Effects of different discount levels on healthy products coupled with a healthy choice label, special offer label or both: results from a web-based supermarket experiment

Wilma E Waterlander1,4*, Ingrid HM Steenhuis1, Michiel R de Boer1,2, Albertine J Schuit1,3 and Jacob C Seidell1

Abstract

Background: Two strategies commonly recommended to improve population diets include food labels and food taxes/subsidies. The aim of this study was to examine the effects of both strategies separately and in combination.

Findings: An experiment with a 3x3 factorial design was conducted, including: three levels of price reduction (10%; 25%; and 50%) x three labels ('special offer', 'healthy choice' and 'special offer & healthy choice') on healthy foods defined following the Choices front-of-pack nutrition label. N = 109 participants completed the experiment by conducting a typical weekly shop for their household at a three-dimensional web-based supermarket. Data were analysed using analysis of covariance.

Participants receiving a 50% price discount purchased significantly more healthy foods for their household in a typical weekly shop than the 10% discount (+8.7 items; 95%CI = 3.8-13.6) and the 25% discount group (+7.7 items; 95%CI = 2.74 - 12.6). However, the proportion of healthy foods was not significantly higher and the discounts lead to an increased amount of energy purchased. No significant effects of the labels were found.

Conclusion: This study brings some relevant insights into the effects of price discounts on healthier foods coupled with different labels and shows that price effects over shadowed food labels. However, price discounts seem to have ambiguous effects; they do encourage the purchase of healthy products, but also lead to increased energy purchases. More research is needed to examine how pricing strategies can work in directing consumers towards interchanging unhealthier options for healthier alternatives.

Keywords: Experiment, Food pricing, Food labelling, Price discounts, Supermarket, Intervention, Public health nutrition, Health promotion, Virtual supermarket
food is discounted [6,7] or buy less products with a health logo because they link it with bad taste [8]). Finally, it is worth exploring whether the effects of labels and discounts could be reinforced if they are combined [9]. Here, labels could be used to identify healthier products, but also to highlight a product promotion.

This study aimed to examine the effects of price discounts on healthy foods in combination with signs informing that the product is healthy, discounted or both. It was hypothesized that the most favourable nutrient purchases would be found when combining the greatest discount with a sign explaining that the item is healthy plus discounted [10].

**Table 1 Number of healthy food products within the 38 food categories in the web-based supermarket**

| Food category                          | Total products (n) | Healthy products (n) |
|----------------------------------------|-------------------|----------------------|
| 1. Potatoes and potato products        | 10                | 7                    |
| 2. Fruits                              | 10                | 10                   |
| 3. Vegetables                          | 41                | 41                   |
| 4. Ready to eat meals                  | 19                | 4                    |
| 5. Meat/ Fish/ Poultry*                | 29                | 13                   |
| 6. Meat products*                      | 18                | 4                    |
| 7. Salads (e.g., crab salad, egg salad, etc.) | 8 | 3            |
| 8. Appetizers/ snacks                  | 6                 | 1                    |
| 9. Cheese                              | 19                | 3                    |
| 10. Dairy drinks (e.g., milk, yoghurt drink, etc.)* | 15 | 8            |
| 11. Desserts*                          | 21                | 4                    |
| 12. (Whipped) cream                    | 5                 | -                    |
| 13. Butter                             | 6                 | 2                    |
| 14. Eggs                               | 2                 | -                    |
| 15. Bread*                             | 15                | 6                    |
| 16. Pastry                             | 14                | 4                    |
| 17. Snacks/ refreshments               | 12                | 3                    |
| 18. Frozen snacks                      | 10                | -                    |
Table 1 Number of healthy food products within the 38 food categories in the web-based supermarket\(^a\) (Continued)

| Category                                      | Web-based supermarket | Web-based supermarket |
|-----------------------------------------------|-----------------------|-----------------------|
| Ice (cream)                                  | 8                     | 1                     |
| Frozen pastry                                 | 2                     | -                     |
| Coffee                                        | 7                     | -                     |
| Evaporated milk/ sugar/ sweeteners            | 9                     | 2                     |
| Baking products                               | 13                    | 4                     |
| Sweet sandwich fillings*                      | 10                    | 3                     |
| Breakfast products                            | 13                    | 6                     |
| Pasta/ Rice/ Noodles*                         | 12                    | 4                     |
| Mixes for sauces                              | 12                    | 1                     |
| Seasonings                                    | 9                     | 1                     |
| Herbs and spices                              | 10                    | -                     |
| Oils/ Sauces and pickles                      | 26                    | 9                     |
| Soups                                         | 12                    | 2                     |
| Canned foods (excluding fruits and vegetables)| 10                    | 3                     |
| Beverages (excluding soda)                    | 6                     | 3                     |
| Soda*                                         | 24                    | 14                    |
| Alcoholic beverages                           | 19                    | -                     |
| Candy                                         | 14                    | 3                     |
| Chocolate                                     | 20                    | -                     |
| Crisps/ nuts/ toast                           | 16                    | 3                     |
| **Total**                                     | **512**               | **172 (33.6%)**       |

\(^a\) Healthy products are defined following the Choices front-of-pack nutrition label criteria which are based on the international WHO recommendations regarding saturated fat, trans fat, sodium, and added sugar [13].

\(^b\) These product categories were selected for within category analysis.

---

**Figure 2** CONSORT flow diagram.

---

Signed in for web-based supermarket experiments and were screened for eligibility (n = 658)

- Excluded (n)
  - Not meeting inclusion criteria (n = 222)
  - Decline to participate (n = 9)

Included in other web-based supermarket studies (n = 273)

**Randomized (n = 154)**
Methods

The study was conducted using a three-dimensional (3-D) web-based supermarket (Figure 1). This virtual supermarket was designed to mimic a real-life supermarket and included 512 unique products, modelling the product assortment of a regular supermarket. Further information about the software can be found elsewhere [11,12].

A randomized experiment with three levels of price reduction x three types of labels on healthy foods was conducted. Healthy products were defined following the Choices front-of-pack nutrition label criteria [13] (Table 1). A sample size was determined using delta-values of fruit and vegetable purchases as effect size [14]. It was determined that a sample of n = 108 would be adequate to demonstrate an effect size of .50 (level of significance .05, power > .90, fixed effects, equal sizes in all treatment cells assumed).

Dutch participants were recruited through newspapers (Figure 2). Inclusion criteria were: being eighteen years or older, speaking Dutch, having an independent household, and having a lower socio-economic status (SES) (having a lower education level or being unemployed). Participants were asked to complete a typical household weekly shop by navigating with a chart between the Virtual Supermarket shelves. Participants received a specific shopping budget, which was calculated based on their household composition, but were not encouraged to spend this entirely. The main outcome measures were: healthy and unhealthy food items (number and

Table 2 Participant characteristics

|                        | Total n = 109 | p*        |
|------------------------|--------------|-----------|
| Sex Female             | 93 (85.3)    | .69       |
| Age 18 – 31            | 18 (16.5)    | .15       |
|                        | 32 – 46      | 56 (51.4) |
|                        | 47 – 61      | 27 (24.8) |
|                        | 62 +         | 8 (7.3)   |
| Grocery Totally respon | 68 (62.4)    | .18       |
| Responsibility Largely responsible | 24 (22.0) | .18 |
| Partly responsible     | 17 (15.6)    |           |
| Education level Low (primary/ lower secondary) | 38 (34.9) | .30 |
| Medium (higher secondary/ intermediate vocational | 58 (53.2) | |
| High (higher vocational/ university | 13 (11.9) |
| Employment status Employed | 38 (34.9) | .38 |
| Other                  | 71 (65.1)    |           |
| Household income Low (0 – 2000) | 32 (29.4) | .09 |
| Medium (2000 – 3000)   | 38 (34.9)    |           |
| High (3000+)           | 39 (35.8)    |           |
| Household size 2.92 (1.43) | .14 |
| Price perception c     | 67.93 (9.43) | .73       |
| Habit score d          | 49.50 (8.3)  | .74       |
| Appreciation score     | 60.23 (7.37) | .13       |
| Web-based supermarket e |             |           |
| Attention to prices in web-based supermarket f | 18.3 (5.3) | .82 |
| Budget in web-based supermarket | 70.63 (23.19) | .09 |
| % of budget spent      | 87.7 (16.0)  | .21       |

Data were measured in 2010 in the Netherlands. Participants included a community sample (n = 109).

Indicates the p-value for chi² tests and ANOVA analysis comparing the nine research conditions.

The standard gross monthly income in the Netherlands (2010) was € 2,508 [17].

Measured by fifteen items (7-point Likert scale) from the seven “price perception construct scale items” (Lichtenstein et al., 1993).

Measured by twelve items (7-point Likert scale) self-report index of habit strength (Verplanken et al., 2003).

Measured by eleven items (7-point Likert scale) on the web-based supermarket software.

Measured by four items concerning attention to prices in the web-based supermarket (7-point Likert scale).
Differences in food purchases were analysed using two-way factorial ANCOVA models. Model 1 (crude) included the fixed factors level of price discount, type of promotion sign used and the interaction discount x promotion label. Model 2 (fully adjusted) included the fixed factors level of price discount, type of promotion label and the interaction discount x promotion label.

Results

N = 109 participants were included in final analysis (Figure 2) (Table 3). 93% of the participants indicated that their experimental purchases aligned with their regular groceries (score ≥5).

The crude models revealed that participants in the 50% discount condition purchased significantly more healthy foods than participants in the 25% or 10% discount condition (Table 3). Likewise, the proportion of healthier products purchased was highest in the 50% discount condition; however differences between groups were not statistically significant. No significant differences were observed in the number of unhealthy foods purchased. Therefore, the total number of foods and total energy purchased was significantly higher in the highest discount condition. Similar results were found when looking within the eight major food categories (Additional file 1). No statistical significant differences

| Discount | 10% discount | 25% discount |
|----------|--------------|--------------|
|          | B            | Lower 95% CI | Upper 95% CI | B            | Lower 95% CI | Upper 95% CI |
| N        | -            | -            | -            | 1.81         | -3.74       | 7.35         |
| Unhealthy| 0.5% discount| -3.20        | -8.42        | 2.02         | -1.39       | -6.76        |
| N Healthy| 0.5% discount| -            | -            | -0.44        | -5.57       | 4.70         |
|          | 0.5% discount| -8.58**      | -13.4        | -3.75        | -9.02***    | -14.0        |
| Total items| 0.5% discount| -            | -            | 1.37         | -6.90       | 9.63         |
|          | 0.5% discount| -11.8**      | -19.6        | -4.00        | -10.4*      | -18.4        |
| Total    | 0.5% discount| -            | -            | 2.899        | -4.936      | 10.733       |
| Calories | 0.5% discount| -8.878**     | -16.258      | -1.499       | -5.980      | -13.566      |
| N Healthy| 0.5% discount| -            | -            | -0.41        | -4.21       | 3.38         |
| excl F&V | 0.5% discount| -5.65**      | -9.22        | -2.07        | -6.06**     | -9.73        |
| % Healthy| 0.5% discount| -            | -            | -2.53        | -9.24       | 4.18         |
|          | 0.5% discount| -4.02        | -10.3        | 2.30         | -6.55‡      | -13.1        |
| % Healthy| 0.5% discount| -            | -            | -1.75        | -6.46       | 2.95         |
| excl F&V | 0.5% discount| -2.32        | -6.75        | 2.11         | -4.07       | -8.63        |
| Vegetables| 0.5% discount| -            | -            | -82.8‡       | -88.7       | 721          |
| (gram)   | 0.5% discount| -1,108       | -1,866       | -350         | -1,191***   | -1,970       |
| Fruit    | 0.5% discount| -            | -            | 398          | -384        | 1,180        |
| (gram)   | 0.5% discount| -544         | -1,280       | 193          | -146        | -903         |
| % budget | 0.5% discount| -            | -            | -1.34        | -8.99       | 6.31         |
| Spent    | 0.5% discount| 5.52         | -1.69        | 12.7         | 4.18        | -3.23        | 11.6 |

Data were measured in 2010 in the Netherlands. Participants included a community sample (n = 109).

* Results of two-way ANCOVA including the fixed factors level of discount, type of promotion label and the interaction discount x promotion label.

** Significant at p < .05.

*** Significant at p < .01.
between the three label types were found, except for proportion of budget spent (Table 4) (Additional file 2). Similar results were observed in the fully adjusted models. Finally, the interaction discount x promotion sign was not significant at an alpha of 0.10 in any of the models.

**Discussion**

This study in an experimental web-based supermarket examined the effects on food purchases of price discounts on healthy foods in combination with three different labels. Results indicated a positive trend between the proportion of healthier products purchased and higher discounts, however, these differences were not statistically significant. Most importantly, participants significantly increased healthy food purchases due to the price discounts, but did not significantly change the number of unhealthy foods purchased. Therefore, total energy purchased was significantly higher in the highest discount condition. No significant differences in food purchases were observed between the different label conditions.

An important limitation of this study is the absence of a control condition. Therefore, we were unable to segregate the effects of the price and labeling interventions. Also, it limits the interpretation of the results. Nevertheless, the results from this study bring some relevant new insights, especially since evidence on the effects of price discounts and labels from experimental studies in larger food environments is missing. An important finding was that the price discounts lead to significant higher energy purchases; which is in line with earlier studies [7,18,19] and confirms that it is essential to design price discounts carefully [20]. One possible way to limit extra energy purchases is by restricting the price discounts to fruits and vegetables (opposed to all healthier foods). A recently published pricing experiment revealed that 50% price discounts on fruits and vegetables lead to significantly increased fruit and vegetable purchases and no changes in other food categories [5].

Another relevant finding is that the effects of the price discounts were stronger than the effects of the effects of food labels. For example, in condition one (‘special offer’...
...and 10% discount) participants purchased on average 21.9 healthy food items; in condition 7 (‘special offer’ & 50% discount) this number was 32.5. Furthermore, our study did not observe differences in food purchases between the label conditions, showing that promotion and health labels had similar effects. While there is much literature on the effects of food labels, most studies to date were limited to consumer understanding instead of effects on purchases [3]. Studies measuring food purchases objectively are vital since understanding a FOP label does not automatically imply that people will change food purchases. One recent study on the effects of FOP traffic-light nutrition labelling on online food purchases using sales data revealed that the traffic light indicators had no influence on sales [21]. Likewise, our study revealed no effects of food labels on food purchases. This has important implications for food labeling policy and shows that FOP labeling alone might not be enough to influence food purchases.

Giessen et al. published a study into the effects of calorie information and taxes on high-calorie foods on university student’s lunch decisions. They found that a 25% tax increase was effective to reduce calorie purchases, but that this effect was lowered in the presence of calorie information [22]. The authors therefore argue that it may be more important to communicate calorie information than to tax products. Our study showed no interactions between the price and labelling interventions, and, in contrast to earlier findings, that the sales labels did not upturn the effects of pricing alone. Previous research showed that using the word ‘sale’ beside a price (without actually varying the price) can increase demand by more than 50% [23]. One explanation for the absence of such effects in our study is that our sample size was not specifically powered for these interaction effects. Furthermore, participants might not have felt the necessity to react on the sales labels because they only shopped once in our web-based supermarket and did not consider missing out on future deals [23,24].

**Conclusion**

This study brings some relevant insights into the effects of different price discounts on healthier foods coupled with different labels on overall food purchases and forms a valuable basis for future research. Food labels did not seem to have a large impact on food purchases. Price discounts did significantly encourage the purchase of healthy products, but did not discourage the purchase of unhealthy foods and therefore lead to increased energy purchases. More research is needed to unravel how pricing strategies can best be designed to result in overall improved food purchases and what role food labels could have to reach this goal. This research should be specifically aimed at finding ways to direct consumers towards interchanging unhealthier options for healthier alternatives.

**Additional files**

**Additional file 1:** Effects of varying price discount levels on the percentage of healthy food products purchased within eight different product categories, the Netherlands (2010).

**Additional file 2:** Effects of varying different promotion labels on the percentage of healthy food products purchased within eight different product categories, the Netherlands (2010).

**Abbreviations**

FOP labels: Front-of-pack labels; RCT: Randomized controlled trial.

**Competing interests**

The authors declare that they have no competing interests.

**Authors’ contributions**

WES was responsible for designing the study, data collection, analysis and interpretation of data. This author was involved in drafting the manuscript and has given final approval of the version to be published. IHWS was responsible for the conception and design of this study. This author also revised the manuscript critically for important intellectual content and has given final approval of the version to be published. MRB was responsible for the conception and design of this study. This author also revised the manuscript critically for important intellectual content and has given final approval of the version to be published. AJS was responsible for the conception and design of this study. This author also revised the manuscript critically for important intellectual content and has given final approval of the version to be published. All authors read and approved the final manuscript.

**Acknowledgements**

We would like to thank Kim Dolstra, Lennart Roest and Marcel Mekkes for their excellent help with the data collection. This work was supported by a grant from the Netherlands Organization for Health Research and Development (ZonMw) – project number 50-50105-96-426. This funding body was involved in study design but had no other role in this manuscript. Second, we received funding from a special Software Development Fund of VU University Amsterdam which is dedicated to SARA Computing and Networking Services Amsterdam for use in the development of new scientific software tools (VU – SARA collaboration). This funding was used to develop the Virtual Supermarket the funding body had no further role in this study.

**Author details**

1Department of Health Sciences and the EMGO Institute for Health and Care Research, Faculty of Earth and Life Sciences, VU University Amsterdam, De Boelelaan 1085, Amsterdam 1081 HV, The Netherlands. 2Department of Health Sciences, Community and Occupational Medicine, University Medical Center Groningen, University of Groningen, P.O. Box 30006, Groningen, The Netherlands. 3National Institute for Public Health and the Environment, P.O. Box 13720 BA, Bilthoven, The Netherlands. 4Present address: National Institute for Health Innovation, School of Population Health, The University of Auckland – Tamaki Campus, Private Bag 92019, Auckland Mail Centre, Auckland 1142, New Zealand.

Received: 6 August 2012 Accepted: 14 May 2013
Published: 16 May 2013

**References**

1. Sacks G, Veerman JL, Moodie M, Swinburn B. Traffic-light nutrition labelling and ‘junk-food’ tax: a modelled comparison of cost-effectiveness for obesity prevention. Int J Obesity 2011, 35:S1001–S1009.
2. Faulkner G, Grootendorst P, Nguyen VH, Andreewa T, Arbour-Nicitopoulos K, Christopher M, Cash SB, Cavley J, Donnelly P, Drewnowski A, et al.
Economic instruments for obesity prevention: results of a scoping review and modified delphi survey. Int J Behav Nutr Phys Act 2011, 8. doi:10.1186/1479-5868-8-109.

3. Hersey JC, Wohlgemant KC, Arsenault JE, Kosa KM, Muth MK. Effects of front-of-package and shelf nutrition labeling systems on consumers. Nutr Rev 2013, 71:7–14.

4. Epstein LH, Janikowski N, Nederkoorn C, Raynor HA, French SA, Finkelstein E. Experimental research on the relation between food price changes and food-purchasing patterns: a targeted review. Am J Clin Nutr 2012, 95:789–809.

5. 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, 97:886–895.

6. Waterlander HE, Steenhuis IH, de Boer MR, Schuit AJ, Seidell JC. Introducing taxes, subsidies or both: The effects of various food pricing strategies in a web-based supermarket randomized trial. Prev Med 2012, 54:323–330.

7. Epstein LH, Dealing KK, Roba LG, Finkelstein E. The influence of taxes and subsidies on energy purchased in an experimental purchasing study. Psychol Sci 2010, 21:406–414.

8. Horgen KB, Brownell KD: Comparison of price change and health message interventions in promoting healthy food choices. Health Psychol 2002, 21:505–512.

9. Waterlander WE, de Mul A, Schuit AJ, Seidell JC, Steenhuis IH: Perceptions on the use of pricing strategies to stimulate healthy eating among residents of deprived neighbourhoods: a focus group study. Int J Behav Nutr Phys Act 2010, 7. doi:10.1186/1479-5868-7-44.

10. Chetty R, Looney A, Kroft K. Salience and taxation: theory and evidence. Am Econ Rev 2009, 99:1145–1177.

11. Waterlander WE, Scarpa M, Lentz D, Steenhuis IH. The virtual supermarket: an innovative research tool to study consumer food purchasing behaviour. BMC Public Health 2011, 11:589.

12. Waterlander WE, Ni Mhurchu C, Steenhuis IH. The use of virtual reality in studying complex interventions in our everyday food environment. In Virtual Reality Human Computer Interaction. Edited by Tang Rijeka X. Croatia: InTech; 2012:229–260.

13. Roedenburg AJC, Popkin BM, Seidell JC. Development of international criteria for a front of package food labelling system: the international choices programme. Eur J Clin Nutr 2011, 65:1190–1200.

14. Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd edition. Hillsdale, New Jersey: Lawrence Erlbaum Associates; 1988.

15. Lichtenstein DR, Riedway NM, Netemeyer RG. Price perceptions and consumer shopping behavior: a field study. JMark Res 1993, 30:234–245.

16. Verplanken B, Orbell S. Reflections on past behavior: a self-report index of habit strength. J Appl Soc Psychol 2002, 33:1313–1330.

17. Standard Income (Modaal inkomen). http://www.cpb.nl/publicatie/centraal-economisch-plan-2013.

18. Nordstrom J, Thunstrom L. The impact of tax reforms designed to encourage healthier grain consumption. J Health Econ 2009, 28:622–634.

19. Myttyn O, Gray A, Rayner M, Rutter H. Could targeted food taxes improve health? J Epidemiol Community Health 2007, 61:689–694.

20. Eyles H, Ni Mhurchu C, Ngheim N, Blyak T. Food pricing strategies, population diets, and non-communicable disease: a systematic review of simulation studies. PLoS Med 2012, 9:e1001353.

21. Sacks G, Tikellis K, Millar L, Swinburn B. Impact of ‘traffic-light’ nutrition information on online food purchases in Australia. Aust N Z J Public Health 2011, 35:122–126.

22. Giesen JC, Payne CR, Havermans RC, Jansen A. Exploring how calorie information and taxes on high-calorie foods influence lunch decisions. Am J Clin Nutr 2011, 93:679–680.

23. Anderson ET, Simester DI. Mind your pricing cues. Harv Bus Rev 2003, 81:97–103.

24. Darke PR, Chung CMY. Effects of pricing and promotion on consumer perceptions: it depends on how you frame it. J Retailing 2005, 81:35–47.

doi:10.1186/1479-5868-10-59
Cite this article as: Waterlander et al.: Effects of different discount levels on healthy products coupled with a healthy choice label, special offer label or both: results from a web-based supermarket experiment. International Journal of Behavioral Nutrition and Physical Activity 2013 10:59.