Nudging and social marketing techniques encourage employees to make healthier food choices: a randomized controlled trial in 30 worksite cafeterias in The Netherlands

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ABSTRACT

Background: Currently, many studies focus on how the environment can be changed to encourage healthier eating behavior, referred to as choice architecture or "nudging." However, to date, these strategies are not often investigated in real-life settings, such as worksite cafeterias, or are only done so on a short-term basis.

Objective: The objective of this study is to examine the effects of a healthy worksite cafeteria ["worksite cafeteria 2.0" (WC 2.0)] intervention on Dutch employees' purchase behavior over a 12-wk period.

Design: We conducted a randomized controlled trial in 30 worksite cafeterias. Worksite cafeterias were randomized to either the intervention or control group. The intervention aimed to encourage employees to make healthier food choices during their daily worksite cafeteria visits. The intervention consisted of 14 simultaneously executed strategies based on nudging and social marketing theories, involving product, price, placement, and promotion.

Results: Adjusted multilevel models showed significant positive effects of the intervention on purchases for 3 of the 7 studied product groups: healthier sandwiches, healthier cheese as a sandwich filling, and the inclusion of fruit. The increased sales of these healthier meal options were constant throughout the 12-wk intervention period.

Conclusions: This study shows that the way worksite cafeterias offer products affects purchase behavior. Situated nudging and social marketing–based strategies are effective in promoting healthier choices and aim to remain effective over time. Some product groups only indicated an upward trend in purchases. Such an intervention could ultimately help prevent and reduce obesity in the Dutch working population. This trial was registered at the Dutch Trial Register (http://www.trialregister.nl/trialreg/admin/rctview.asp?TC=5372) as NTR5372. *Am J Clin Nutr* 2018;107:236–246.

Keywords: food choice behavior, nudging, overweight, randomized controlled trial, social marketing

INTRODUCTION

Most food choices are made automatically (1–3). However, currently, the "obesogenic environment" makes it very difficult not to succumb to the temptations of highly caloric and palatable foods and, as a result, makes it difficult not to consume more than the body requires (4). Despite the awareness of this health threat and the presence of interventions to enhance people's lifestyles (5–9), the worldwide prevalence of excessive body weight, including in European countries such as The Netherlands, is high. For example, in 2016, 50.2% of Dutch adults were classified as overweight (10). In addition to targeting individuals who are willing to change their behavior, another approach is to redesign the food environment in such a way that it encourages people to automatically make healthy food choices. This could have a longer-lasting effect, because it does not require self-control or cognitive capacity (11) and has the advantage of reaching more people than when recruiting for specific interventions (12).

A food environment qualifying for the study on the effects of such adaptations is the worksite cafeteria. The worksite cafeteria is a typical setting where people seem to have "freedom of choice," because there is no set menu, but where the products offered, combined with impulsive human food choice behavior, are very determining for what customers choose. Most of these decisions are not based on prolonged deliberation, but on quick and automatic heuristic processing (13–17). Furthermore, many people visit a worksite cafeteria daily during their working life, which means that even small changes will ultimately affect people's diets positively (18). For example, a switch from white bread to whole-wheat bread during the average working life of 39.9 y (19) can contribute to one's health by lowering the risk of high blood pressure, stroke, and coronary artery disease (20). Redesigning a food environment, such as a worksite cafeteria, can be referred to as choice architecture or "nudging" (21), the purpose of which is to provoke the desired purchasing behavior by making it more attractive and easier. An example of this is to give more prominence to the placing of healthier snack options than unhealthy snack options (13, 21).

A recent systematic review of 42 studies on the effectiveness of nudging in changing dietary choices of adults toward healthier

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choices showed that nudging strategies resulted in an average increase of 15.3% in healthy nutritional choices (22). However, it must be noted that most of the included studies were conducted in laboratories and were of short duration, often 4 wk (23, 24), and are thus not widely generalizable. For example, most study settings were in laboratories (48%) and only 17% were in canteens.

Logically, there is a need for an intervention in a real-life food environment setting, such as worksite cafeterias as previously indicated. To develop the most effective intervention, it is important to know the target audience. Responding to what moves and motivates them is crucial to elevating the chances for the intervention to be successful (25).

Social marketing is a method that translates the researchers' insights into the target audience to a mix of strategies. These strategies can be subdivided into the so-called 4 P's (product, place, price, and promotion), which categorize strategies according to the target they affect, and coincide with nudging strategies. On the basis of these nudging and social marketing techniques, we developed an intervention named the "worksite cafeteria 2.0'' [WC 2.0; described in **Figure 1** and elsewhere (32)]. WC 2.0 aims to improve the purchasing rate of healthier options, and accordingly the eating behavior, of Dutch employees when visiting their worksite cafeteria. Our study assessed the effect of the WC 2.0 intervention on the purchasing behavior of Dutch employees. The research question guiding this study is as follows: Can nudging and social marketing techniques encourage healthier purchases in worksite cafeterias?

METHODS

Study design

A randomized controlled trial involving 30 worksite cafeterias in The Netherlands was conducted from March to June 2016. The trial contained 2 research arms: the WC 2.0 intervention and the control condition (i.e., no changes to the cafeteria offerings). The development of the intervention and the design of the study have been described previously (32). The measurements in the worksite cafeterias started in mid-March 2016, and lasted for 15 wk. In the first 3 wk, baseline measurements were performed (baseline phase). The intervention was executed during the subsequent 12 wk (intervention phase). We selected worksite cafeterias of companies who outsource catering to a contract catering company. All of the participating catering companies are members of Veneca, the Trade Association for Dutch Catering Companies. This project is a collaboration between Vrije Universiteit Amsterdam and Veneca. The trial was registered at the Dutch Trial Register (NTR5372), and the Medical Ethics Committee of VU University Medical Center Amsterdam confirmed that this study does not apply to the Medical Research Involving Human Subjects Act (WMO), due to the nature of the measurements (sales data and anonymous questionnaires distributed among adults).

Inclusion criteria

Inclusion criteria for worksite cafeterias included the following: *1*) a minimum of 100 lunch customers/d to ensure sufficient sales, *2*) a cash register system that can register separate products to measure sales shifts within product groups, *3*) cash registers must be staffed or all products must be scanned to ensure

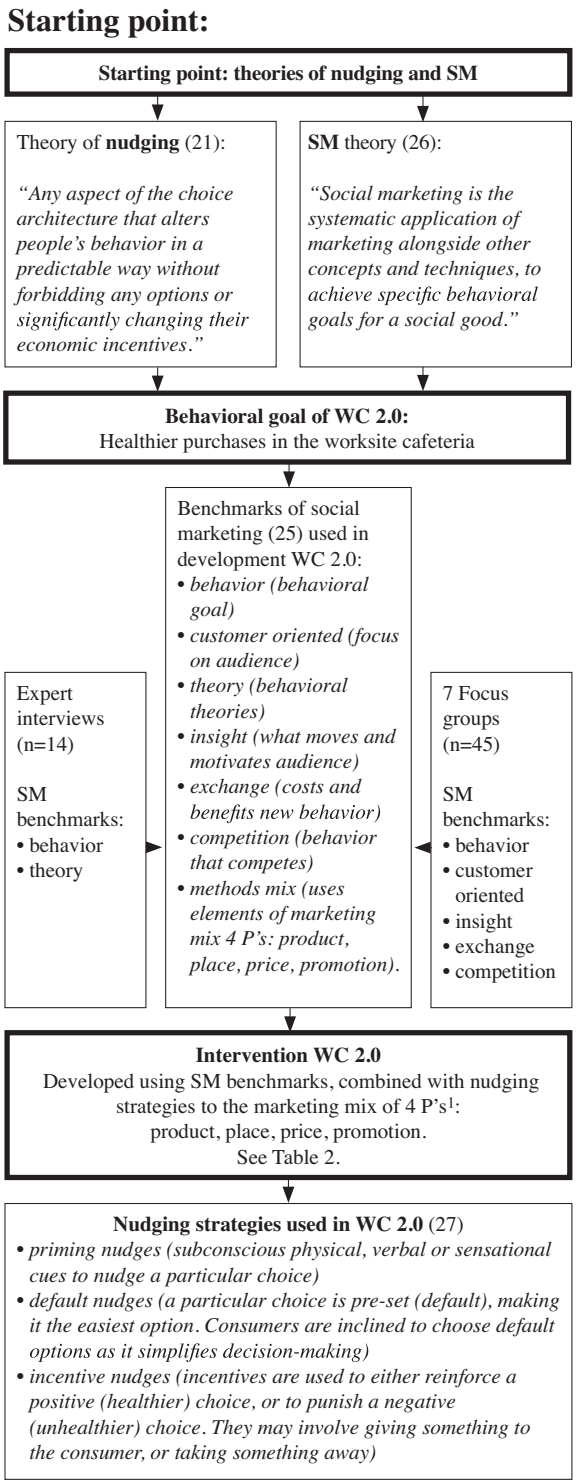

FIGURE 1 Intervention development and theory. [1]4 P's: product, place, price, and promotion, which categorize strategies according to the target they affect and coincide with nudging strategies. For instance, the strategy of placing healthier snack options more prominently fits in the category of "placement" strategies. Furthermore, by using social marketing, the strategy of changing the price can be added. Not all price strategies meet with the conditions of nudging, because a price increase violates freedom of choice by removing an option. Price is however a strong determinant for food purchase behavior, and thereby an important strategy (28–31). SM, social marketing; WC 2.0, worksite cafeteria 2.0.

accurate registration, and *4*) the worksite cafeteria or the company will not organize active nutritional or health campaigns from January 2016 until August 2016 because these could interfere with the effect of the intervention; in addition, the company gives permission to change *5*) the selection of products for 12 wk during the experiment, *6*) the routing in the cafeteria for 12 wk during the experiment, *7*) the price of products for 12 wk during the experiment, *8*) the promotion of products and menus for 12 wk during the experiment, and *9*) measurement of sales data during the study, and permission *10*) to conduct a questionnaire among their employees. Two inclusion criteria were changed during the inclusion phase to ensure the inclusion of a sufficient number of cafeterias. Criterion 1, "a minimum of 100 lunch customers/d", was changed to a minimum of 80 lunch customers/d. Furthermore, in terms of criterion 3, 2 worksite cafeterias with partly self-scanning cash registers, which could result in errors (e.g., missing products), were included. This was due to the high accuracy of registration by customers, compared with registration by cashiers, which was derived from purchase and sales equations. This means that very few items were not charged or deliberately registered as another product, as opposed to when this was done by cash register staff. The information about the accuracy was provided by the account managers, derived from purchase and sales data.

Recruitment

Recruitment started at the end of 2014 by providing all 9 catering companies that were members of the Trade Association for Dutch Catering Companies with information about the study. In June 2015, an article calling for participating worksite cafeterias was published in a hotel and catering industry magazine, and an appeal on a radio station and at a conference for human resource managers was made. Sixty-two companies expressed interest, of which 47 were visited by 1 of the researchers (EV) and the account manager of their catering company to inform them about the study protocol. Ultimately, all 31 worksite cafeterias included were run by 1 of 5 Veneca members. **Figure 2** shows the flowchart of the inclusion. During an intake meeting in the cafeteria, all of the inclusion criteria were checked. Baseline characteristics of participating companies, such as the type of employees (white or blue collar) and the number of daily visitors of the cafeteria, are shown in **Table 1**. Account managers provided this information during the intake meeting before randomization. EV randomly assigned worksite cafeterias to the intervention or control group (controlled by ELV) in blocks, stratified for size ($\geq$500 or <500 visitors/d), by using a Random Number Generator in Microsoft Excel (Microsoft Corporation). Participating companies varied from chemical (6), automotive (1), electronic (5), power engineering (1), food (2), and finance and insurance (5) industries to government institutions (7) and facility and entertainment industries (3). The companies were located across The Netherlands, with most companies ($n = 18$) located in the more urban western area.

Intervention

The WC 2.0 intervention consisted of 14 strategies (see **Table 2**) and was designed to result in the purchasing of healthier

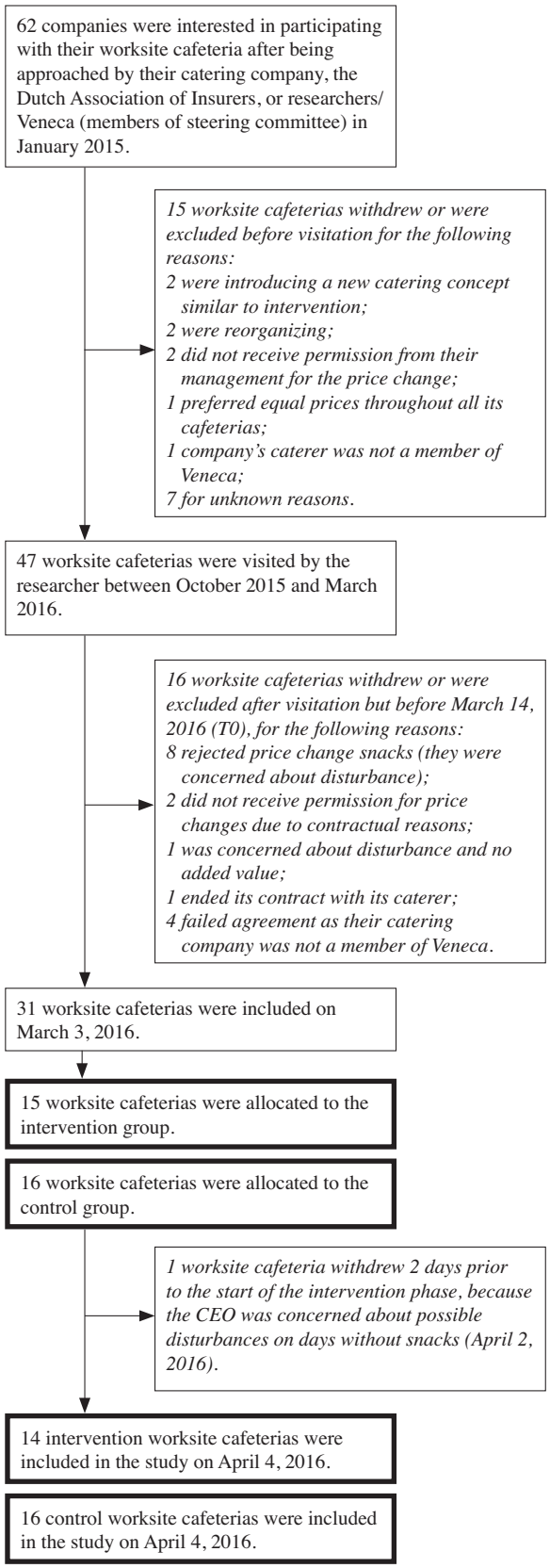

FIGURE 2 Flowchart of inclusion of worksite cafeterias.

TABLE 1
Baseline characteristics of the worksite cafeterias[1]

Characteristics	Intervention group worksite cafeterias ($n = 14$)	Control group worksite cafeterias ($n = 16$)
Daily visitors		
n[2]	235 (90–850)	247 (80–1000)
%[3]	36.5	47.4
White collar,[4] %	82	77
Other eating locations in walking distance,[5] *n* (%)		
Very few	8 (57.1)	7 (43.8)
Reasonable number	4 (28.6)	6 (37.5)
A lot	2 (14.3)	3 (18.8)
Price of sandwich, €	2.66 (1.95–3.49)	2.54 (1.75–3.25)
Price of fried snack, €	0.99 (0.50–1.52)	1.09 (0.55–1.75)
Price of soup, €	0.81 (0.42–1.29)	0.76 (0.40–1.12)
Expenditure per customer, €	3.12 ± 0.26	3.12 ± 0.45

[1] Values are means (ranges) or means ± SDs unless otherwise indicated.
[2] Mean number of daily visitors of the worksite cafeteria.
[3] Daily visitors of the worksite cafeteria as a percentage of all employees working in the company building with this worksite cafeteria.
[4] Percentage of white collar workers compared with blue collar workers.
[5] Distance reachable by foot within 10 min of walking.

food options. The intervention was optimized through focus groups and expert interviews to obtain actual insights into the target audience. This helped us understand the possible effectiveness and feasibility of strategies useful for encouraging the purchasing of healthier options. A detailed description of the emergence and support of this selection of strategies is described elsewhere (32), and Figure 1 shows a schematic overview of the theory and emergence of the intervention. The strategies can be divided into the 4 P's of social marketing (product, place, price, and promotion) that categorize strategies according to the factor on which they have an effect. For instance, the P of "product" comprises strategies affecting the proportion of healthier options available. "Place" strategies involve the placement and the order of food products in the worksite cafeteria. See Table 2 for all strategies. Within all of the intervention worksite cafeterias, new increased prices (snacks) and decreased prices (healthier "better choice" sandwiches, healthier "better choice" salads, and combo deals) were derived from the regular prices. Price increases and

TABLE 2
Intervention strategies[1]

Strategy	Description
Product	
1	In every product category, ≥1 product of "better choice" is visibly offered.
2	A warm lunch meal is also offered in a smaller portion.
3	Fruit and vegetables are offered.
4	Water is offered for free.
5	The visible share of healthy ("better choice") products is ≥60%.
6	Warm snacks[2] are offered ≤3 d/wk.
Place	
7	Healthy products are at the beginning of the route. These products are salads, fruit and vegetables, bread, bread topping, and healthier sandwiches.[3]
8	Of every product group, the "better choice" product or presentation of this product is most visible (at the front at eye level).
9	If there is a shelf at the cash register, it is partly filled with fruit and vegetables; fruit and vegetables are on top or at the front.
Price	
10	A relatively cheap combo deal is offered with milk,[4] coffee, tea, or vegetable juice, a healthier sandwich,[3] and fruit with a price comparable to the average price of a sandwich in the same cafeteria.
11	Prices of warm snacks[2] (e.g., chicken nuggets) are increased by 25% and prices of healthier sandwiches[3] are decreased by 25%.
Promotion	
12	There is only promotion of food products in the "better choice" category (or the Choice criteria for combined meals).
13	When a healthy product is promoted, it has a recognizable, permanent spot in the cafeteria.
14	On the menu (e.g., on displays or Intranet), the healthy products are named first.

[1] Data from reference 32. "Better choice" indicates a product classified as most healthy (relative healthiness) in 1 out of 3 categories within its product group. The classification is based on the amounts of saturated fat and *trans* fat, added sugar, salt, dietary fiber, and overall energy density (20, 33, 34).
[2] Snacks contain all fried snacks such as fries, chicken nuggets, or spring rolls, but also puff pastry snacks such as sausage rolls and cheese rolls.
[3] "Healthier" sandwiches meet the criteria of the Choice logo (34). This category can also be a salad that meets the criteria of the Choice logo (34) (in collaboration with dietitians of all catering companies a list with products is formed).
[4] This can also be buttermilk or a semi-skimmed milk drink without added sugar.

TABLE 3
Product groups and criteria

Product group	Detailed description of product group and criteria
Snacks	Deep-fried snacks and puff pastry snacks (e.g., croquette, French fries, chicken nuggets, spring rolls, sausage rolls of puff pastry)
Fruit	Single pieces of unpeeled fruit and vegetables and portions of snack vegetables
Prepackaged snacks	Chocolate bars, cookies, muffins, granola bars, bags of candy or chips
Healthier ("better choice") sandwich	Sandwiches meeting the guidelines for "better choice" products[1]
Healthier ("better choice") salad	Salads meeting the guidelines for "better choice" products[1]
Healthier ("better choice") cheese	Types of cheese meeting the guidelines for "better choice" products[1] (e.g. low fat cheese with 20% FDM and with 30% FDM, cottage cheese, dairy spread, cheese spread with 30% FDM)
Healthier ("better choice") meat	Meat products meeting the guidelines for "better choice" products[1] (e.g., ham, chicken breast, roast beef)

[1] According to the Guidelines Food Choices (34). FDM, fat in dry matter.

decreases comprised 25% of the baseline prices. The combo deal consisted of a combination of a healthier "better choice" sandwich (or in some cafeterias a healthier "better choice" salad), low-fat milk, and a piece of fruit. This combo deal was available daily and had an overall price discount of 25%. The sandwich or salad was also sold separately at a 25% discount.

Measurements

This project used 3 data collection methods: sales data, a worksite cafeteria scan, and an online questionnaire. All of the measures were quantitative and were performed similarly in both the intervention and control companies. Primary outcome measures were sales data of sandwiches, sandwich fillings, salads, fruit and snack vegetables, snacks, and prepackaged snacks. Sales of these product groups were a direct derivative of the intervention strategies and were objectively measured by obtaining cash register outputs. Over the 15 wk (3 wk before and 12 wk during the intervention), we collected sales data on 30 worksite cafeterias in The Netherlands. Cash register outputs provided data on all products sold per day (between 1130 and 1400) and the number of customers that day (between 1130 and 1400).

We derived secondary outcome measures from the worksite cafeteria scan (hereafter referred to as the "scan"). The scan is a checklist to objectively measure the degree to which the intervention was executed correctly (correct: 1 point; partial: 0.5 points; not executed: 0 points). In the case of the control groups, the scan measures the extent to which the worksite cafeteria already applies the 14 strategies that form part of the bundle of strategies from the WC 2.0 intervention. Both a researcher (EV) and 1 trained research assistant executed these measurements. The assistant's first scans were performed together with the researcher to ensure reliability. Furthermore, interscanner reliability was ensured by using detailed instructions on how to score the execution. For example, for strategy 5 (Table 2), all products were counted, and for every product group it was measured if $\geq$60% of all products within this product group was a healthier ("better choice") option. When not all product groups, but more than half, reached 60%, this strategy was scored as "partially" executed. Furthermore, the researchers discussed all initial scans they performed alone, and discussed scores until there was agreement. During the 12-wk intervention phase, a scan was executed unannounced every 3 wk in the intervention cafeterias. The control cafeterias were instructed not to change anything during the intervention phase.

The questionnaire obtained secondary outcomes from data on the employees visiting the worksite cafeteria. All of the employees were asked to anonymously complete the questionnaire, which was based on validated concepts [vitality is defined based on 3 dimensions, namely: energy, motivation and resilience, and was measured with Vita-16 (35)], during the baseline phase (March 2016) and at the end of the intervention phase (June 2016). Participation was voluntary. Satisfaction of the employees with the worksite cafeteria was gauged by scoring an overall mark (1–10) and by answering questions about factors such as products and prices. Examples of these questions are "What do you think of the range of products offered in the worksite cafeteria?" and "What do you think of the price of the products offered in the worksite cafeteria?" These characteristics were measured on a 5-point Likert scale in line with the question. Answer options were as follows: very good, good, neutral, poor, very poor and very cheap, cheap, not expensive/not cheap, expensive, very expensive, or I don't know. In addition, the purchase or use of some products targeted by the intervention was monitored by questions, including "Does the worksite cafeteria offer free drinking water? If so, how often do you take a glass of water?" Self-reported demographic variables were also collected. These included age (years), sex (male or female), body weight (kilograms), height (centimeters), level of education [primary school or basic vocational education (low educational level), secondary vocational education or high school degree (medium educational level), or higher vocational education or university degree (high educational level)], household size (number of adults and children), frequency of having lunch at the worksite cafeteria (1, 2, 3, 4, or 5 times/wk; $<$1 time/wk; or never), and the proportion of lunch purchased in the worksite cafeteria (whole lunch, part of lunch, or nothing).

Statistical analysis

Sales

We collected sales data for all of the worksite cafeterias and recorded them in Excel files (Microsoft Corporation). In these records, all products were recoded into product categories. For instance, the products "banana," "apple," and "orange" were grouped together in the "single piece of fruit" product category. All of the products in assigned product categories as analyzed in this study are shown in **Table 3**. These product groups were chosen because prepared sandwiches, snacks, and bread combined

with separate toppings or fillings, such as cheese, are common lunch items in Dutch worksite cafeterias (36). The composition of a Dutch lunch differs from American lunches in that bread, rather than a hot meal, is mostly consumed. Furthermore, the intervention strategies also targeted healthy products, such as fruit, and unhealthy products, such as prepackaged snacks like candy. In Table 2, strategy 10 (i.e., a "combo deal") was introduced to the intervention cafeterias. When the total combination of products included in the combo deal was purchased, it was registered as a combo deal. The separate sales of the "healthier choice sandwich" and "healthier choice salad" that could also be purchased within the combo deal are represented in the sales of the product groups "healthier ("better choice") sandwich" and "healthier ("better choice") salad". After allocating all of the products to product categories, sales numbers were merged. In SPSS (IBM SPSS Statistics 23), zeros were added to the data set where no sale took place. Daily sales data of all product groups were calculated into weekly sales, divided by the number of customers during that week, and multiplied by 100 to determine sales per 100 customers/wk.

To evaluate the intervention effect, we performed a multilevel regression analysis (MLwiN version 2.36) for each primary outcome measure. We used multilevel analysis because of the hierarchical structure of the data (i.e., weekly measures were clustered within a worksite cafeteria, and worksite cafeterias were clustered within catering companies). We analyzed data according to the intention-to-treat principle (instead of a per-protocol analysis) and used a linear mixed model analysis with 3 levels: "*i*", time ($n = 15$ measuring points, 1 for each week); "*j*", worksite cafeterias ($n = 30$), and "*k*", catering companies ($n = 5$).

Repeated measures (15 wk) were clustered within cafeterias ($n = 30$), and cafeterias were clustered within catering companies ($n = 5$). For all levels, the inclusion of a random intercept was considered on the basis of the likelihood ratio test (37). A significance level of 0.05 was maintained for all analyses, 2-sided. For the combo deal, no regression analysis was performed because the control cafeterias did not introduce a combo deal.

Scan

For all 14 strategies, it was recorded whether they were executed correctly (correctly: 1 point; partial: 0.5 points; not executed: 0 points). The mean score of correctly executed strategies from those applicable are presented to give insight into the degree of implementation of the intervention. Given the short time slots to perform scans (i.e., just before lunchtime, 1130), control cafeterias were not visited during the intervention phase. They were, however, instructed not to change anything in the worksite cafeteria. The account manager of the catering company monitored whether anything was changed in the control cafeterias during the intervention period. We used SPSS version 23 to analyze these data.

Questionnaire

Differences in demographic variables between the intervention and control employees at baseline were tested with chi-square tests and *t* tests with SPSS version 23. At the end of the intervention phase, *t* tests were used to explore differences in the scores of satisfaction between the employees of the intervention and the control companies.

RESULTS

Sales data results

Table 4 shows the mean number of products sold per 100 customers for the intervention group and the control group separately. When corrected for baseline differences, significant differences between intervention and control worksite cafeterias during the intervention phase were noted for sales of healthier sandwiches, healthier cheese, and fruit.

During the intervention, a significantly higher number of healthier ("better choice") sandwiches were sold in the intervention cafeterias than in the control cafeterias (i.e., mean ± SD: 3.3 ± 3.1 compared with 0.9 ± 2.2, respectively) per 100 customers. However, the purchases of regular sandwiches decreased (from 14.2 ± 7.8 to 11.3 ± 7.1) in the intervention cafeterias. In the control group, the sales of this product per 100 customers remained constant (from 13.0 ± 9.3 to 13.4 ± 9.1) (data not shown). The difference in sales of regular sandwiches between the groups was also significant.

For the cheese product group, we observed a significant increase in the purchasing of the "better choice" (low-fat) cheese in the intervention group during the intervention phase compared with the control group (from 1.3 ± 1.7 to 4.8 ± 3.5 compared with 2.3 ± 4.3 to 3.3 ± 7.1, respectively).

The results show that consumers in the intervention group bought an additional 0.7 pieces of fruit per 100 consumers compared with the control group. This difference was significant after correction for baseline differences.

For the 3 product groups showing significant differences between intervention and control cafeterias, we performed further analyses to test for an interaction effect over time. We found no difference in effect between the 2 cafeteria types for healthier choice sandwiches, healthier choice cheese, or fruit. **Figure 3** shows the sales per 100 customers of healthier ("better choice") sandwiches over time. **Figure 4** shows the same for healthier cheese toppings, and **Figure 5** shows the sales for fruit. Figures 3–5 indicate that the effect of the intervention, as seen in elevated sales, stayed constant over the intervention period.

As shown in Table 4, no significant differences between cafeteria types were noted for snacks, prepackaged snacks, healthier "better choice" salads, and healthier "better choice" meat products for bread toppings. During the intervention, a mean ± SE of 1.5 ± 1.4 combo deals per 100 customers was sold (see Table 2, price strategy 10). There was no decrease in the number of customers visiting the intervention cafeterias during the baseline phase (mean ± SD: 785.8 ± 356.3) compared with the intervention phase (772.0 ± 313.0) [$t(14) = 0.608$, $P = 0.553$]. Regression analysis showed that the mean difference in the number of customers between the baseline and intervention phase (between the intervention and control groups) was not significant, corrected for baseline mean customer number.

TABLE 4
Crude and adjusted intervention effects on sales of product groups and the strategies applied per product group[1]

	Number of products sold per 100 customers				Adjusted		
	Control group	Intervention group	Crude β (SE)	Adjusted[2] β (SE)	Lower 95% CI	Upper 95% CI	Strategies applied from Table 2
Snacks							1, 5, 6, 8, 11, 12
Baseline phase[3]	26.7 ± 22.3	28.3 ± 10.6					
Intervention phase[4]	25.3 ± 20.4	23.7 ± 14.3					
Overall effect			−1.64 (6.04)	−3.00 (2.76)	−8.40	2.40	
Fruit[5]							1, 3, 7, 9, 10, 12, 13, 14
Baseline phase[3]	9.1 ± 9.2	6.8 ± 4.6					
Intervention phase[4]	8.7 ± 8.4	9.4 ± 5.6					
Overall effect			0.60 (2.49)	2.70* (0.6)	1.52	3.88	
Prepackaged snacks							1, 8, 9, 12
Baseline phase[3]	3.4 ± 3.7	2.4 ± 2.0					
Intervention phase[4]	3.4 ± 5.2	2.5 ± 3.8					
Overall effect			−0.52 (1.12)	0.15 (0.57)	−0.97	1.26	
Healthier ("better choice") sandwich							1, 5, 7, 8, 10, 11, 12, 13, 14
Baseline phase[3]	1.3 ± 2.7	0.2 ± 0.5					
Intervention phase[4]	0.9 ± 2.2	3.3 ± 3.1					
Overall effect			2.49* (0.83)	3.13* (0.73)	1.70	4.55	
Healthier ("better choice") salad							1, 5, 7, 8, 10, 11, 12, 13, 14
Baseline phase[3]	0.3 ± 0.6	0.1 ± 0.3					
Intervention phase[4]	0.5 ± 1.5	1.2 ± 2.3					
Overall effect			0.68 (0.57)	0.68 (0.57)	−0.43	1.80	
Healthier ("better choice") cheese							1, 5, 7, 8
Baseline phase[3]	2.3 ± 4.3	1.3 ± 1.7					
Intervention phase[4]	3.3 ± 7.1	4.8 ± 3.5					
Overall effect			1.52 (2.05)	2.76* (1.15)	0.51	5.01	
Healthier ("better choice") meat							1, 5, 7, 8
Baseline phase[3]	7.5 ± 7.0	6.8 ± 4.5					
Intervention phase[4]	8.6 ± 10.7	9.2 ± 4.7					
Overall effect			0.65 (3.07)	1.40 (1.63)	−1.80	4.61	

[1] Values are means ± SDs unless otherwise indicated. Results are from multilevel analysis ($n = 30$). Mean sales of product groups for intervention ($n = 14$) and control ($n = 16$) worksite cafeterias during the preintervention baseline phase and intervention phase, and crude and adjusted intervention effects, and the strategies applied per product group. *$P < 0.05$.
[2] The adjusted model was corrected for baseline sales data for that product group.
[3] Mean sales data for 3 wk before the intervention.
[4] Mean sales data for 12 wk of the intervention.
[5] Fruit is the sum of all single pieces of fruit sold, snack vegetables, and the pieces of fruit incorporated in the combo deal.

Scan: compliance with the intervention protocol

Table 5 shows the scores from the scan data at baseline for both the intervention and control cafeterias. It shows the mean number of correctly executed strategies of the mean number of eligible strategies (≤14; see Table 2). Table 5 also shows the results of the scan during the intervention phase in the intervention cafeterias and shows that 77% of the eligible strategies were conducted correctly in the intervention cafeterias. This compliance rate remained stable over the intervention period.

Questionnaire

Results from the questionnaire (T0: $n = 904$; T1: $n = 657$; T0: 53.2% men; T1: 49.3% men) showed only a significant difference between intervention and control group at baseline for the diversity of products offered. Employees in the intervention cafeterias were slightly more positive at baseline than those in the control cafeterias (mean ± SD: 3.70 ± 0.74 compared with 3.58 ± 0.79; $P < 0.05$). After the intervention, no significant difference was found between the 2 groups (3.55 ± 0.82 and 3.47 ± 0.77 for the intervention and control group, respectively).

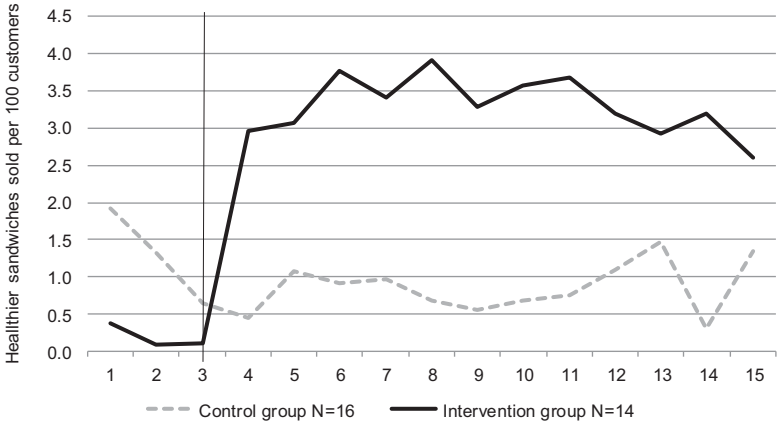

FIGURE 3 Sales of healthier ("better choice") sandwiches over time. The vertical line marks the start of the intervention period (week 4).

Furthermore, the intervention group was marginally less satisfied with the type and diversity of products in the cafeterias after the intervention (mean ± SD: T1 compared with T0—3.77 ± 0.64 and 3.70 ± 0.74 at T0 compared with 3.66 ± 0.66 and 3.47 ± 0.77 at T1, respectively; $P < 0.05$).

DISCUSSION

The WC 2.0 intervention was designed to encourage employees to make healthier choices during their daily worksite cafeteria visits. By conducting 14 nudging and social marketing strategies (77% of which were executed as intended), we aimed to promote the purchasing of healthier lunch products. We found significantly positive effects of the intervention on purchases for 3 of the 7 studied product groups: healthier sandwiches, healthier cheese as sandwich fillings, and fruit. The elevated sales per 100 customers of these healthier food options were constant throughout the 12-wk intervention period. Despite growing consensus that nudging strategies are promising intervention methods to increase healthy food purchases (13, 22, 38, 39), real-life investigations of such interventions are scarce and, to date, the methodologic quality and reporting of these studies have not been optimal (39–41).

To our knowledge, this is the first randomized controlled trial to investigate the effectiveness of a combination of nudging and social marketing strategies exposed to real-life worksite cafeteria customers on a daily basis, thus strengthening its ecological validity. We found that healthier sandwiches were purchased to a greater extent than regular sandwiches, possibly influenced by the extent and range of multiple strategies targeting this product. Healthier sandwiches were displayed more prominently than regular sandwiches, and were promoted as the "sandwich of the day" without explicitly advertising it's "healthiness." In addition, price discounts further promoted these sandwiches and likely contributed to the success of the sale of these sandwiches, because price is a determining factor in purchasing behavior (28–31). For example, a recent review showed that a 10% discount on healthy products resulted in a 12% purchase increase (42). Slightly increased sales of healthier cheese suggest that consumers do not consider the fat content or taste when purchasing cheese. We found that consumers are more greatly influenced by the proportion of visually offered products (60% healthier cheese compared with 40% regular cheese), especially because the price had not been changed. In addition, display placement could have influenced purchases (i.e., healthier cheeses were placed more prominently, at eye level). However, evidence of this is

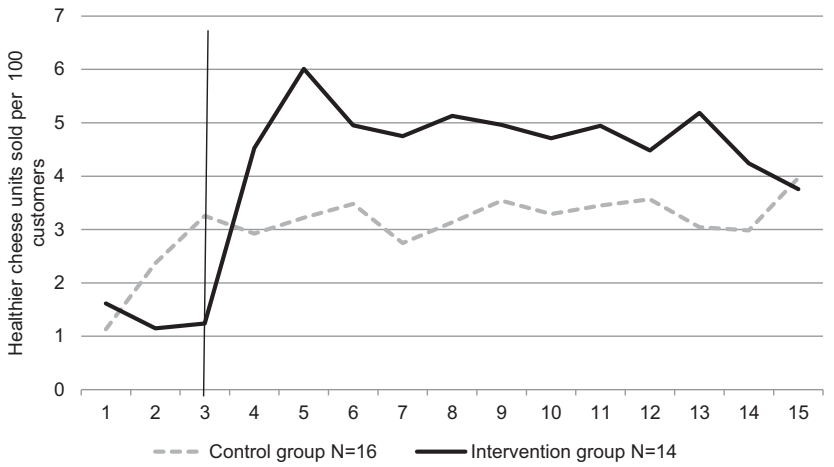

FIGURE 4 Sales of healthier ("better choice") cheese over time. The vertical line marks the start of the intervention period (week 4).

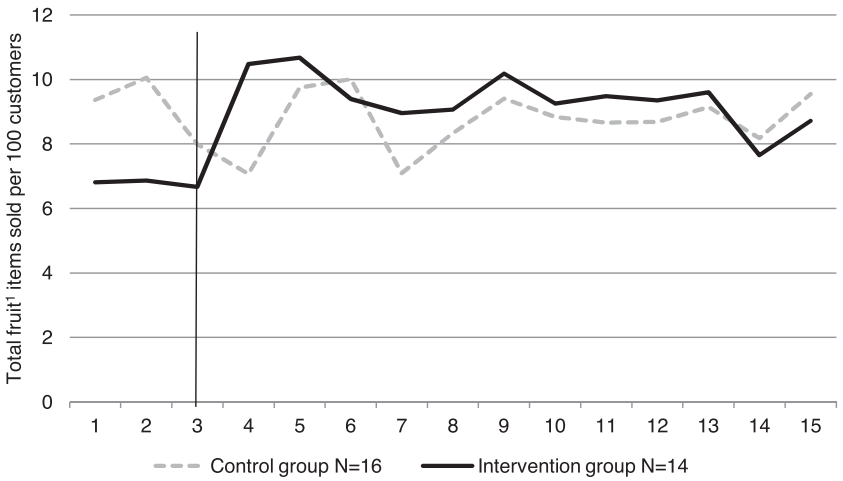

FIGURE 5 Sales of fruit over time. The vertical line marks the start of the intervention period (week 4). [1]"Fruit" is the sum of single pieces of fruit, snack vegetables, and combo deals that also contained a single piece of fruit.

mixed (43, 44). In addition, more fruit (sold separately as well as in combo deals) was sold in the intervention cafeterias than in the control cafeterias during the intervention period. This difference became significant after adjusting for unexplained differences at the baseline. The combo deal discount and prominent placement of fruit at the cash registers may have caused this effect. It must be noted that the effects for all product groups, with the exception of prepackaged snacks, were as expected. For prepackaged snacks, a lack of effect could be a result of these being purchased at times other than at lunchtime. Furthermore, in most participating companies, vending machines with prepackaged snacks were also present. Applying the strategies to vending machines could be advantageous, because their content is easy to adapt.

For snacks, the 25% price increase was not substantial enough to prevent customers from purchasing them. This is in contrast to the findings of the previously mentioned review, which reported a 3% decrease in fast-food sales as a result of a 10% price increase (42). That was, however, the result of only 3 studies in fast-food cafeterias. In worksite cafeterias, snacks are relatively inexpensive compared with prepared products, resulting in a small absolute price increase, and snacks are still a cheap option. Furthermore, offering snacks only 3 d/wk could have resulted in a change in days on which people buy snacks; those who usually buy 2 snacks/wk could still do so, for example. This justifies improving on this strategy by only offering snacks once a week.

The first strength of this study is the length of the intervention (i.e., 12 wk). In many experiments, the exposure to nudge strategies is too short to draw conclusions about the sustainability of the effects (13, 45). Second, the real-life setting is also considered a strength. In laboratory settings, by contrast, only one-time choices are studied. However, exposure to choice-determining factors in the worksite cafeteria is a recurring phenomenon. Other mechanisms could also play a role, because repeated exposure evokes automatic and habitual behavior (1). A real-life setting also provides a realistic view of implementation, increasing the chance of implementation for health promotion. Third, the considerable number of 30 participating worksite cafeterias is an innovation in studies of this type. Finally, the design is an asset due to the presence of a control group, allowing control for external influences.

The first limitation is that we only assessed food purchased and not actual dietary intake, which could differ. Sales data are, however, a more objective measure than food-frequency questionnaires because no items are forgotten (46). Measuring actual intake by means of 24-h dietary recalls or photographing food and leftovers would have been a better strategy, because it gives information about possible compensational behavior. Nevertheless, this could have caused bias because consumers would have known that they were being studied. Furthermore, because the health aspects of the strategies were not communicated

TABLE 5
Results from scan data at baseline T0 (weeks 1–3) and during the intervention (T1)[1]

	Time of measurements, scores				
	T0 (weeks 1–3)	T1A (weeks 4–6)	T1B (weeks 7–9)	T1C (weeks 10–12)	T1D (weeks 13–15)
Intervention cafeterias ($n = 14$)	3.1 ± 1.0 of 13.6 ± 0.6	10.5 ± 1.3 of 13.6 ± 0.6	10.6 ± 1.2 of 13.4 ± 0.7	10.4 ± 1.5 of 13.4 ± 0.8	10.3 ± 1.3 of 13.4 ± 0.8
Control cafeterias ($n = 16$)	3.2 ± 1.0 of 13.4 ± 0.6	—	—	—	—

[1]Values are means ± SDs of correctly executed strategies of eligible strategies. Correctly executed strategies scored 1 point; partly correctly executed strategies scored 0.5 points. For example, strategy 5 (Table 2) ["The visible share of healthy ('better choice') products is ≥60%" was sometimes correct for almost all product groups but not all of them. In that case, 0.5 points were given.

explicitly, we do not expect employees to compensate for their healthier purchases. A second limitation is the lack of significant differences that could have resulted from smaller than expected effects. Some of the included worksite cafeterias offer a large variety of food products (e.g., warm meals, snacks, prepared salads and sandwiches, salad from bars, bread and toppings, soups, and yogurt). Therefore, the effects were smaller in cafeterias with a diverse range of options. In addition, healthier salads could only be offered in cafeterias that already served complete salads, resulting in customers being offered less than expected. Third, we cannot distinguish between the effects of the individual strategies. Finally, not monitoring the control cafeterias during the intervention is a limitation. We have no proof of whether the participating cafeterias implemented any of the strategies, despite their assurances. We also did not address whether intervention cafeterias changed cafeteria costs or revenues, which is important to study for potential future strategy adoption. However, participating catering companies expressed their interest in cooperating due to the changing demands of customers and employers with regard to healthier options.

Considering the small changes to purchases, the clinical relevance of this intervention is a topic for discussion. Substituting a slice of regular cheese with low-fat cheese will not solve the problem of excess weight. This decrease of 25 kcal (based on a 30-g package of 109 kcal compared with 84 kcal) could hypothetically "save" 5000 kcal/y (40 wk × 5 d), which, on its own, most likely will not overcome obesity. However, the consistently elevated sales of healthier cheese indicate that permanent implementation could affect employees' daily food intake, because it appears that the strategies remain effective independent of their novelty. It is therefore proof of the mechanism shaping people's choices and will be useful in future health promotions.

From our findings, we can formulate several recommendations. For example, some strategies should be sharpened (e.g., offering fried snacks <3 times/wk). With regard to facilitating the implementation in practice, the unique cooperation with caterers resulted in extensive expertise and support, making the realization easier. Furthermore, the caterers' positive experiences (e.g., the fact that customers did not complain) resulted in caterers and employers being more willing to cooperate. We recommend that caterers benefit from these experiences by conducting pilot studies, for example. We also recommend having a catering manager trained to execute the strategies. Our compliance rate of 77% of strategies executed as intended is reasonable but can be improved. A tool to monitor strategy implementation (e.g., a digital application) would also be useful. Our study shows that the way products are offered in the worksite cafeteria affects purchase behavior. Strategies based on nudging and social marketing executed in a real-life setting are effective in encouraging healthier food purchases by employees and aim to remain effective over time.

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