Co-construction and Evaluation of a Prevention Program for Improving the Nutritional Quality of Food Purchases at No Additional Cost in a Socioeconomically Disadvantaged Population

Marlène Perignon, Christophe Dubois, Rozenn Gazan, Matthieu Maillot, Laurent Muller, Bernard Ruffieux, Hind Gaigi, Nicole Darmon

▶ **To cite this version:**

Marlène Perignon, Christophe Dubois, Rozenn Gazan, Matthieu Maillot, Laurent Muller, et al.. Co-construction and Evaluation of a Prevention Program for Improving the Nutritional Quality of Food Purchases at No Additional Cost in a Socioeconomically Disadvantaged Population. Current Developments in Nutrition, 2017, 1 (10), pp.1-10. 10.3945/cdn.117.001107 . hal-01868342

HAL Id: hal-01868342
https://hal.science/hal-01868342

Submitted on 26 May 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population

Marlène Perignon[1,4], Christophe Dubois[1], Rozenn Gazan[1,2], Matthieu Maillot[2], Laurent Muller[3], Bernard Ruffieux[3], Hind Gaigi[1], Nicole Darmon[1,4,*]

[1] Aix-Marseille Univ, INSERM, INRA, NORT, 13005 Marseille, France

[2] MS-Nutrition, 13005 Marseille, France

[3] INRA, UMR GAEL, 38000 Grenoble, France

[4] INRA, UMR MOISA, 34060 Montpellier, France

Authors' last names : Perignon, Dubois, Gazan, Maillot, Muller, Ruffieux, Gaigi, Darmon

* **Corresponding author**: Nicole Darmon, UMR MOISA, 2 place Viala, 34060 Montpellier, France. E-mail: nicole.darmon@inra.fr

List of abbreviations: CIQUAL: Centre d'Information sur la Qualité des Aliments; HFSS: foods high in fat/salt/sugar; MAR: mean adequacy ratio; NQP: nutritional quality for price, RDA: recommended dietary allowance; SED: solid energy density, SFA: saturated fatty acid

Sources of Support: This work was funded by the Regional Health Agency in the Provence Alpes Côte d'Azur Region (ARS PACA) and the French National Cancer Institute (INCA). The funding bodies had no role in the protocol design, analysis or interpretation of the data, writing the manuscript, or the decision to submit the manuscript for publication.

Short running head: Improving nutritional quality of food purchases

Clinical Trial Registry number: This trial was registered at clinicaltrials.gov as NCT02383875

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

Abstract

Background: Food prices influence food choices. Purchasing foods with higher nutritional quality for their price may help improve the diet quality of socio-economically disadvantaged individuals.

Objective: To describe the co-construction and evaluation of the 'Opticourses' prevention program promoting healthy eating among participants in deprived socio-economical situations by improving the nutritional quality of their household food purchases with no additional cost.

Methods: Individuals were recruited in poor districts of Marseille, France. The intervention and evaluation tools and protocols were co-constructed with 96 individuals. Then, 93 adults willing to participate in a standardized intervention comprising five participative workshops on "diet and budget" were enrolled. Impact on food purchases was estimated with experimental economics: 2-days experimental food purchase intents were observed at baseline and endline for workshop participants (WP, n=35) and controls (n=23), using monetary incentives to limit social-desirability bias. Changes in food and nutrient content and energy cost (€/2000kcal) of experimental purchases were assessed.

Results: Participative workshops including playful activities around food purchase practices and nutritional quality, taste and price of foods were co-constructed. Experimental purchases contained a large amount of energy at baseline for both WP and controls (5114 and 4523kcal/d.pers). For WP only, the mean energy content decreased between baseline and endline (−1729 kcal/d.pers, $p<0.01$, medium effect size: Cohen's d=0.5), and percentage energy from free sugars and from foods high in fat, sugar and salt also decreased (both $p<0.05$ and medium effect sizes), while energy cost remained unchanged. No significant changes between baseline and endline were observed for controls.

Conclusion: After the intervention, the energy content of participants' experimental purchases was closer to their needs, suggesting that workshops helped them to plan and

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

rationalize their food purchases better. Nutritional quality of the experimental purchases increased but not energy cost, showing that the co-constructed ‘Opticourses’ prevention program can favorably change food purchasing behaviors of socio-economically disadvantaged individuals with no additional cost.

Keywords: Intervention; low-income; diet; nutritional quality; food purchasing behavior; experimental economics; cost; food prices

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

Introduction

The diets of the most socially disadvantaged individuals in industrialized countries are characterized by low intakes of fruit and vegetables, and by an overall poorer nutritional quality (1). This is partly explained by the high price per calorie ratio of fruits and vegetables compared with that of high-fat high-sugar products (2,3). Socially disadvantaged individuals perceive food prices as a barrier to adopting healthier diets (4,5). It is especially important for these populations to develop strategies to achieve good nutritional quality with a small budget. An intervention targeting socially disadvantaged populations must take into account their actual beliefs and expectations. A co-construction approach is thus recommended, involving participants at each step of the intervention, in order to maximize its impact (6,7).

It is more difficult to have a balanced diet with a low food budget (8), and a minimal food budget (estimated at around 3.5€/d.person in France) is strictly needed to design diets that are both nutritious and socially acceptable (9,10). When the food budget is low but above this critical threshold, designing a balanced diet involves favoring a selection of foods with good nutritional quality for their price (11). Additionally, for a given food product, replacing national brands by generic products can lower cost without impairing nutritional quality. Branded products have been found to be up to four times more costly than generic products with equivalent nutritional contents (12,13).

Experimental economics is a powerful methodology for evaluating the impact of a public policy. The principle is to bring participants revealing their real choices by using incentive-compatible mechanisms (14). In nutrition, experimental economics has been used for *ex ante* evaluations of policies such as taxes and subsidies or nutritional labeling systems (15–18).

Evaluating the impact of an intervention is a key step that has to be rigorous, feasible and controlled (19,20). However, when nutrition prevention interventions are evaluated, the methodology generally used exhibits limitations due to declarative and social desirability bias

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

(21–23). To reduce such bias, the present study implemented a framed field experiment (24) to evaluate the impact of the intervention on food purchasing behavior.

The Opticourses project is multi-factorial, territorial and participative. It was implemented in disadvantaged neighborhoods in Marseille (France) with the aim of improving the nutritional quality of food purchases in populations with budgetary constraints (25,26). The project addressed both the supply side, through an in-store intervention (27), and the demand side, through a prevention program based on participatory workshops. By focusing on household food supply, a daily activity that everyone knows and feels able to handle, the Opticourses program is engaging and pragmatic, in accordance with the principles of health promotion (28). The objective of the current study was to describe the co-construction of the Opticourses program with participants in deprived social situations and the evaluation of its impact on the nutritional quality and cost of household food purchases, using experimental economics.

Methods

Population characteristics

Recruitment of socio-economically disadvantaged individuals was carried out in community centers (*n*=9) and health & care centers (*n*=2) whose staff showed interest in the intervention and motivation to be involved. All were located in socio-economically deprived districts of Marseille, France. The participants volunteered to take part in an intervention that included a set of five two-hour workshops on “Diet and Budget”. Inclusion criteria were: voluntary consent to participate in the study, residence in a socio-economically deprived district of Marseille (13th, 14th or 15th district), involvement in household food purchases, and financial difficulties as assessed by social workers. All the participants gave their written informed consent to participate in the study. No institutional review board approval was required for this research, as stated by the Comité de Protection des Personnes Sud-Méditerranée, which

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

reviewed the protocol of the Opticourses intervention. This trial was registered at clinicaltrials.gov as NCT02383875.

Co-construction of protocol and tools

To maximize its effectiveness, the intervention was designed on the basis of the principles of co-construction and participative research. Participants were involved in the elaboration of the intervention, in order to implement a non-binding, playful intervention tailored to the target population. This co-construction approach integrates the principles of health promotion (28) and social cognitive theory (29). It was applied to develop the protocol, and the tools of the intervention and evaluation process. The intervention tools were developed through an iterative process (**Figure 1**): initial proposition of a tool by the research team, based on operational objectives, participants' expectations expressed in early workshops, estimated feasibility and cost; design of a first version by the research team; testing of the first version by the participants during the workshops and collection of information, both qualitative (understanding, participants' opinion, time of use) and quantitative (test answers, consistency of results); development of improved versions that were re-tested; validation and finalization. Different versions of the intervention protocol were also tested in the co-construction stage. The standardized tools and protocol were then used in the intervention stage.

Intervention

The Opticourses workshops aimed at guiding the participants toward household food purchases of good nutritional quality at no additional cost, building on better knowledge of food groups and nutritional quality of foods, awareness of foods combining good nutritional quality with a "fair price", knowledge and know-how sharing among participants (discussions on "tips and tricks", beliefs about food, recipes, etc.), collection of all the household food supply over a month (26), and advice based on the analysis of actual participants' food purchase practices.

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

The standardized protocol resulting from the co-construction stage took the form of five two-hour workshops held every two weeks, except for the last workshop, mainly dedicated to evaluation, held one month after the fourth workshop. Workshops were group sessions (6–12 participants) organized in the community or health & care centers, and led by a professional in health promotion and nutrition and dietetics. An assistant took charge of data collection and helped in conducting the workshops. The workshops were built on real food purchases, including participants' household purchase receipts they collected over a month. Complete information on the Opticourses program content was provided during the first workshop, so that individuals not interested could decide to not attend the subsequent workshops. The main activities set during workshops were: discussions about food purchase strategies; information on the characteristics of food groups using a food group categorization game; information on the nutritional quality of foods using a game where food was classified into four nutritional quality classes based on the SAIN,LIM nutrient profile system (30); overview of the notion of nutritional quality for price (NQP) based on a list of foods with both good nutritional quality and a low price within each food group, and the "fair price booklet" tool (31) (tool providing a list of foods with good nutritional quality and the price below which the product could be considered as relatively inexpensive); analysis of real food purchases by the participants using a game consisting in classifying food expenditure by food groups; working on beliefs about food using a tasting game (participants blindly compared the taste of commonly consumed foods of equivalent nutritional quality but of different prices and brands). During the fourth workshop, after an analysis of monthly household food receipts, the research team gave individual feedback to participants on the nutritional quality of their food purchases and the contribution of each food group to total food expenditure, and offered advice on how to improve the nutritional quality of their food purchases at no additional cost.

Quantitative evaluation

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

Evaluating the impact of the intervention on knowledge

Two tools were developed to evaluate the impact of the intervention on knowledge: the "food group test" and "NQP test". Both tests were taken voluntarily by the participants, before and after the intervention. In the "food group test", the participants were asked to assign a color code (e.g., green for fruit and vegetables, blue for dairy products, etc.) to 14 foods pictures. In the "NQP test", 10 pairs of foods were presented to the participants, each pair made up of foods differing in their NQP. Each pair was composed either of similar foods with a similar price but different nutritional content (e.g. whole-grain sliced bread at 1.75€ per kg *vs*. white sliced bread at 1.73€ per kg), or foods belonging to the same food group, with similar prices and different nutritional quality (e.g. canned chickpeas at 1.62€ per kg *vs*. frozen fried potatoes at 1.64€ per kg), or foods with similar nutritional quality but different prices (e.g., two types of potato flakes at 3.90 € per kg (National brand) or 1.78 € per kg (Discount version)), or two different foods (i.e., of different nutritional quality) but consumed similarly during meals (e.g. sweet flan at 2.60€ per kg *vs.* fruit compote at 2.75€ per kg). Participants were instructed to pick the food in each pair they would advise a friend to buy when he/she wants to balance his/her food purchases with a limited budget. For both tests, a global score was computed as the total points obtained from correct answers (wrong or non-responses were ignored).

Evaluating the impact of the intervention on food purchasing behavior using experimental economics

A catalogue of 300 food items (http://www.opticourses.fr/node/24) was specifically developed for the study, based on prices and pictures of foods collected a few months before the intervention from a supermarket located in the participants' neighborhood. Each page displayed pictures of food front packages, unit prices (€) and prices per kilo, as done in supermarket advertising catalogues. Use of the same catalogue ensured that participants were

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

faced with the same supply and diversity of foods throughout the study. Foods were grouped in the catalogue according to a retail-based categorization (22 categories, **Supplemental Table 1**). The participants' task consisted in selecting foods for the next two days for their household, based on food items featured in the catalogue. This selection constituted a food purchase intent. Just as when doing their regular shopping, participants were free to choose the nature and amount of food they wanted to select. To avoid potential bias related to the declarative nature of these purchase intents, the task was made incentive-compatible, by informing participants that they could earn a 10€ coupon if their next food purchases in a real store reflected their purchase intent during the experiment. They were thus prompted to shop in the experiment as they would in a real food store. At the following workshop, shopping receipts of real food purchases brought by participants were confronted with their experimental food purchases. To get the coupon, the shopping receipts had to feature at least six items corresponding to the experimental purchase intents. The objective of this incentive was to assess true changes in food purchase behaviors by limiting the effects of social desirability, i.e. when participants direct their choices to please or impress the workshop facilitator. Workshop participants (intervention group) took part in two experimental sessions (at the first and last workshops), and the changes in their experimental purchases were compared between baseline and endline. In addition, to assess if having already performed the test affects the experimental purchases of the subsequent session, a control group composed of 23 persons recruited in the same community centers, but who did not participate in the workshops, also took part in two experimental sessions of food purchase intents at three-week intervals (baseline and endline), based on the same instructions and protocol than workshop participants i.e. using the catalogue and incentive with coupon.

Our hypothesis was that workshops could help improving the balance of food purchases, and consequently their nutrient content, with no additional cost. Thus, the nutritional

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

characteristics of the experimental purchases were assessed both at the food group and nutrient levels. For that purpose, each food in the catalogue was associated with a nutritional composition for 100g of food as consumed, based on the French CIQUAL database (Centre d'Information sur la Qualité des Aliments, https://pro.anses.fr/tableciqual/index.htm) that states the nutritional composition and edible portion of French food products. Total weight (grams per day per person) and total energy content (kcal per day per person) were estimated for each experimental purchase by summing the weight (as consumed) and energy content of all the foods and drinks selected, and dividing it by the number of household members and days for which purchases were planned. In addition to the classification into 22 categories relevant to the retail environment, as mentioned previously, all foods in the catalogue were classified into 8 groups (Starch, Fruit and Vegetables, Meat-Fish-Eggs, Dairy products, Fats, Foods high in fat/salt/sugar (HFSS), Mixed dishes, and Juices and soft drinks) derived from the French National Nutrition and Health Program (32). Contribution of these 8 food groups to total food purchases was estimated in weight and energy. Water was excluded from all the analyses since it was mainly tap water.

The Mean Adequacy Ratio (MAR) and the Solid Energy Density (SED) were used to assess the nutritional quality of the experimental food purchases, as previously described by Vieux *et al.* (33). In addition, three nutrients to be limited were also assessed, namely sodium, saturated fatty acids (SFAs) and free sugars. The nutritional quality assessment methodology is fully described in Supplemental File.

Based on experimental food purchases selected by the participants and food prices from the catalogue, the total expenditure (€/pers*d) and energy cost (€ per 2000kcal) were estimated for each experimental food purchase.

Qualitative evaluation

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

How the participants perceived the impact of the workshops on their food purchases was assessed by a qualitative evaluation. Individual semi-directed interviews and one group interview were conducted by an external evaluator one month after the intervention, using an interview grid including questions about modification of food purchases. These interviews were proposed to participants coming from the different community or health centers, yielding a sub-sample of 19 interviews. Interviews were recorded using field notes and transcribed. Interview transcriptions were analyzed using conventional content analysis (34) and categorized thematically.

Statistical analysis

Descriptive and statistical analyses were performed using the SAS 9.4 software. Socio-demographic characteristics were compared (a) between workshop participants who performed the experimental economics quantitative evaluation (evaluated intervention group) *vs.* those who did not (non-evaluated intervention group), and (b) between intervention *vs.* control groups using the non-parametric chi-squared test for qualitative variables and the Mann-Whitney test for continuous variables. Within the evaluated intervention group, the scores of the 'Food group' and 'NQP' tests, and the nutritional characteristics and food composition of the experimental purchases were compared between baseline and endline (i.e. before *vs.* after the intervention) using a paired *t*-test and a generalized linear mixed model for repeated measures (with a compound symmetry covariance matrix) for adjustment on age, gender, the financial situation, number of individuals in the household and number of children. Within the control group, the nutritional characteristics and food composition of experimental food purchases were compared between the first and second session of experimental food purchases (i.e., baseline *vs.* endline) using paired *t*-tests as well with a generalized linear mixed model for repeated measures for adjustment on age, gender, the financial situation, number of individuals. Effect sizes for dependent groups (Cohen's d (35))

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

were computed for significant variables. The significance level was set at 5% ($p < 0.05$) for all the tests.

Results

Characteristics of the population

In all, 96 persons (9 groups, 8 centers) participated in the co-construction stage (September 2012–April 2013). Then, 93 persons (14 groups, 7 centers) took part in the intervention stage, with intervention in site 1 starting in April 2013 and intervention in site 7 ending in June 2014. Thirty-five persons took part in the evaluation of knowledge and in the food purchase experiment, i.e. 38% of the intervention participants; 23 other persons (3 sites) also took part in the food purchase experiments, but without participating in the workshops (control group) (**Supplemental Figure 1**). Socio-demographic characteristics were not significantly different between the workshop participants who completed the evaluation and those who did not (**Table 1**). Evaluated workshop participants were mainly women (77%), with a mean age of 51y and a mean number of household members of 3.1, including 1.3 children; 44% declared severe financial difficulties (**Table 1**). Socio-demographic characteristics were not significantly different between evaluated workshops participants and the control group, except for age, which was significantly lower in the control group (45.4y *vs.* 50.9y, p=0.038) (**Table 1**). Participation rates in the five workshops varied (**Figure 2**): 94% of intervention participants attended the first workshop, and the participation rate then remained relatively stable (40–48%) over the following four workshops.

Impact on knowledge

Scores obtained in the “food group test” were significantly higher after the participative workshops than those obtained before the intervention (13.2 ± 1.8 and 12.1 ± 1.9 respectively, p<0.01). Scores of the “NQP test” were not significantly different before and after the intervention (6.6 ± 1.4 and 6.9 ± 1.6, respectively, p=0.30).

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

Impact on food purchasing behavior: experimental economics evaluation

Table 2 shows the nutritional characteristics and cost of experimental food purchases of workshops participants before and after the intervention. The energy content of the experimental food purchases significantly decreased by 38% after the participative workshops (5114 *vs.* 3385 kcal per person per day, $p<0.01$ for both crude and adjusted p-values), as did the food expenditure (9.73 vs 7.22 € per person per day, $p<0.01$ for both crude and adjusted p-values). However, energy cost remained unchanged. The SED decreased from 128 kcal/100g to 119 kcal/100g after the intervention (crude $p<0.04$), i.e. a reduction of 7.6%, but the significance was lost after adjustment. The MAR did not change significantly. The energy contribution of free sugars decreased significantly from 8.5% to 5.8% ($p<0.01$ for both crude and adjusted p-values), while that of SFA and sodium content expressed for 2000kcal remained similar. The contribution of food groups to the total energy of the experimental purchases was significantly different at baseline and endline (**Table 2**). Percent energy from the HFSS group was halved (from 11.0 to 5.5%, $p<0.01$ for both crude and adjusted p-values). In parallel, a decrease occurred in the energy contribution from fruit and vegetables (from 10.1 to 13.6% of total energy, crude p=0.03) and from meat-fish-eggs (from 15.8 to 21.1% of total energy, crude p=0.02,), but the statistical significances of those changes were lost after adjustment (adjusted p=0.06 for both food groups). Based on the classification proposed by Cohen (36), the calculated effect sizes (d) were medium for energy content (d=0.5) and the energy contributions from proteins (d=0.6), free sugars (d=0.5), meat-fish-eggs (d=0.5) and HFSS (d=0.5). Effect sizes were small for the food expenditure (d=0.4), the SED (d=0.3) and the energy contribution from fruits and vegetables (d=0.4) (**Table 2**).

In the control group, none of the characteristics of experimental food purchases were significantly different between the two sessions (all $p>0.05$, **Table 3**). In particular, the mean

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

280 energy contents were 4523 and 4711 kcal/pers*d at baseline and endline respectively
281 (p=0.71).

282 **Qualitative evaluation**

283 The analysis of participants' declarations highlighted their improved knowledge about the
284 nutritional quality of foods (e.g., the difference in nutritional quality between potatoes and
285 vegetables, and between sweet dairy desserts and yogurts), and their awareness of the share of
286 their food budget allocated to the different food groups. Fifteen out of the 19 participants
287 interviewed 1 month after the intervention gave concrete examples indicating how they had
288 modified their food purchase behavior. The analysis of participants' declarations identified
289 three types of modification: changes in the type of foods purchased, changes in purchasing
290 attitudes and strategies, and changes in culinary practices. Among changes in the type of
291 foods purchased, soft drinks were the most frequently cited. One person in three declared they
292 had reduced or even stopped their purchases of sodas and/or replaced their purchases of fruit
293 'nectars' (i.e. sugared fruit juices) by fruit juices. Other modifications of foods purchased
294 were expressed in terms of quantity (e.g. increased legumes or fruits and vegetables
295 purchases) and quality (e.g. substitution of white bread by whole-grain bread). The changes in
296 purchasing attitudes and strategies included more attention paid to labeled information
297 (product composition and price per kilo), changes and/or diversification of purchasing points,
298 improved opinion of cheaper brand products, retrieval and purchases of these products, and
299 better control of food budget. The changes in culinary practices included cooking oneself, or
300 cooking differently (e.g., less fat, more vegetables). The following synthesis of transcripts
301 illustrates the different modifications to food purchase behaviors:
302 *"Now, after shopping for food, I still keep the receipts. They help me check if I've managed*
303 *my budget well. I look at the price per kilo of foods and don't get confused with orange juices*
304 *anymore (sugar and fruit). I've bought canned fish, and several times I've prepared some*

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. . DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

lovely dishes with raw vegetables and sardines. When I'm cooking starches, I add some fresh vegetables. I shared the tips and tricks with my friends who by the way have noticed that I've changed the way I cook." (Female, 51y)

"I buy too much fat, I've cut back a bit. I buy more fruit and vegetables, it doesn't get too expensive for me, I do my shopping at Noailles [very popular market in the center of the town]. *I already used to, but I wasn't buying much fruit and legumes. I also buy more legumes (red beans and lentils). I used to shop at Dia or Simply markets and now I go to Carrefour, the other participants told me it's less expensive and it's true. I pay more attention to labels and especially the price per kilo" (Female, 46y).*

"I buy cheaper brand products, before I never did because I thought they were poorer quality. I know how to tell the real juices from the ones with only sugar: I buy the real ones and I don't buy sodas anymore. I buy whole-grain bread instead of white bread. For minced meat, I look and I take no more than 12% fat, 5% I can't, it's too expensive. I've changed many things, I spend 330€ (per month) instead of 360€ before, so it's a bit cheaper and I'm purchasing better things. I use more different oils, I like canola oil, I blend them. I also try to add less salt. I used to buy a lot of sweet products. I buy a bit more fish, beef and chicken and less pork. I diversify shops a bit (Aldi, Leader Price) but I don't have a car, it's not easy." (Female, 51y)

Participants were able to analyze their own food purchases and identify ways to improve them, as supported by several transcripts: "*I realized the burden of sweet products in my food budget" (group interview); "For me it's easy since I save money and it's a true motivation" (Female, 59y); "Now I look at what I purchase, I used not to necessarily" (group interview); "I look differently when I do my shopping" (Female, 42y); "I look at labels more carefully, especially the price per kilo."(Female, 53y).*

Discussion

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

The present study shows that co-constructed participative workshops based on recreational-entertaining activities around food purchase practices and nutritional quality and price of foods can favorably change food purchasing behaviors of individuals in deprived social situations without significantly increasing their food expenditure. Interviews revealed three types of change in purchasing behaviors: changes in the type of foods purchased, changes in purchasing attitudes and strategies (attention paid to label information, purchasing points, and opinion on cheaper brand products), and changes in culinary practices. Quantitative evaluation of the intervention was performed on food purchase intents using experimental economics to limit social desirability bias. Unlike controls, workshop participants decreased the total energy of their experimental food purchases (toward more realistic energy levels), suggesting a better ability to assess the needs of their households for 2 days and adapt purchases accordingly. The evaluation also showed that the intervention improved food purchasing behaviors, as indicated by decreased energy contribution from free sugars and from products high in fat, salt, and sugar, and nearly significant increased energy contribution from fruit and vegetables (adjusted p-value=0.06) at the endline in the intervention group only, and at no additional cost.

Similar reduction in the total number of calories purchased were previously observed in low-income families in the US who received home-based nutrition education sessions (37). To our knowledge, most individual-directed interventions to promote healthy eating are based on activities around food consumption or cooking skills (38–40). Yet, changing food consumption behavior implies changing food purchasing behavior. An originality and asset of the present study was to use food purchases and prices as an entry point to address the question of healthy diet with individuals in deprived social situations. Implementing workshops on food purchases a major daily, tangible concern for this population – rather

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. . DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

than on food intake can induce a stronger motivation of the participants, which is a success factor for interventions in health education (6).

Many population-directed policies designed to improve the nutritional quality of food purchase rely on enhancing access to information (41). The underlying assumption is that people act rationally when making food choices. In economics jargon, rationality means that consumers maximize their lifetime happiness when they allocate their scarce resources of time and money (42). Nonetheless, various studies have shown that the provision of nutritional information has moderate effects (41,43–46). The main reason may be that consumers do not behave as *Econ* (47). For instance, consumers have a limited capacity to process information and may even be distracted when provided with additional information (48). In that respect, the Opticourses workshops focused on tacit knowledge (*know-how*) rather than explicit knowledge (*know-what*). With tips & tricks on food purchasing (fair price booklet, real purchase analyses), the intervention provided participants with practical knowledge on how to build healthy diets. By doing so, the Opticourses workshops provide participants with the necessary tools for fast and frugal food decision making, allowing the construction of healthier diets despite bounded rationality (49).

Different reports and studies explored the levers for effective interventions on diet, in particular for socioeconomically disadvantaged populations (6,7,20,38–40,50,51). A WHO report assessing the evidence on effective interventions on diet and physical activity (7) underlined that multi-component interventions adapted to the local context and involving participants in the planning and implementation stages were found to be the most successful. Co-construction was a key component of the present study to engage participants, with a specific attention given to the format of the intervention to be both playful, with multiple, diversified activities, and with reachable goals. Empowerment is known to be a success factor in health promotion in the field of nutrition (50). This is particularly true for vulnerable

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

379 populations, who are more prone to low self-esteem (20). The present workshops enabled
380 participants to appropriate tools and knowledge to act favorably on their purchases, thus
381 enhancing auto-efficacy and self-esteem. Moreover, conducting the intervention in the form
382 of group workshops has been identified as a key lever to improve the effectiveness of
383 interventions promoting nutrition and physical activity among socioeconomically
384 disadvantaged populations (51).
385 Interventions promoting healthy eating are generally evaluated through self-reported and so
386 potentially biased dietary intakes or behaviors (40,52). The experimental economics approach
387 has already been used in public health and nutrition to assess food tax (15) and labeling
388 policies (17). To our knowledge, the present study is the first to implement this approach in an
389 innovative way to evaluate the impact of a nutritional intervention in a real setting.
390 Experimental economics limits social desirability bias, and so reveals true consumer
391 preferences by using incentive mechanisms (53). Also, placing participants under controlled
392 conditions, as close as possible to those of the real world, ensured that the observed changes
393 in purchasing behavior were not influenced by modifications in the purchasing environment
394 (diversity and price of food supply, purchasing points, etc.). In addition, the conditions of
395 implementation of the evaluation method were tailored for a target population with potentially
396 low literacy skills. While questionnaires could be perceived as demanding, normative and
397 difficult to fill out, the food catalogue and instructions given placed the participants in a
398 comfortable day-to-day activity that preserved their self-esteem. The main strength of this
399 study is that it improved food purchasing behaviors despite the limited room for maneuver in
400 terms of economical means. Participants had a low budget for food (previously estimated at
401 3.65€/pers*d (26)), very close to the lowest cost at which a nutritionally adequate diet can be
402 achieved (~3.5€/pers*d) as estimated by Darmon et al. (9), and very close to the cost of
403 2000kcal of experimental food purchases in the present study. The beneficial changes in food

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

404 purchasing behaviors could be explained by the anticipation and rationalization of food
405 purchasing highlighted by the decrease in the total energy of experimental food purchases
406 after the intervention. Workshop participants may have realized the importance of the act of
407 purchase, and of purchasing foods rationally rather than automatically/routinely.
408 The present study has limitations. In the intervention stage, attrition rate was approximately
409 50% after the first workshop. This was expected, because recruitment is known to be difficult
410 in low-income populations (20,54). The high attrition rate may reflect a sensible economic
411 decision about the time/benefit ratio of attending the workshops (42). However, the
412 participation rate in the following workshops, once the participants had understood and agreed
413 with the format and contents of the intervention, remained stable, which highlights the
414 importance of providing complete information and engaging people during the first workshop.
415 Another limitation is that the quantitative evaluation was only performed by a sub-sample of
416 intervention participants, was not randomized, and did not assess the long-term effect of the
417 intervention. However, the participants who carried out the quantitative evaluation (n=35)
418 were not significantly different in terms of socio-demographic characteristics from those who
419 did not (n=58), the specificity of the observed changes were tested with a control group
420 (n=23), and the sample sizes were sufficient to highlight significant differences between the
421 control and intervention groups. In addition, the endline experimental food purchases of the
422 control group were assessed after a shorter interval of time (3 weeks) than the intervention
423 group (10 weeks). This may have introduced a bias in the design but allowed to limit the
424 attrition rate that might have been higher in control after 10 weeks. Also, the evaluation tools
425 were new and not quantitatively validated, but face validity was assessed by researchers and
426 participants who evaluated whether the items were relevant to assess the measured concept,
427 and acceptability and feasibility were tested with the co-construction group. Finally, the size
428 of the effects was medium or small. However, moderate effects were expected since it is

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

unlikely that an intervention on its own induces radical shifts in food purchase behaviors. These moderate effects can comfort the idea that social desirability bias was limited and that participants revealed true choices.

The present study shows that co-constructed participative workshops, based on actual food purchase practices, can guide individuals in deprived social situations towards household food purchases of better nutritional quality without increasing their food expenditure. It shows relevance and feasibility of using experimental economics for evaluating the impact on food purchasing behavior of a public health nutrition intervention conducted in a real setting. The "game-like" aspect of the experimental economics approach enables participants to deliver unbiased evaluations, while preserving their self-esteem.

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

Acknowledgments

We thank the scientists, dieticians, project manager and assistants who helped carry through the Opticourses project, and all the study participants.

Conflict of interest: The authors declare that they have no conflict of interest.

Authors' contributions: ND, CD and HG designed and conducted the intervention. MP, CD and ND interpreted the data and drafted the manuscript. MM and RG analyzed the data. LM and BR designed the experimental economic assessment and were involved in the interpretation of the results. All authors critically reviewed the manuscript and approved the final version.

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. . DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

References

1. Darmon N, Drewnowski A. Does social class predict diet quality? Am J Clin Nutr. 2008;87:1107–17.
2. Drewnowski A, Darmon N. The economics of obesity: dietary energy density and energy cost. The American journal of clinical nutrition. 2005. p. 265S–273.
3. Maillot M, Darmon N, Darmon M, Lafay L, Drewnowski A. Nutrient-dense food groups have high energy costs: An econometric approach to nutrient profiling. J Nutr. 2007;137:1815–20.
4. Beydoun MA, Wang Y. How do socio-economic status, perceived economic barriers and nutritional benefits affect quality of dietary intake among US adults? Eur J Clin Nutr. Nature Publishing Group; 2008;62:303–13.
5. 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. BioMed Central; 2010;7:44.
6. Peters L, Molleman G, Hommels L, Ploeg M, Hosman C, Jané-Llopis E. Outil de pilotage et d'analyse de l'efficacité attendue des interventions en promotion de la santé. Preffi 2.0. Guide explicatifs, les fondements de Preffi. Institut pour la Promotion de la Santé et pour la Prévention des Maladies (NIGZ), editor. Woerden, Pays-Bas; 2003.
7. WHO. Interventions on diet and physical activity .What works? 2009;1–48.
8. Darmon N, Drewnowski A. Contribution of food prices and diet cost to socioeconomic disparities in diet quality and health: a systematic review and analysis. Nutr Rev. 2015;73:643–60.
9. Darmon N, Ferguson EL, Briend A. Impact of a cost constraint on nutritionally adequate food choices for French women: an analysis by linear programming. J Nutr

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

475 Educ Behav. 2006;38:82–90.
476 10. Maillot M, Darmon N, Drewnowski A. Are the lowest-cost healthful food plans
477 culturally and socially acceptable? Public Health Nutr. 2010;13:1178–85.
478 11. Maillot M, Ferguson EL, Drewnowski A, Darmon N. Nutrient profiling can help
479 identify foods of good nutritional quality for their price: a validation study with linear
480 programming. J Nutr. 2008;138:1107–13.
481 12. Cooper S, Nelson M. “Economy” line foods from four supermarkets and brand name
482 equivalents: a comparison of their nutrient contents and costs. J Hum Nutr Diet.
483 2003;16:339–47.
484 13. Darmon N, Caillavet F, Joly C, Maillot M, Drewnowski A. Low-cost foods: how do
485 they compare with their brand name equivalents? A French study. Public Health Nutr.
486 2009;12:808–15.
487 14. Harrison GW. Making Choice Studies Incentive Compatible. In: Kanninen BJ, editor.
488 Valuing Environmental Amenities Using Stated Choice Studies. Springer Netherlands;
489 2006. p. 67–110.
490 15. Darmon N, Lacroix A, Muller L, Ruffieux B. Food price policies improve diet quality
491 while increasing socioeconomic inequalities in nutrition. Int J Behav Nutr Phys Act.
492 BioMed Central; 2014;11:66.
493 16. Crosetto P, Muller L, Ruffieux B. Helping consumers with a front-of-pack label:
494 Numbers or colors? J Econ Psychol. 2016;55:30–50.
495 17. Muller L, Ruffieux B. Modification des achats en réponse à l’apposition de différents
496 logos d’évaluation nutritionnelle sur la face avant des emballages. Cah Nutr Diététique.
497 2012;47:171–82.
498 18. Crosetto P, Muller L, Ruffieux B. Réponses des consommateurs à trois systèmes
499 d’étiquetage nutritionnel face avant. Cah Nutr Diététique. 2016;51:124–31.

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

19. Cambon L, Minary L, Ridde V, Alla F. Transferability of interventions in health education: a review. BMC Public Health. 2012;12:497.

20. INSERM. Inégalités sociales de santé en lien avec l'alimentation et l'activité physique. Inégalités sociales de santé en lien avec l'alimentation et l'activité physique. 2014. 329-370 p.

21. Fisher RJ. Social Desirability Bias and the Validity of Indirect Questioning. J Consum Res. 1993;20:303–15.

22. Hebert JR, Clemow L, Pbert L, Ockene IS, Ockene JK. Social Desirability Bias in Dietary Self-Report May Compromise the Validity of Dietary Intake Measures. Int J Epidemiol. 1995;24:389–98.

23. Norwood FB, Lusk JL. Social Desirability Bias in Real, Hypothetical, and Inferred Valuation Experiments. Am J Agric Econ. 2011;93:528–34.

24. Harrison GW, List JA. Field Experiments. J Econ Lit. 2004;42:1009–55.

25. Darmon N, Gaigi H, Dubois C. Opticourses [Internet]. [cited 2016 Jul 11]. Available from: http://www.opticourses.fr/

26. Marty L, Dubois C, Gaubard MS, Maidon A, Lesturgeon A, Gaigi H, Darmon N. Higher nutritional quality at no additional cost among low-income households : insights from food purchases of "positive deviants." Am J Clin Nutr. 2015;102:190–8.

27. Gamburzew A, Darcel N, Gazan R, Dubois C, Maillot M, Tomé D, Raffin S, Darmon N. In-store marketing of inexpensive foods with good nutritional quality in disadvantaged neighborhoods: increased awareness, understanding, and purchasing. Int J Behav Nutr Phys Act. 2016;13:104.

28. World Health Organization. Ottawa Charter for Health Promotion. First International Conference on Health Promotion. Ottawa, Canada; 1986.

29. Albert Bandura. Health Promotion by Social Cognitive Means. Heal Educ Behav.

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

2004;31:143–64.

30. Darmon N, Vieux F, Maillot M, Volatier J-L, Martin A. Nutrient profiles discriminate between foods according to their contribution to nutritionally adequate diets: a validation study using linear programming and the SAIN,LIM system. Am J Clin Nutr. 2009;89:1227–36.

31. Dubois C, Gaubard MS, Darmon N. Identification des aliments de bon rapport qualité nutritionnelle/prix pour le projet de recherche interventionnelle OPTICOURSES. Inf Diététique. 2015;2:21–33.

32. Hercberg S, Chat-Yung S, Chauliac M. The French National Nutrition and Health Program: 2001-2006-2010. Int J Public Health. 2008;53:68–77.

33. Vieux F, Soler L-G, Touazi D, Darmon N. High nutritional quality is not associated with low greenhouse gas emissions in self-selected diets of French adults. Am J Clin Nutr. 2013;97:569–83.

34. Hsieh H-F, Shannon SE. Three Approaches to Qualitative Content Analysis. Qual Health Res. 2005;15:1277–88.

35. Dunlap WP, Cortina JM, Vaslow JB, Burke MJ. Meta-analysis of experiments with matched groups or repeated measures designs. Psychol Methods. 1996;1:170–7.

36. Cohen J. Statistical power analysis for the behavioral sciences. L. Erlbaum Associates; 1988. 567 p.

37. Cortés DE, Millán-ferro A, Schneider K, Vega RR, Caballero AE. Food Purchasing Selection Among Low-Income, Spanish-Speaking Latinos. Am J Prev Med. Elsevier Inc.; 2013;44:S267–73.

38. McGill R, Anwar E, Orton L, Bromley H, Lloyd-Williams F, O'Flaherty M, Taylor-Robinson D, Guzman-Castillo M, Gillespie D, Moreira P, et al. Are interventions to promote healthy eating equally effective for all? Systematic review of socioeconomic

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

inequalities in impact. BMC Public Health. BioMed Central; 2015;15:457.

39. Oldroyd J, Burns C, Lucas P, Haikerwal A, Waters E. The effectiveness of nutrition interventions on dietary outcomes by relative social disadvantage: a systematic review. J Epidemiol Community Heal. 2008;62:573–9.

40. Reicks M, Trofholz AC, Stang JS, Laska MN. Impact of cooking and home food preparation interventions among adults: outcomes and implications for future programs. J Nutr Educ Behav. Elsevier; 2014;46:259–76.

41. Downs JS, Loewenstein G, Wisdom J. Strategies for Promoting Healthier Food Choices. Am Econ Rev. 2009;99:159–64.

42. Cawley J. An economic framework for understanding physical activity and eating behaviors. Am J Prev Med. 2004;27:117–25.

43. Bassett MT, Dumanovsky T, Huang C, Silver LD, Young C, Nonas C, Matte TD, Chideya S, Frieden TR. Purchasing Behavior and Calorie Information at Fast-Food Chains in New York City, 2007. Am J Public Health. 2008;98:1457–9.

44. Burton S, Creyer EH, Kees J, Huggins K. Attacking the Obesity Epidemic: The Potential Health Benefits of Providing Nutrition Information in Restaurants. Am J Public Health. 2006;96:1669–75.

45. Finkelstein EA, Strombotne KL, Chan NL, Krieger J. Mandatory Menu Labeling in One Fast-Food Chain in King County, Washington. Am J Prev Med. 2011;40:122–7.

46. Harnack LJ, French SA, Oakes JM, Story MT, Jeffery RW, Rydell SA. Effects of calorie labeling and value size pricing on fast food meal choices: Results from an experimental trial. Int J Behav Nutr Phys Act. 2008;5:63.

47. Kahneman D. Maps of Bounded Rationality: Psychology for Behavioral Economics. Am Econ Rev. 2003;93:1449–75.

48. Simon HA. A Behavioral Model of Rational Choice. Q J Econ. 1955;69:99–118.

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

575 49. Gigerenzer G. Fast and Frugal Heuristics: the Tools of Bounded Rationality. Blackwell
576 Handbook of Judgment and Decision Making. D. Koehler. 2004. p. 62–88.
577 50. Brandstetter S, Rüter J, Curbach J, Loss J. A systematic review on empowerment for
578 healthy nutrition in health promotion. Public Health Nutr. 2015;1–9.
579 51. Ball K. Traversing myths and mountains: addressing socioeconomic inequities in the
580 promotion of nutrition and physical activity behaviours. Int J Behav Nutr Phys Act.
581 2015;12:142.
582 52. Perez-Escamilla R, Hromi-Fiedler A, Vega-Lopez S, Bermudez-Millan A, Segura-
583 Perez S. Impact of Peer Nutrition Education on Dietary Behaviors and Health
584 Outcomes among Latinos: A Systematic Literature Review. J Nutr Educ Behav.
585 2008;40:208–25.
586 53. Harrison GW, Rutström EE. Experimental Evidence on the Existence of Hypothetical
587 Bias in Value Elicitation Methods (Chapter 81). In: Smith CRP and VL, editor.
588 Handbook of Experimental Economics Results. Elsevier; 2008. p. 752–67.
589 54. Corbie-Smith GM. Minority recruitment and participation in health research. N C Med
590 J. 2004;65:385–7.
591

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. . DOI : 10.3945/cdn.117.001107

Version postprint

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

592 **Tables**

593 Table 1. Population characteristics

594

	Co-construction (*n*=96)		Intervention (*n*=93)				Control (*n*=23)		
			Evaluated (*n*=35)		Non-evaluated (*n*=58)		*p*-value[1]		*p*-value[2]
Age, y (*n*)	48.4 ± 7.7	(67)	50.9 ± 11.2	(34)	47.0 ± 13.0	(27)	0.094	45.4 ± 9.6 (23)	0.038
Number in household (*n*)	3.7 ± 2.0	(62)	3.1 ± 1.8	(35)	2.3 ± 1.4	(25)	0.080	3.3 ± 1.6 (23)	0.186
Number of children (*n*)	2.0 ± 1.7	(59)	1.3 ± 1.5	(35)	1.2 ± 1.4	(22)	0.941	1.6 ± 1.3 (23)	0.135
Women, % (*n*)	80.0	(96)	77.1	(35)	70.7	(58)	0.496	91.3 (23)	0.163
Financial situation, % (*n*)		(48)		(34)		(17)		(23)	
Stable	12.5		11.8		17.7		0.770	13.0	0.932
Precarious	52.1		44.1		47.1			47.8	
Severe difficulties	35.4		44.1		35.3			39.1	

Results are mean ± SD or %, [1] from Chi-squared test of homogeneity for qualitative variables and Mann and Whitney test for continuous variables to test difference between participants who did *vs.* did not complete the evaluation; [2] from Chi-squared test of homogeneity for qualitative variables and Mann and Whitney test for continuous variables to test difference between evaluated intervention participants *vs.* controls.

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

595 Table 2. Nutritional and cost characteristics of experimental food purchases of workshops
596 participants (*n*=35) before the intervention (baseline) and after it (endline).

597

	Baseline	Endline	*p*-value[1]	Adjusted *p*-value[2]	Effect size[3]
Energy (kcal/pers*d)	5114 ± 3883	3385 ± 2374	<0.01	<0.01	0.5
Expenditure (€/pers*d)	9.73 ± 7.10	7.22 ± 4.78	<0.01	<0.01	0.4
Energy cost (€/2000kcal)	3.03 ± 1.45	3.44 ± 2.00	0.30	0.36	
SED (kcal/100g)	128.4 ± 25.5	118.7 ± 30.1	0.04	0.10	0.3
MAR (% adequacy/2000 kcal)	81.3 ± 8.5	82.1 ± 7.4	0.56	0.42	
Proteins (% of total energy)	18.7 ± 4.3	21.5 ± 5.6	<0.01	0.02	0.6
Carbohydrates (% of total energy)	52.7 ± 9.7	49.7 ± 10.7	0.11	0.08	
Free sugars (% of total energy)	8.5 ± 6.0	5.8 ± 6.1	<0.01	<0.01	0.5
Fats (% of total energy)	25.5 ± 7.1	25.4 ± 8.1	0.94	0.65	
SFA (% of total energy)	10.7 ± 3.9	10.6 ± 4.2	0.95	0.72	
Sodium (mg/2000 kcal)	2038 ± 430	2182 ± 754	0.20	0.13	

Food group	Baseline	Endline	*p*-value[1]	Adjusted *p*-value[2]	Effect size[3]
Fruits and Vegetables (% of total energy)	10.1 ± 5.8	13.6 ± 10.0	0.03	0.06	0.4
Starch (% of total energy)	43.4 ± 19.7	40.8 ± 19.0	0.44	0.47	
Meat Fish Eggs (% of total energy)	15.8 ± 9.1	20.1 ± 9.6	0.02	0.06	0.5
Mixed dishes (% of total energy)	1.9 ± 3.3	2.6 ± 4.8	0.29	0.13	
Dairy products (% of total energy)	12.3 ± 7.7	13.2 ± 9.2	0.56	0.43	
HFSS (% of total energy)	11.0 ± 12.0	5.5 ± 11.0	<.01	0.01	0.5
Drinks (% of total energy)	3.9 ± 3.8	2.9 ± 4.1	0.11	0.15	
Fats (% of total energy)	1.6 ± 2.3	1.3 ± 2.5	0.55	0.63	

598 Results are mean ± SD or %; [1] from paired *t*-test; [2] from mixed model adjusted for age, gender,
599 financial situation, number in household, number of children; [3] Calculation of effect size
600 (Cohen's d) for dependent sample was described elsewhere (35)
601 HFSS: Foods high in fat, sugar, salt; MAR: Mean adequacy ratio; SED: Solid energy density;
602 SFA: Saturated fatty acids
603
604

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

605 Table 3. Nutritional and cost characteristics of experimental food purchases of the control
606 group (*n*=23) during the first session (baseline) and the second session (endline)

607

	Baseline	Endline	*p*-value[1]	Adjusted *p*-value[2]
Energy (kcal/pers*d)	4523 ± 2924	4711 ± 2747	0.71	0.63
Expenditure (€/pers*d)	8.75 ± 5.13	8.84 ± 4.43	0.90	0.94
Energy cost (€/2000kcal)	3.17 ± 1.38	3.06 ± 1.36	0.77	0.71
SED (kcal/100g)	136.8 ± 23.9	136.3 ± 020.3	0.91	0.90
MAR (% adequacy/2000kcal)	80.2 ± 07.2	80.9 ± 06.2	0.56	0.77
Proteins (% energy)	17.1 ± 04.8	17.5 ± 03.2	0.61	0.91
Carbohydrates (%energy)	49.9 ± 08.0	50.6 ± 07.4	0.74	0.56
Fats (% energy)	30.2 ± 05.8	29.2 ± 05.9	0.55	0.61
Free sugars (% energy)	11.4 ± 04.5	11.7 ± 05.1	0.79	0.74
SFA (% energy)	13.6 ± 03.6	12.9 ± 02.9	0.43	0.79
Sodium (mg/2000kcal)	1976 ± 0460	1887 ± 0310	0.23	0.55
Food group	**Baseline**	**Endline**	***p*-value[1]**	**Adjusted *p*-value[2]**
Fruits and Vegetables (% of total energy)	8.7 ± 6.0	8.0 ± 5.3	0.39	0.39
Starch (% of total energy)	34.3 ± 10.4	35.2 ± 13.5	0.82	0.82
Meat Fish Eggs (% of total energy)	11.4 ± 07.7	12.2 ± 07.2	0.51	0.51
Mixed dishes (% of total energy)	3.3 ± 3.5	3.4 ± 3.0	0.93	0.93
Dairy products (% of total energy)	15.3 ± 05.1	16.3 ± 05.0	0.52	0.52
HFSS (% of total energy)	18.4 ± 08.7	17.0 ± 11.2	0.56	0.56
Drinks (% of total energy)	5.7 ± 3.1	5.6 ± 3.6	0.79	0.79
Fats (% of total energy)	2.9 ± 2.5	2.4 ± 2.4	0.44	0.44

608 Results are mean ± SD or %; [1] from paired *t*-test; [2] from mixed model adjusted for age, gender,
609 financial situation, number in household, number of children
610 HFSS: Foods high in fat, sugar, salt; MAR: Mean adequacy ratio; SED: Solid energy density;
611 SFA: Saturated fatty acids
612

613

614

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

615 **Figure legends**

616 Figure 1. Principles of the co-construction approach

617 Figure 2. Participation rate at each workshop during the intervention stage (n=93)

618

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. . DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

619 **Online Supporting Material**

620 **Supplemental Table 1: Food categorization of the experimental purchase catalogue**

Food categories
Fruits and Vegetables
Canned vegetables
Legumes
Frozen vegetables
Breads
Meat
Processed meat
Fish
Prepared dishes
Mashed and fried potatoes
Rice, pasta, semolina
Sauces
Eggs and Cream
Cheese
White cheese
Yogurts and milk
Desserts
Chocolate and sweets
Biscuits
Pastries
Salted snacks
Juices and Drinks

621

622 **Supplemental method: Nutritional quality of food purchases**

623 The MAR was used as an indicator of nutritional quality, as previously described by Vieux *et*
624 *al.* (1), to evaluate if the workshops helped improve the nutritional content of food purchases
625 for a whole set of nutrients. The MAR, expressed for 2000 kcal, was calculated as the mean
626 percentage of daily recommended intakes for 23 key nutrients (proteins, fiber, Ca, K, Fe, Mg,
627 Zn, Cu, I, Se, DHA, ALA, LA and vitamins A, C, D, E, B1, B2, B3, B6, B9 and B12), as
628 follows:

$$MAR/2000\text{ kcal} = \frac{1}{23}\sum_{bn=1}^{23}\frac{Q_{bn}}{RDA_{bn}} \times 100$$

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

where Q_{bn} is the quantity of each beneficial nutrient (*bn*) adjusted to a total energy of 2000 kcal, and RDA_{bn} is the corresponding Recommended Dietary Allowance (RDA) for this nutrient. The age and gender being known for the study participants but not for each member of their households, the average value of the RDA for adult men and women has been used. The reference values for the 23 recommended nutrients are given in **Supplemental Table 2**. The contribution from each nutrient was capped at 100% so that a high intake of one nutrient could not compensate for the low intake of another (1). The SED, calculated as the ratio between total energy and total weight and expressed in kcal/100g was also used as an indicator of nutritional quality. As proposed by Ledikwe *et al.* (2), only items typically consumed as foods, including soups, were included in the calculation of SED, whereas foods typically consumed as beverages, such as milk, juices, and other drinks, were excluded. Three nutrients to be limited were also assessed, namely sodium (expressed in mg/d*pers and mg/2000kcal), saturated fatty acids (SFAs) and free sugars, both expressed in percentage of total energy. The term “free sugars” refers to added sugars plus sugars naturally present in honey, syrups, and fruit juices (3). The free sugar content of each food item had previously been added to the CIQUAL database (4).

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

647 **Supplemental Table 2**. Reference values for the 23 recommended nutrients used in the

648 calculation of the Mean Adequacy Ratio

Nutrient	Reference value[1]
Proteins (g/d)	60
DHA (mg/d)	0.11
Fiber (g/d)	30
Linolenic acid (g/d)	1.8
Linoleic acid (g/d)	9
Vitamin A (mcg/d)	700
Vitamin B6 (mg/d)	1.7
Vitamin D (mcg/d)	5
Thiamin (mg/d)	1.2
Riboflavin (mg/d)	1.6
Niacin (mg/d)	13
Folates (mcg/d)	315
Vitamin B12 (mcg/d)	2.4
Vitamin C (mg/d)	110
Vitamin E (mg/d)	12
Calcium (mg/d)	900
Potassium, (mg/d)	3100
Magnesium, (mg/d)	390
Iodine (mg/d)	150
Selenium (mcg/d)	55
Copper (mg/d)	1.8
Zinc (mg/d)	11
Iron (mg/d)	13

[1] Mean of the recommended dietary allowances for men and women (5)

649

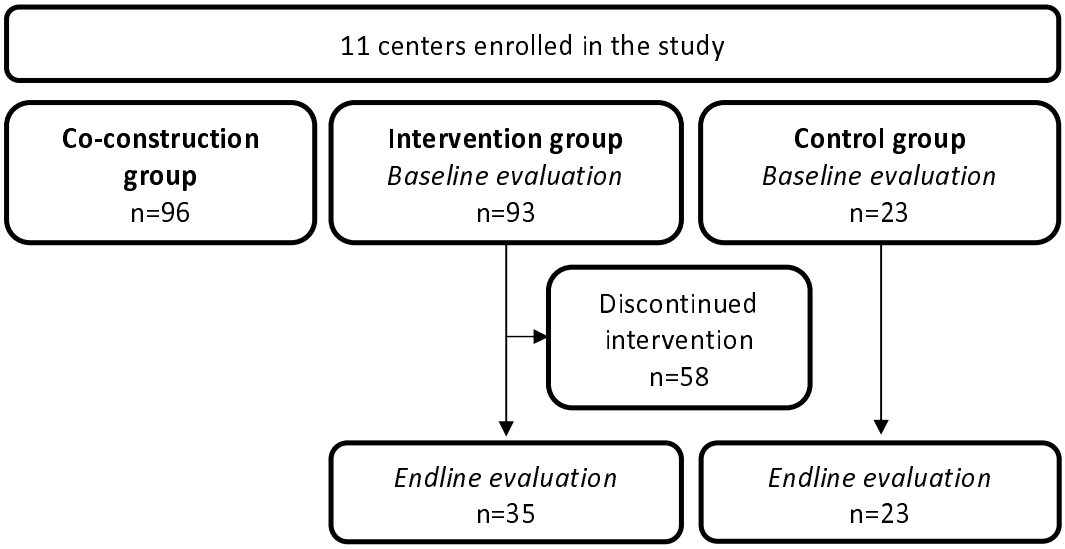
650

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. . DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

651 **Supplemental Figure 1**: Flow chart of the study



652

653 **Supplemental References**

654 1. Vieux F, Soler L-G, Touazi D, Darmon N. High nutritional quality is not associated
655 with low greenhouse gas emissions in self-selected diets of French adults. Am J Clin
656 Nutr. 2013;97:569–83.

657 2. Ledikwe JH, Blanck HM, Khan LK, Serdula MK, Seymour JD, Tohill BC, Rolls BJ.
658 Dietary energy density determined by eight calculation methods in a nationally
659 representative United States population. J Nutr. 2005;135:273–8.

660 3. World Health Organization. Diet, Nutrition, and the Prevention of Chronic Diseases:
661 Report of a Joint WHO/FAO Expert Consultation. WHO technical report series 916.
662 Geneva, Switzerland: WHO; 2003.

663 4. Bocquier A, Vieux F, Lioret S, Dubuisson C, Caillavet F, Darmon N. Socio-economic
664 characteristics, living conditions and diet quality are associated with food insecurity in
665 France. Public Health Nutr. Cambridge University Press; 2015;1–10.

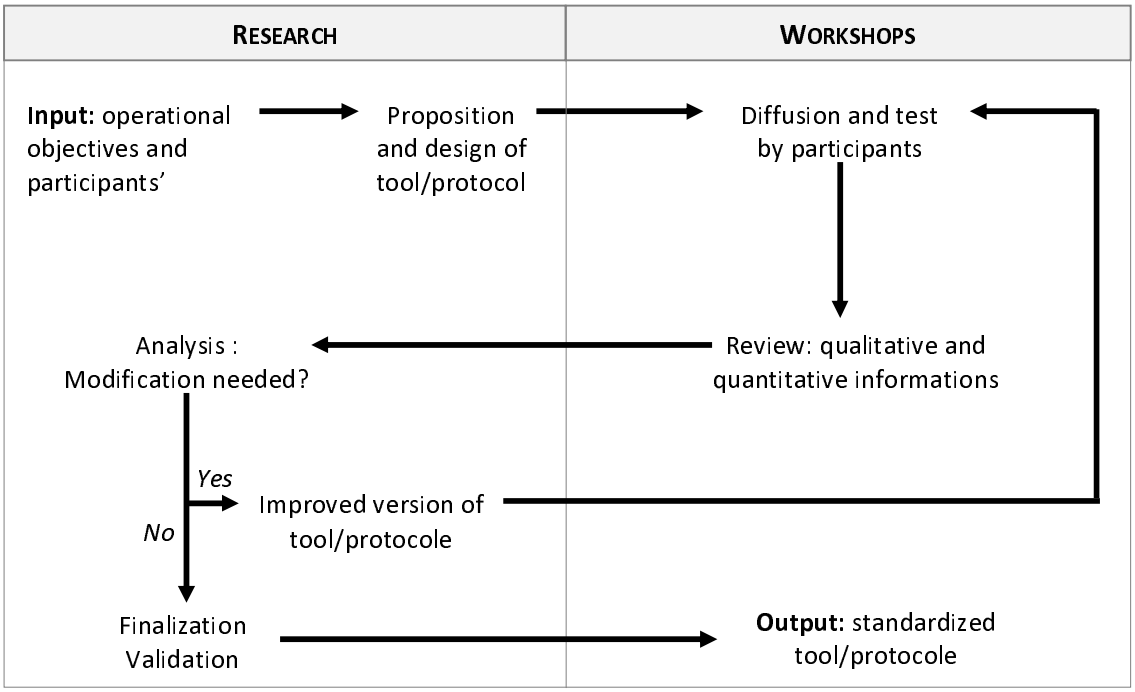
666 5. Martin A. Apports nutritionnels conseillés pour la population française. 3ème édition
667 [Recommended nutritional intakes for the French population]. AFSSA. Paris, France:
668 Lavoisier; 2001. 660 p.

Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

Figure 1.

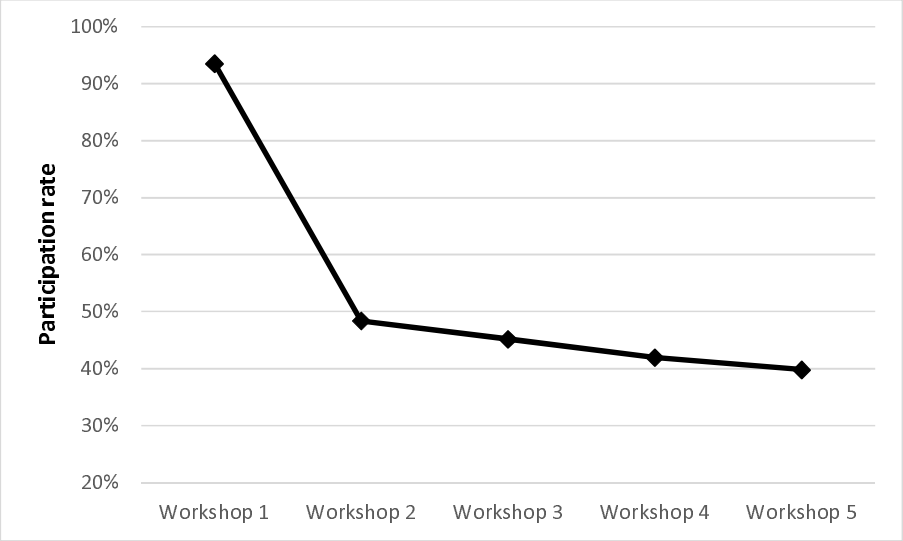


Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107

Downloaded from cdn.nutrition.org on October 17, 2017 - First published online on September 13, 2017 in Current Developments in Nutrition. DOI: 10.3945/cdn.117.001107

Figure 2.



Version postprint

Comment citer ce document :
Perignon, M., Dubois, C., Gazan, R., Maillot, M., Muller, L., Ruffieux, B., Gaigi, H., Darmon, N. (2017). Co-construction and evaluation of a prevention program for improving the nutritional quality of food purchases at no additional cost in a socio-economically disadvantaged population. Current Developments in Nutrition, 1 (10), 1-10. , DOI : 10.3945/cdn.117.001107