, 11.7)	0.905
Time 3	−4.8 (−15.8, 6.1)	0.387	−6.0 (−21.6, 9. 7)	0.454	−1.8 (−11.2, 7.7)	0.714
Dried fruit (g/wk)						
Time 2	20.3 (−11.1, 51.7)	0.204	−4.0 (−23.3, 15.3)	0.684	4.0 (−14.8, 22.9)	0.675
Time 3	4.1 (−7.3, 15.5)	0.480	−1.6 (−11.6, 8.5)	0.761	0.7 (−8.9, 10.3)	0.892
Canned fruit (g/wk)						
Time 2	16.6 (−18.7, 51.8)	0.357	−4.6 (−34.5, 25.3)	0.762	9.7 (−21.2, 40.6)	0.538
Time 3	−0.6 (−26.8, 25.6)	0.946	−0.3 (−23.7, 23.2)	0.982	−20.9 (−43.7, 1.9)	0.072
Bottled water (mL/wk)						
Time 2	203.6 (−87.3, 494.5)	0.170	20.0 (−276.0, 316.0)	0.895	31.2 (−255.9, 318.4)	0.831
Time 3	103.7 (−92.2, 299.5)	0.299	54.3 (−153.0, 251.6)	0.589	29.2 (−170.1, 228.5)	0.774
Sugar-sweetened beverage (mL/wk)						
Time 2	386.2 (−52.1, 824.5)	0.084	173.0 (−206.4, 552.3)	0.371	881.4 (−686.6, 2449.5)	0.271
Time 3	191.1 (−72.5, 454.7)	0.155	261.1 (18.1, 504.1)	0.035	483.0 (−108.8, 1074.7)	0.110
Diet beverage (mL/wk)						
Time 2	74.2 (−200.7, 349.0)	0.597	117.8 (−195.0, 430.5)	0.461	381.5 (−277.5, 1040.5)	0.257
Time 3	−100.8 (−270.8, 69.2)	0.245	96.8 (−108.4, 301.9)	0.355	178.2 (−135.0, 491.4)	0.265
Self-reported consumption[2]						
Vegetables (g/wk)						
Time 2	−25.8 (−145.4, 93.8)	0.672	22.2 (−98.4, 142.7)	0.718	25.5 (−99.6, 150.6)	0.689
Time 3	22.8 (−90.6, 136.2)	0.694	−34.0 (−152.1, 84.2)	0.573	12.1 (−103.4, 127.6)	0.837
Fruit (g/wk)						
Time 2	167.0 (−26.4, 360.4)	0.091	187.7 (−9.0, 384.3)	0.061	157.9 (−45.0, 364.7)	0.135
Time 3	243.2 (50.2, 436.2)	0.014	84.9 (−104.4, 274.1)	0.380	83.4 (−115.5, 282.2)	0.411
Tap water (mL/wk)						
Time 2	−198.6 (−629.9, 232.7)	0.367	−50.9 (−479.5, 377.7)	0.816	6.5 (−441.0, 454.0)	0.977
Time 3	112.8 (−347.3, 572.8)	0.631	−255.7 (−738.8, 227.4)	0.299	150.9 (−338.1, 640.0)	0.545
Bottled water (mL/wk)						
Time 2	34.0 (−299.0, 367.0)	0.841	98.3 (−259.5, 456.1)	0.590	354.6 (−29.4, 738.5)	0.070
Time 3	−24.8 (−351.0, 301.5)	0.882	−118.4 (−422.4, 185.5)	0.445	69.6 (−240.1, 379.3)	0.660
Sugar-sweetened beverage (mL/wk)						
Time 2	73.4 (0.7, 146.2)	0.048	114.5 (24.8, 204.2)	0.012	30.0 (−17.8, 77.7)	0.219
Time 3	41.1 (−14.7, 96.8)	0.149	83.7 (5.3, 162.2)	0.036	23.6 (−15.2, 62.4)	0.233

(Continued)

TABLE 3 (*Continued*)

	Price reduction		Behavior change		Price reduction + behavior change	
	B (95% CI)	*P*	*B* (95% CI)	*P*	*B* (95% CI)	*P*
Diet beverage (mL/wk)						
Time 2	46.3 (−47.3, 139.9)	0.332	9.7 (−73.3, 92.7)	0.819	52.9 (−53.4, 159.3)	0.329
Time 3	−0.1 (−90.2, 90.0)	0.999	23.9 (−79.8, 127.7)	0.651	−5.6 (−95.4, 84.2)	0.903

[1]Analyzed by using linear regression models. The control group was the reference. All models were adjusted for baseline outcome, catchment area, age, country of birth, marital status, household income, and number of children living at home. SHELf, Supermarket Healthy Eating for Life.

[2]For consistency of reporting coefficients, self-reported consumption, which was measured in servings per day, was converted to grams or milliliters per week by multiplying by 7 and a factor that corresponded to the number of grams per serving (vegetables: 75 g/serving; fruit: 150 g/serving; beverages: 125 mL/serving).

withdrawn, which would have led to observed decreases in product purchasing. Similarly, Geliebter et al. (15) showed a lessening of pricing effects in the nondiscount follow-up period, but the study involved a shorter (8-wk) intervention period and a small sample (*n* = 47). Collectively, these findings provide insight into the sustainability of intervention effects, suggesting that a relatively long duration of exposure to price reductions may be required to sustain changes in healthy purchasing behavior.

The SHELf behavior-change intervention did not increase fruit, vegetable, or low-calorie beverage purchasing or consumption, and the intervention that combined behavior change with price reductions did not appear to confer greater benefits than for the price-reduction intervention alone. Two previous supermarket-based randomized controlled trials that combined price reduction with education showed effects on purchases of healthy foods of price reductions but not of an education intervention (17, 19). Other evidence on the impact of nutrition-education and behavior-change approaches has been mixed, although there is evidence that supports their effects (6, 32). The reasons for the nonsignificant impact of behavior change in the current study will be examined by using process-evaluation data.

The increases in fruit and vegetable quantities purchased from baseline to time 2 were ∼2–3 servings/wk each, which represented an ∼35% increase for fruit and ∼15% increase for vegetable purchasing (21% and 12% increases, respectively, relative to controls). Potentially, the greater increase seen for fruit may have resulted from cost being perceived as a greater barrier to fruit than vegetable consumption and the greater amenability to increasing fruit than vegetable intake (33). The total increase of 4–6 servings/wk of combined fruit and vegetables represented a significant increase of almost an additional serving per day. However, note that purchasing was assessed at the household level, and these servings may have been spread across multiple individuals. It was difficult to adjust for household size in these analyses because some households had a single loyalty card, whereas other households had multiple cards that may or may not have been linked. Nonetheless, the increased quantities of fruit and vegetable purchasing that resulted from the price discount were important in light of the evidence that even small increases in fruit and vegetable consumption benefit health by reducing risk of coronary heart disease, stroke, and cardiovascular and cancer mortality (34–36). For example, an increase as small as 50 g fruit and vegetables/d (less than a serving) is associated with 20% risk reduction in all-cause mortality (37). Because of these findings, in terms of broader implementation, ongoing subsidies could be established via changes to existing sales-taxation structures; ongoing industry discounts such as the wide-scale rollout of Coles' fresh produce "super-specials," which was an initiative informed by this study; or as part of national or state-based nutrition programs that target high-need, low-income families and potentially in conjunction with taxes on selected food products that could raise revenue to fund the subsidies. Market responses to wide-scale subsidies are unknown and would require monitoring.

The findings of increased purchasing of sugar-sweetened beverages at time 3 in the behavior-change intervention and increased consumption of sugar-sweetened beverages in the price-reduction (time 2) and behavior-change (times 2 and 3) interventions were unexpected. The potential that these interventions had unintended adverse effects on increasing the purchasing or consumption of sugar-sweetened beverages should be considered. For example, price-reduction participants may have spent the money saved from discounted products to purchase more sugar-sweetened beverages (substitution effects), or behavior-change intervention activities may have unintentionally promoted increased consumption of sugar-sweetened beverages. The latter effect seems unlikely because the objective outcome of

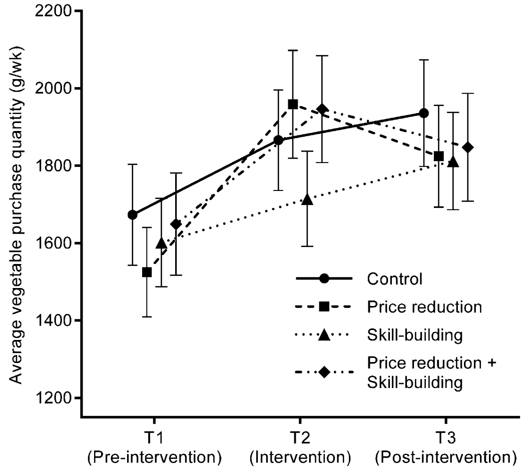

FIGURE 2 Average (±SE) weekly vegetable purchase quantities (g/wk) for participants (*n* = 574) in SHELf intervention groups across 3 time points. Linear regression models showed significant intervention effects on vegetable purchasing for the price-reduction group relative to the control group at T2 (*P* = 0.046). SHELf, Supermarket Healthy Eating for Life; T1, time 1; T2, time 2; T3, time 3.

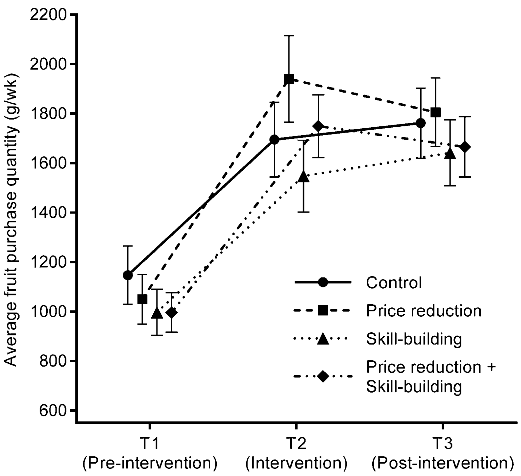

FIGURE 3 Average (±SE) weekly fruit purchase quantities (g/wk) for participants (n = 574) in SHELf intervention groups across 3 time points. Linear regression models showed significant intervention effects on fruit purchasing for the price-reduction group (P = 0.008) and combined price-reduction and skill-building group (P = 0.030) relative to the control group at T2. SHELf, Supermarket Healthy Eating for Life; T1, time 1; T2, time 2; T3, time 3.

the purchasing of carbonated sugar-sweetened beverages increased at time 3 (6 mo postintervention) but not immediately postintervention when it might have been expected that any effect would have been the strongest. In addition, there was no significant increase in the purchasing of consumption of sugar-sweetened beverages in the combined price-reduction skill-building intervention. Previous trials that involved fruit and vegetable discounts showed no evidence of substitution effects (e.g., see reference 19). The magnitudes of increases were also very small. Values of sugar-sweetened beverage purchasing were highly variable at baseline with highest values in the control group; subsequent increases in intervention groups could have reflected a regression to the mean.

Previous research showed that fruit and vegetables cost relatively more on a per-kilogram and per-calorie basis than do sugar-sweetened beverages (38). In addition, promotion catalogs and store observations showed that carbonated beverages are regularly heavily discounted in supermarkets; e.g., either Coca-Cola or Pepsi multipacks are discounted by up to 50% in Australia in major supermarket chains most weeks. Hence, there may have been little additional incentive to opt in to the SHELf price-discount promotion because these beverages were already cheap and accessible. The advertising of brands of sugar-sweetened beverages also far outweighs that of fruit and vegetables (39). These ongoing routine price reductions and promotions may have ameliorated the potential influence of the SHELf price intervention on beverage purchases.

To our knowledge, this is the first article to report the economic costs of pricing strategies on healthy food-purchasing behavior in a randomized controlled trial despite a long-recognized need for such economic evaluations (10, 40, 41). Therefore, a direct cost comparison to other studies on pricing strategies for healthy food purchasing was unachievable. However, an indirect-comparison approach adds insights for policy makers. The additional cost of A$158/household over the price reduction (equivalent to A$632/y) was less than that in a US study that showed a US$36/fortnight (US$936/y) premium on a healthier food basket compared with the government-endorsed Thrifty Food Plan shopping basket (42). This cost difference may have reflected the exclusion in our study of a broader range of food items including higher-cost lean meats and whole grains (42). The comparison of costs and outcomes between the intervention arms suggested that the price discount alone may have given better value for money than did the skill-building or combined interventions. This result is consistent with other reports (43) that policies that influence access to affordable fruit and vegetables may be more cost-effective than are skill-building approaches.

Limitations of this study included a potential sampling bias because of recruitment from the Coles FlyBuys database. However, FlyBuys is the largest loyalty system in Australia with >10 million enrolled households from a range of sociodemographic backgrounds. The exclusion of 68 participants with incomplete data resulted in the loss of a subset of the sample who were younger and had generally less-healthy baseline purchasing and food-consumption profiles. Our agreement with industry partners did not permit us to analyze substitution effects (i.e., whether and how the discount affected the purchasing of non-targeted products). Although consumption outcomes may have been prone to self-report or measurement error, sales-transaction data provided objective measures of the impact. The assessment of purchasing at the household level made it difficult to calculate effect sizes for individual participants; however, other studies showed correlations between household purchases and individual consumption (44, 45). The large sample size and high retention rates were additional study strengths.

In conclusion, the skills-based approach in the current study had no effects on increasing the consumption of fruit, vegetables, or low-calorie beverages nor did it enhance the effects of a price-reduction alone. Additional research is necessary to understand the reasons for this lack of effect. However, the current findings lend support to growing calls for a focus on sustained healthy food subsidies as part of an approach to promoting increased fruit and vegetable consumption.

Coles supermarkets and the National Heart Foundation of Australia provided in-kind support for this study.

The authors' responsibilities were as follows—KB, SAM, LG, CNM, CP, and DC: designed the research; KB and HNDL: conducted the research; GA: performed statistical analyses; KB: drafted the article with input from all coauthors and took primary responsibility for the final content of the manuscript; and all authors: read and approved the final manuscript. None of the authors reported a conflict of interest related to the study.

REFERENCES

1. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, Amann M, Anderson HR, Andrews KG, Aryee M, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012; 380:2224–60. Erratum in: Lancet 2013;381:628
2. Mozaffarian D, Hao T, Rimm EB, Willett WC, Hu FB. Changes in diet and lifestyle and long-term weight gain in women and men. N Engl J Med 2011;364:2392–404.
3. Kant AK, Graubard BI. Secular trends in the association of socioeconomic position with self-reported dietary attributes and biomarkers in the US population: National Health and Nutrition Examination Survey (NHANES) 1971-1975 to NHANES 1999-2002. Public Health Nutr 2007;10:158–67.
4. Thornton LE, Bentley RJ, Kavanagh AM. Individual and area-level socioeconomic associations with fast food purchasing. J Epidemiol Community Health 2011;65:873–80.

5. Rehm CD, Matte TD, Van Wye G, Young C, Frieden TR. Demographic and behavioral factors associated with daily sugar-sweetened soda consumption in New York City adults. J Urban Health 2008;85: 375–85.
6. Ammerman AS, Lindquist CH, Lohr KN, Hersey J. The efficacy of behavioral interventions to modify dietary fat and fruit and vegetable intake: a review of the evidence. Prev Med 2002;35:25–41.
7. Bowers DE. Cooking trends echo changing roles of women. Food Rev 2000;23:23–9.
8. Lake A, Hyland R, Mathers J, Rugg-Gunn A, Wood C, Adamson A. Food shopping and preparation among the 30-somethings: whose job is it? (The ASH30 study). Br Food J 2006;108:475–86.
9. Mytton OT, Clarke D, Rayner M. Taxing unhealthy food and drinks to improve health. BMJ 2012;344:e2931.
10. An R. Effectiveness of subsidies in promoting healthy food purchases and consumption: a review of field experiments. Public Health Nutr 2013;16:1215–28.
11. Eyles H, Ni Mhurchu C, Nghiem N, Blakely T. Food pricing strategies, population diets, and non-communicable disease: a systematic review of simulation studies. PLoS Med 2012;9:e1001353.
12. Powell LM, Chriqui JF, Khan T, Wada R, Chaloupka FJ. Assessing the potential effectiveness of food and beverage taxes and subsidies for improving public health: a systematic review of prices, demand and body weight outcomes. Obes Rev 2013;14:110–28.
13. Shemilt I, Hollands GJ, Marteau TM, Nakamura R, Jebb SA, Kelly MP, Suhrcke M, Ogilvie D. Economic instruments for population diet and physical activity behaviour change: a systematic scoping review. PLoS ONE 2013;8:e75070.
14. Thow AM, Jan S, Leeder S, Swinburn B. The effect of fiscal policy on diet, obesity and chronic disease: a systematic review. Bull World Health Organ 2010;88:609–14.
15. Geliebter A, Ang IY, Bernales-Korins M, Hernandez D, Ochner CN, Ungredda T, Miller R, Kolbe L. Supermarket discounts of low-energy density foods: effects on purchasing, food intake, and body weight. Obesity (Silver Spring) 2013;21:E542–8.
16. Kristal AR, Goldenhar L, Muldoon J, Morton RF. Evaluation of a supermarket intervention to increase consumption of fruits and vegetables. Am J Health Promot 1997;11:422–5.
17. Ni Mhurchu C, Blakely T, Jiang Y, Eyles H, Rodgers A. Effects of price discounts and tailored nutrition education on supermarket purchases: a randomized controlled trial. Am J Clin Nutr 2010;91:736–47.
18. Shaikh AR, Yaroch AL, Nebeling L, Yeh M-C, Resnicow K. Psychosocial predictors of fruit and vegetable consumption in adults a review of the literature. Am J Prev Med 2008;34:535–43.
19. Waterlander WE, de Boer MR, Schuit AJ, Seidell JC, Steenhuis IH. Price discounts significantly enhance fruit and vegetable purchases when combined with nutrition education: a randomized controlled supermarket trial. Am J Clin Nutr 2013;97:886–95.
20. Ball K, McNaughton S, Mhurchu C, Andrianopoulos N, Inglis V, McNeilly B, Le H, Leslie D, Pollard C, Crawford D. Supermarket Healthy Eating for Life (SHELf): protocol of a randomised controlled trial promoting healthy food and beverage consumption through price reduction and skill-building strategies. BMC Public Health 2011;11: 715.
21. Australian Bureau of Statistics. Australian social trends. Canberra (Australia): Commonwealth of Australia; 2009.
22. Smith LP, Ng SW, Popkin BM. Trends in US home food preparation and consumption: analysis of national nutrition surveys and time use studies from 1965-1966 to 2007-2008. Nutr J 2013;12:45.
23. Ball K, Crawford D, Mishra G. Socio-economic inequalities in women's fruit and vegetable intakes: a multilevel study of individual, social and environmental mediators. Public Health Nutr 2006;9:623–30.
24. Australian Bureau of Statistics. 2033.0.55.001 - Socio-economic Indexes for Areas (SEIFA), data only, 2006. Canberra (Australia): Commonwealth of Australia; 2008.
25. Bartholomew LK, Parcel GS, Kok G, Gottlieb NH. Planning health promotion programs: an intervention mapping approach, 2nd ed. San Francisco, CA: Jossey-Bass; 2006.
26. Stokols D. Translating social ecological theory into guidelines for community health promotion. Am J Health Promot 1996;10:282–98.
27. Bandura A. Social foundations of thought and action: a social cognitive theory. Englewood Cliffs (NJ): Prentice-Hall; 1986.
28. Rutishauser I, Webb K, Abraham B, Allsopp R. Evaluation of short dietary questions from the 1995 National Nutrition Survey. Canberra (Australia): Commonwealth of Australia; 2001.
29. Sanigorski AM, Bell A, Swinburn B. Association of key foods and beverages with obesity in Australian schoolchildren. Public Health Nutr 2007;10:152–7.
30. Campbell MK, Piaggio G, Elbourne DR, Altman DG. CONSORT 2010 statement: extension to cluster randomised trials. BMJ 2012;345: e5661.
31. Australian Bureau of Statistics. Average weekly earnings Australia. Canberra (Australia): Australian Bureau of Statistics; 2012.
32. Pomerleau J, Lock K, Knai C, McKee M. Interventions designed to increase adult fruit and vegetable intake can be effective: a systematic review of the literature. J Nutr 2005;135:2486–95.
33. Pollard C, Miller M, Woodman RJ, Meng R, Binns C. Changes in knowledge, beliefs, and behaviors related to fruit and vegetable consumption among Western Australian adults, 1995 to 2004. Am J Public Health 2009;99:355–61.
34. Dauchet L, Amouyel P, Hercberg S, Dallongeville J. Fruit and vegetable consumption and risk of coronary heart disease: a meta-analysis of cohort studies. J Nutr 2006;136:2588–93.
35. He FJ, Nowson CA, Lucas M, MacGregor GA. Increased consumption of fruit and vegetables is related to a reduced risk of coronary heart disease: meta-analysis of cohort studies. J Hum Hypertens 2007;21: 717–28.
36. Oyebode O, Gordon-Dseagu V, Walker A, Mindell JS. Fruit and vegetable consumption and all-cause, cancer and CVD mortality: analysis of Health Survey for England data. J Epidemiol Community Health 2014;68:856–62.
37. Khaw K-T, Bingham S, Welch A, Luben R, Wareham N, Oakes S, Day N. Relation between plasma ascorbic acid and mortality in men and women in EPIC-Norfolk prospective study: a prospective population study. Lancet 2001;357:657–63.
38. Drewnowski A, Darmon N. The economics of obesity: dietary energy density and energy cost. Am J Clin Nutr 2005;82(Suppl):265S–73S.
39. Pollard C, Binns C. Vegie man could be the new David (to tackle Goliath). Aust N Z J Public Health 2008;32:92–3.
40. Brun JK. Where are we going? J Am Diet Assoc 1987;87:S81–2.
41. Wall J, Ni Mhurchu C, Blakely T, Rodgers A, Wilton J. Effectiveness of monetary incentives in modifying dietary behavior: a review of randomized, controlled trials. Nutr Rev 2006;64:518–31.
42. Jetter KM, Cassady DL. The availability and cost of healthier food alternatives. Am J Prev Med 2006;30:38–44.
43. Cobiac LJ, Vos T, Veerman JL. Cost-Effectiveness of interventions to promote fruit and vegetable consumption. PLoS ONE 2010;5:e14148.
44. Eyles H, Jiang Y, Ni Mhurchu C. Use of household supermarket sales data to estimate nutrient intakes: a comparison with repeat 24-Hour dietary recalls. J Am Diet Assoc 2010;110:106–10.
45. Ransley JK, Donnelly JK, Khara TN, Botham H, Arnot H, Greenwood DC, Cade JE. The use of supermarket till receipts to determine the fat and energy intake in a UK population. Public Health Nutr 2001;4: 1279–86.