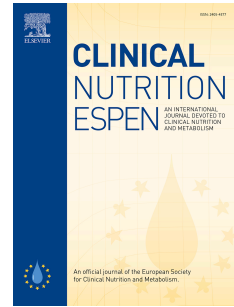


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Nudging strategies to improve food choices of healthcare workers in the workplace cafeteria: a pragmatic field study

Running title: Nudging to improve food choices

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Abstract

Background & Aims: Dutch healthcare workers experience the highest workload and absenteeism rates compared to all other professions. This has been associated with a more unhealthy diet. Nudging strategies in the workplace have been shown to improve food choices. We studied the potential of a combination of evidence and practice-based nudging strategies; determined their feasibility in a real-life setting; and explored their effectiveness on healthier purchases over a two-month period in a hospital workplace cafeteria.

Methods: We conducted an explorative, prospective field study. Based on information gathered through a literature search and a qualitative field study, we selected the potentially most effective and feasible nudges. These were subsequently implemented in a commercial workplace cafeteria of a Dutch academic medical centre. The selected nudging strategies included product placement, increasing the ratio of healthy to unhealthy product options, and providing nutritional information and motivational statements. Data on the products purchased was collected using photographs of the lunch trays of healthcare workers, with the products then labelled and their nutritional value calculated. Effects were evaluated after one and two months. Chi-square analyses were used to analyse differences over time.

Results: A total of 905 photographs of lunches were analysed (approximately 300 at each time point). The nudging strategies implemented resulted in a 41% increase in the purchase of whole-wheat products at the expense of non-whole-wheat products, between baseline and final measurement ($p=0.012$). The purchases of healthy and unhealthy bread fillings and beverages did not significantly change during the study period.

Conclusion: This explorative study showed that a combination of three nudging strategies partly improved healthy food choices for lunch in a Dutch healthcare setting. These results may help guide other professionals to implement nudging strategies to improve employee food choices. Future

research should evaluate the effect over a longer period of time, thereby identifying the most effective combination of nudging strategies and investigate how these effect the health of hospital employees.

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INTRODUCTION

Nearly 44% of Dutch healthcare workers experienced high workloads in 2019. Moreover, employees in the healthcare sector had the highest absenteeism rates (1, 2). These work-related problems are associated with poorer individual wellbeing and could be either the cause or consequence of a less healthy nutritional intake (3, 4). Stress significantly alters eating behaviour by increasing the intake of calorie-dense and highly palatable foods, and it has also been linked to binge eating. In addition, shift work, which is done by many healthcare workers, is associated with a less healthy diet, both during shifts and on the following days (5). Consequently, healthcare workers are prone to have a suboptimal dietary intake, explaining part of their increased risk of overweight, obesity and comorbid conditions (4). Thus, supporting a healthier diet among healthcare workers at the workplace could prevent overweight, obesity and related diseases and thereby possibly prevent absenteeism.

The work setting has been identified as a suitable place for dietary interventions, especially since people spend a large part of their day at work (6, 7). Moreover, eating outside home is related to a higher energy and fat intake (8, 9), the consumption of products with a higher energy density (10) and exceeding recommended portion sizes (11). Several studies have shown a beneficial effect on the health status of employees after dietary interventions in a diversity of work settings (12-14). In such settings, nudging strategies have proven to be a preferable form of intervention to influence healthy behaviour (15-17) as they encourage people to choose for the healthier options, without restricting them in their choices (18).

Three types of nudges can be distinguished: cognitive (i.e. traffic light systems), affective (i.e. attractive packaging) and behavioural nudges (i.e. increasing availability of healthy choices) (19). These three types of nudges can be translated into implementation strategies, including changes in products, placement and promotion (20). Studies focusing on nudging interventions in work settings have shown positive effects on healthy nutritional choices, although the number of studies performed is limited, especially in the healthcare setting (12-14, 21, 22).

Since healthcare workers are more susceptible to an unhealthy dietary intake, it is important to help them improve their food choices during work time. Moreover, a lack of insight into the practical problems that can be encountered in the process of implementing such nudging strategies in real-life settings might hamper professionals from taking the step to making healthier food choices in their own healthcare setting.

Therefore, the current study demonstrates how a combination of nudging strategies was implemented in a stepwise approach, determining their feasibility in a real-life setting and exploring their effectiveness on healthier purchases over a two-month period in a hospital workplace cafeteria.

MATERIALS AND METHODS

Study Design

We conducted a pragmatic field study and an explorative, prospective study in the workplace cafeteria of the Erasmus Medical Center, Rotterdam, the Netherlands, which is a tertiary referral hospital. This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and judged by the Dutch Medical Ethical Commission of Human Research (CCMO) as a non-medical scientific study. Verbal informed consent was obtained from all employees. Verbal consent was witnessed and formally recorded.

Study Population

The workplace cafeteria is open to all visitors, patients and healthcare workers of the academic hospital. This study only focused on healthcare workers at the hospital, who, moreover, visit the cafeteria more often and on a regular basis, as opposed to patients and visitors. Healthcare workers were eligible for inclusion if their employee badge was visible.

Literature search and qualitative field study

First, in January 2019, we performed a literature search in Pubmed, including the following search terms: (((("Feeding Behavior/psychology"[Mesh] OR "Food Preferences"[Mesh]) AND "Health Promotion/methods"[mesh]) AND (("workplace"[All Fields]) OR cafeteria[all fields] OR canteen[all fields])) OR ("Feeding Behavior/psychology"[Mesh] OR "Food Preferences"[Mesh] AND ("Nudging"[All Fields] OR Nudge[All Fields]) AND (("workplace"[All Fields]) OR cafeteria[all fields] OR canteen[all fields])). Additionally, studies were obtained via ResearchGate, Google Scholar and ScienceDirect. The results of this search are summarised in supplementary Table 1.

Second, in February 2019, a field study among employees and catering staff was performed using semi-structured interviews, to select the potentially most effective and feasible nudges from those found in the literature search. Healthcare workers who were having lunch at the workplace cafeteria were asked how their lunch choices were affected by certain elements. Based on the combination of these evidence-based and practice-based findings, we selected eight potentially effective nudging strategies. Subsequently, a group discussion was organised with the caterer, including both managers and catering staff, to evaluate the feasibility of these findings, taking into account financial and logistical issues. Finally, four strategies were selected for the prospective study.

Selected nudging strategies

The four nudging strategies selected are listed below, categorised according to point of focus:

1) Placement: healthy choices at the front, unhealthy choices at the back. Positioning healthy options at the front, so that they are easily accessible and visible, with unhealthier options more to the back, can nudge consumers to make healthier choices (19, 23-25). This first nudging strategy aimed to rearrange sandwiches, slices of plain bread, bread fillings and beverages. See Table 2 for criteria based on the Dutch Healthy Food Guidelines (26) for classifying these products as healthy or unhealthy. Sandwiches

were defined as bread already prepared with fillings, while plain bread included slices of bread, buns, baguettes and croissants without fillings.

2) Product: whole-wheat bread ratio 75% vs non-whole-wheat bread 25%. According to the nudging strategies of Velema et al. (27), the majority of the products offered should be the healthier option in order to increase their purchase share. At the start of this study, 20% of the bread products offered were whole-wheat, versus 80% of non-whole-wheat. We aimed to change this to a ratio of 75% whole-wheat vs 25% non-whole-wheat. This required a change in the purchasing policy of the caterer, which they judged as feasible.

3) Product: introducing a yoghurt bar. Yoghurt is a source of protein, calcium and vitamin B2 and B12 and, accordingly, consuming healthy variants at lunch contributes to meeting the recommended intake of at least 300 grams of dairy per day (26). In the Netherlands, 25% of dairy products, including milk, cheese and yoghurt, are consumed at school or work during lunch (28). For the third nudging strategy, we advised to create a yoghurt bar, including low-fat yoghurt, quark and healthy toppings such as fresh fruit, unsalted nuts and seeds, in compliance with the dietary recommendations of the Dutch Healthy Food Guidelines.

4) Promotion: providing information that is cognitively stimulating, and leading to the purchase of the healthy option. For the fourth nudging strategy, signage with information emphasising the health benefits of the products offered, as well as encouraging statements, were developed for sandwiches, slices of plain bread, bread fillings, salad boxes, beverages, dairy products and snacks. The signs were placed close to the corresponding products. Examples include: ‘Muesli contains a lot of fibre, B vitamins and less sugar compared to cruesli’; ‘Whole-wheat bread contains dietary fibre which lowers bad LDL cholesterol and the risk of diabetes type II’; and ‘Good job, Erasmus MC! You’ve eaten three times as much salad in the last three months’.

Data Collection

We checked whether the caterer of the workplace cafeteria had adhered to the recommendations by randomly checking the availability, visibility and placing of food products and information signs approximately once a week.

From October 2019 to December 2019, we collected data on purchases made in the hospital cafeteria. Photographs of serving trays were taken as a proxy for data on sales. While the healthcare workers were waiting to pay, they were asked whether they would agree to have their serving tray photographed anonymously.

Data was collected during lunchtime at six time points: two measurements at baseline (T0), two measurements after one month (T1) and two final measurements after two months (T2). Each measurement time point included a Tuesday and a Friday, as it was hypothesized that sales at the beginning of the week may differ from those at the end. Taking into consideration that, on an average day, 600 purchases are made between 8.00 a.m. and 3.00 p.m., we aimed for a minimum of 150 photographs per time point in order to collect a sufficient amount of data for a valid analysis.

Statistical Analysis

The workplace cafeteria also allowed customers to bring and consume their own food. Accordingly, photographs of the trays may have included both products purchased in the cafeteria and products from home. However, we only included products bought at the cafeteria in the analyses. The photographs taken were checked manually and every food product that had been purchased was documented. Subsequently, the number of purchases per food product was calculated and, based on the Dutch Healthy Food Guidelines, classified into healthy and unhealthy products or into whole-wheat and non-whole-wheat bread (26) (Table 3). Bread products were included in the classification in two ways: bread already prepared with fillings (in the Netherlands defined as sandwiches) was classified as

healthy/unhealthy, and bread products excluding fillings were classified into three categories: whole-wheat bread, brown bread and white bread.

Chi-square analyses were performed to check for differences in the total amount of food products purchased between T0, T1 and T2. All tests were performed in IBM Statistics SPSS Version 25 and p-values < 0.05 were considered statistically significant.

RESULTS

Qualitative study

By means of a literature search, we found 21 relevant studies that had been performed in the United States ($n = 10$), Europe ($n = 9$), Australia ($n = 1$) and Asia ($n = 1$) between 2004 and 2018. The studies were mainly conducted at school and workplace cafeterias, of which 14% were situated in hospitals. Table 1 summarises essential information about the studies included.

In our field study, 23 healthcare workers were interviewed during their lunch at the workplace cafeteria, including doctors ($n = 5$), nurses ($n = 5$), researchers ($n = 5$), medical students ($n = 4$) and other workers ($n = 4$). The participants had an average age of 34.2 years (range 20-60 years) and the majority were female (83%), in line with the fact that 72% of the hospital employees were women. One third bought their entire lunch at work that day and 22% visited the workplace cafeteria more than twice a week. The interviewees were asked what would assist them in making healthier choices for lunch, with their answers clustered into four options: (1) lower prices for healthy choices, (2) optimising the balance between unhealthy and healthy ingredients in prepared meals, (3) optimising presentation of healthy food (readily available, easy to take away) and (4) increasing the number of tasty, satiating healthy dishes. Since pricing is not considered a nudging strategy, we identified the wishes classified into options 2, 3 and 4 as possible targets that could be influenced by means of a nudging strategy. However, option 4 proved not to be feasible for the caterer, since this would increase the workload of the staff, and it was therefore not further developed.

Feasibility

Overall, the workplace cafeteria implemented the recommended strategies fairly well. The products were placed at the recommended location and the information signs were visible for the majority of the time (> 80%). The cafeteria served a weekly menu of dishes prepared onsite, which changed daily. This meant that not all sandwiches were available at all measurement time points. However, at least one of the three healthiest sandwiches was always available. The change to a ratio of 75:25 for whole-wheat to non-whole-wheat bread was only partially implemented due to the large stock of non-whole-wheat bread. A 50:50 distribution was achieved. Furthermore, supply problems resulted in the absence of whole-wheat bread sandwiches on the second final measurement day (T2, day 2). The recommended new positioning of beverages was partly implemented – only for water and dairy drinks, due to contractual agreements with the soft drink suppliers. With respect to the implementation of the yoghurt bar, the caterer at the cafeteria was overly enthusiastic and had already implemented it before baseline measurements were conducted. As a result, we were forced to exclude this strategy from the current study analyses. Finally, the caterer indicated that total profits were stable during the study period, suggesting that these strategies did not influence profitability and could therefore be continued for a longer period of time.

Purchases of Healthy Food

A total of 905 photographs of lunch trays were collected: 297 at baseline (T0), 305 after one month (T1) and 303 after two months (T2). Soup, slices of plain bread, beverages and sandwiches contributed to more than half of the products sold (52.6%, 53.3% and 51.9% for T0, T1 and T2 respectively; Table 3).

The percentage of healthy sandwiches purchased was 47.6%, 40.4% and 48.1% for T0, T1 and T2 respectively, showing no significant change during the study period ($p = 0.638$). The purchases of whole-wheat slices of plain bread showed a non-significant increase from 16.9% to 24.3% between T0

and T2 ($p = 0.112$). When combining the data on sandwiches and slices of plain bread, the purchases of whole-wheat bread increased by 41% from 12.7% to 22.0% between T0 and T2, while a decrease of 29% was found for non-whole-wheat bread ($p = 0.012$) (Table 4 and Figure 1).

The ratio of healthy to unhealthy bread fillings did not change significantly during the study period (from 47.0% vs 53.0% respectively at baseline to 51.4% vs 48.6% after two months ($p = 0.325$); Table 4). Although the absolute number of healthy beverages increased from 58 items to 76 items, the percentage of healthy beverages decreased from 86.6% to 83.8% during the study period ($p = 0.109$; Table 4), due to more purchases of beverages in total (Table 3).

DISCUSSION

Our explorative, prospective study was performed to examine whether introducing a combination of nudging strategies in a workplace cafeteria of an academic hospital would improve purchases of healthier food among healthcare professionals during lunchtime. After two months, the combination of three nudging strategies increased the purchase of whole-wheat bread significantly, at the expense of non-whole-wheat bread. The ratio of healthy to unhealthy bread fillings and beverages did not change significantly.

The potentially higher intake of dietary fibre associated with an increased intake of whole-wheat bread might lead to higher levels of satiety and potentially to health improvements, since dietary fibre intake is associated with a lower risk of coronary heart disease, stroke, hypertension, diabetes, gastrointestinal diseases and obesity (29, 30). To determine whether our nudging strategies might have an actual impact on the health of the employees, a longer study is needed in which the complete daily dietary intake is taken into account.

We found only one other study that was similar to ours with respect to setting, intervention and population. This study, conducted by Thorndike et al., focused on implementing both a traffic light system and a nudging intervention regarding product placement in a hospital cafeteria (31). The change

in product placement was successful for the sales of sandwiches, but the strongest effect was found for beverages. We did not find a positive effect of product placement on purchases of healthy beverages and sandwiches. One possible explanation for the difference in effect on healthy beverage sales is that our placement intervention could not be fully implemented, due to contractual obligations of the caterer, who was not allowed to place the soft drinks elsewhere. In addition, the study by Thorndike et al. was of a longer duration, which allowed them to include the long-term effects of the nudge. With respect to the effect on healthy sandwich purchases, Dutch lunch eating habits are different compared to other countries. In the Netherlands, sandwiches are often self-prepared, with customers buying slices of plain bread and fillings separately. As a result, the power to detect differences in the purchase of whole-wheat pre-prepared sandwiches might have been too low, while the combined data of whole-wheat sandwiches and whole-wheat plain bread was of significance.

Our intervention targeting the promotion of healthy products by introducing signs providing nutritional information which combined cognitive and affective nudges did not result in higher purchases of healthy sandwiches or beverages on its own, but it may have enhanced the positive effects of other nudges for whole-wheat products. Previous studies on the introduction of informative signs have shown beneficial effects (32). Three out of the ten signs aimed at promoting whole-wheat products by emphasising the health effects of high fibre intake. Due to the pragmatic design of our study, it remains inconclusive whether this strategy was successful on its own or only in combination with the two other nudging strategies targeting whole-wheat product sales. As Velema et al. also concluded, implementing a combination of multiple strategies might have an aggregating effect (20). Although technically not a nudge, price has been shown to be a determining factor in purchasing behaviour (33). In our qualitative field study, the participants also indicated that a lower price would encourage them to buy healthier food. Unfortunately, the caterer was not in a position to offer discounts on healthy products, which would probably have helped their sale.

We also encountered some practical challenges with respect to the real-life setting. For example, the changing weekly menus offered by the cafeteria affected the availability of healthy sandwiches. Not all

three healthy sandwich options were available on the measurement days. This might partly explain the non-significant change in healthy sandwich purchases. Furthermore, we could only make limited changes in the positioning of the drinks, as the caterer was bound by contracts with large multinational soft drink suppliers. In addition, a possible confounding factor was the free water tap available for customers, which we could not include in our measurements, so there may have been an increase in the use of water that was not reflected in actual water purchases. Finally, the pre-set target of changing the ratio of whole-wheat to non-whole-wheat bread from 20:80 to 75:25 had stagnated at a ratio of 50:50 due to the large stock of non-whole-wheat bread and supply issues.

Taken together, these practical hurdles may have diminished the possible effects of our nudging strategies on the purchases of healthy food in the workplace cafeteria in the short term. While it is essential to involve the caterer in all steps of the process, it is still possible to encounter practical problems related to conflicting interests (healthy food versus commercial interests). Accordingly, it takes time and perseverance to achieve significant changes.

This study thus has some limitations. Multiple factors influenced the reproducibility in our study. However, we believe that identifying all these factors may help others involved in the process of implementing such nudging strategies in food outlets in a healthcare setting. This is why we followed a structured stepwise approach and described this in detail in our methodology section. We also gathered data anonymously and, as a consequence it was not possible to check for intra-individual differences over time, or to look for differences between for instance gender, social economic status and age. Moreover, we only assessed food purchased and not actual food intake, since we could not take into account food waste.

Another limitation of the study was its relative short duration. A longer study period would have been preferable to cover seasonal effects, check the sustainability of the intervention and to be involved in new contractual agreements that would enable healthier marketing. However, comparable studies also only ranged between 12 and 17 weeks, suggesting that longer intervention studies are difficult to

manage in real-life settings (25, 34). Finally, we did not include a control group, making it impossible to check whether the observed changes were solely due to our intervention.

One strength of this intervention was the real-life setting, making it possible to directly adjust and evaluate the implementation of our findings. Important in this respect was the close collaboration between the caterer and our research team. Compromises had to be made considering the different interests of the parties involved, resulting in the best possible and sustainable strategies for the particular workplace cafeteria. Furthermore, this collaboration raised awareness among the catering managers of the cafeteria of the importance and feasibility of providing more healthy food options. Surprisingly, during the intervention, they introduced other healthy products on their own initiative, such as cherry tomatoes and nuts that were easy to grab. Accordingly, although these could not be included in our analyses, there have been positive side effects of the study.

In conclusion, the purchases of whole-wheat bread during lunchtime by hospital employees significantly increased after simultaneously introducing three nudging strategies (focusing on product, placement and promotion). This was at the expense of non-whole-wheat bread purchases, potentially leading to better health outcomes associated with increased fibre intake. Due to the real-life setting, the measured results for the purchase of healthy food in the hospital workplace cafeteria may have been underestimated.

This pragmatic real life study can be seen as a step in the process of sustainably improving workplace food options, and thereby the work-related health risks of healthcare workers. It shows that significant beneficial effects on the healthcare workers' food purchases can already be achieved with small adjustments. It also reveals possible problems and opportunities encountered in the whole process of implementing such nudging strategies, and the importance of a close collaboration with stakeholders, as well as frequent evaluation moments. While we gave insights in steps that were undertaken in translating evidence from literature to feasible adjustments at the workplace, our approach can be used to guide other professionals when they also take the step to make the food choice a bit healthier within

their own healthcare setting. Future research should evaluate the different nudging strategies separate and combined, over a longer period of time, thereby identifying the most effective combination of nudging strategies, with the aim of finding ways of improving the lunch offer and increasing healthy purchases of healthcare workers. Furthermore, it is important to investigate whether such modifications actually improve the health of hospital employees, by assessing biomedical and/or psychosocial health.

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Statement of Authorship:

REHM, BV and KAB were involved in formulating the research question(s) and the design of the study. REHM and KAB were involved in data collection. REHM, BV and KAB contributed to the analysis of the data. REHM, BV and KAB contributed to writing the manuscript. All authors read and approved the final manuscript. KAB is the guarantor of the article.

Conflict of Interest Statement:

None

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REFERENCES

1. Statistics Netherlands (CBS). Majority of care workers report increased workload 2019 [Available from: <https://www.cbs.nl/nl-nl/nieuws/2019/40/meerderheid-werknemers-zorg-meldt-toename-werkdruk>].
2. Statistics Netherlands (CBS). Employee sickness absence increased further in 2019 2020 [Available from: <https://www.cbs.nl/en-gb/news/2020/12/employee-sickness-absence-increased-further-in-2019>].
3. Yau YHC, Potenza MN. Stress and eating behaviors. *Minerva endocrinologica*. 2013;38(3):255.
4. Mohanty A, Kabi A, Mohanty AP. Health problems in healthcare workers: A review. *Journal of family medicine and primary care*. 2019;8(8):2568.
5. Bucher Della Torre S, Wild P, Dorribo V, Danuser B, Amati F. Energy, Nutrient and Food Intakes of Male Shift Workers Vary According to the Schedule Type but Not the Number of Nights Worked. *Nutrients*. 2020;12(4):919.
6. Robroek SJW, Van Lenthe FJ, Van Empelen P, Burdorf A. Determinants of participation in worksite health promotion programmes: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity*. 2009;6(1):26.
7. Wanjek C. *Food at Work: Workplace solutions for malnutrition, obesity and chronic diseases*: International Labour Organization; 2005.
8. Lachat C, Nago E, Verstraeten R, Roberfroid D, Van Camp J, Kolsteren P. Eating out of home and its association with dietary intake: a systematic review of the evidence. *Obesity reviews*. 2012;13(4):329-46.
9. Kjøllestad MR, Holmboe-Ottesen G, Wandel M. Frequent use of staff canteens is associated with unhealthy dietary habits and obesity in a Norwegian adult population. *Public health nutrition*. 2011;14(1):133-41.
10. Vandevijvere S, Lachat C, Kolsteren P, Van Oyen H. Eating out of home in Belgium: current situation and policy implications. *British journal of nutrition*. 2009;102(6):921-8.
11. Young LR, Nestle M. The contribution of expanding portion sizes to the US obesity epidemic. *American journal of public health*. 2002;92(2):246-9.
12. Byers T, Mullis R, Anderson J, Dusenbury L, Gorsky R, Kimber C, et al. The costs and effects of a nutritional education program following work-site cholesterol screening. *American journal of public health*. 1995;85(5):650-5.
13. Braeckman L, De Bacquer D, Maes L, De Backer G. Effects of a low-intensity worksite-based nutrition intervention. *Occupational Medicine*. 1999;49(8):549-55.
14. Armitage CJ, Conner M. Efficacy of a minimal intervention to reduce fat intake. *Social science & medicine*. 2001;52(10):1517-24.
15. Arno A, Thomas S. The efficacy of nudge theory strategies in influencing adult dietary behaviour: a systematic review and meta-analysis. *BMC public health*. 2016;16(1):676.
16. Bucher T, Collins C, Rollo ME, McCaffrey TA, De Vlieger N, Van der Bend D, et al. Nudging consumers towards healthier choices: a systematic review of positional influences on food choice. *British Journal of Nutrition*. 2016;115(12):2252-63.
17. Broers VJV, De Breucker C, Van den Broucke S, Luminet O. A systematic review and meta-analysis of the effectiveness of nudging to increase fruit and vegetable choice. *The European Journal of Public Health*. 2017;27(5):912-20.
18. Leonard TC, Richard H, Thaler, Cass R, Sunstein, Nudge: Improving decisions about health, wealth, and happiness. Springer; 2008.
19. Cadario R, Chandon P. Which healthy eating nudges work best? A meta-analysis of field experiments. *Marketing Science*. 2019.

20. Velema E, Vyth EL, Steenhuis IHM. Using nudging and social marketing techniques to create healthy worksite cafeterias in the Netherlands: intervention development and study design. *BMC Public Health*. 2017;17(1):1-9.
21. Chu YH, Frongillo EA, Jones SJ, Kaye GL. Improving patrons' meal selections through the use of point-of-selection nutrition labels. *American journal of public health*. 2009;99(11):2001-5.
22. Steenhuis I, van Assema P, van Breukelen G, Glanz K, Kok G, de Vries H. The impact of educational and environmental interventions in Dutch worksite cafeterias. *Health Promotion International*. 2004;19(3):335-43.
23. Van Kleef E, Seijdell K, Vingerhoeds MH, de Wijk RA, van Trijp HCM. The effect of a default-based nudge on the choice of whole wheat bread. *Appetite*. 2018;121:179-85.
24. Romero M, Biswas D. Healthy-left, unhealthy-right: can displaying healthy items to the left (versus right) of unhealthy items nudge healthier choices? *Journal of Consumer Research*. 2016;43(1):103-12.
25. Velema E, Vyth EL, Hoekstra T, Steenhuis IHM. Nudging and social marketing techniques encourage employees to make healthier food choices: a randomized controlled trial in 30 worksite cafeterias in The Netherlands. *The American journal of clinical nutrition*. 2018;107(2):236-46.
26. Dutch Health Council. Dutch Food-based Dietary Guidelines 2015 [Available from: <https://www.gezondheidsraad.nl/documenten/adviezen/2015/11/04/richtlijnen-goede-voeding-2015>].
27. Velema L, Vyth E, Steenhuis I. Hoe verleidt u tot gezondere keuzes in het bedrijfsrestaurant? : Vereniging Nederlandse Cateringorganisaties Vrije Universiteit Amsterdam; 2018.
28. Van Rossum CTM, Buurma-Rethans EJM, Vennemann FBC, Beukers M, Brants HAM, De Boer EJ, et al. The diet of the Dutch: Results of the first two years of the Dutch National Food Consumption Survey 2012-2016. RIVM letter report 2016-0082. 2016.
29. Anderson JW, Baird P, Davis RH, Ferreri S, Knudtson M, Koraym A, et al. Health benefits of dietary fiber. *Nutrition reviews*. 2009;67(4):188-205.
30. Slavin J, Green H. Dietary fibre and satiety. *Nutrition Bulletin*. 2007;32:32-42.
31. Thorndike AN, Riis J, Sonnenberg LM, Levy DE. Traffic-light labels and choice architecture: promoting healthy food choices. *American journal of preventive medicine*. 2014;46(2):143-9.
32. Cecchini M, Warin L. Impact of food labelling systems on food choices and eating behaviours: a systematic review and meta-analysis of randomized studies. *Obesity reviews*. 2016;17(3):201-10.
33. Afshin A, Peñalvo JL, Del Gobbo L, Silva J, Michaelson M, O'Flaherty M, et al. The prospective impact of food pricing on improving dietary consumption: a systematic review and meta-analysis. *PloS one*. 2017;12(3):e0172277.
34. Vasiljevic M, Cartwright E, Pilling M, Lee M-M, Bignardi G, Pechey R, et al. Impact of calorie labelling in worksite cafeterias: a stepped wedge randomised controlled pilot trial. *International Journal of Behavioral Nutrition and Physical Activity*. 2018;15(1):41.
35. Adams MA, Pelletier RL, Zive MM, Sallis JF. Salad bars and fruit and vegetable consumption in elementary schools: a plate waste study. *Journal of the American Dietetic Association*. 2005;105(11):1789-92.
36. Auchincloss AH, Mallya GG, Leonberg BL, Ricchezza A, Glanz K, Schwarz DF. Customer responses to mandatory menu labeling at full-service restaurants. *Am J Prev Med*. 2013;45(6):710-9.
37. Brissette I, Lowenfels A, Noble C, Spicer D. Predictors of total calories purchased at fast-food restaurants: restaurant characteristics, calorie awareness, and use of calorie information. *Journal of nutrition education and behavior*. 2013;45(5):404-11.
38. Chapman K, Ogden J. Nudging customers towards healthier choices. An intervention in the university canteen. *Journal of Food research*. 2012;1(2):13-21.
39. Ensaff H, Homer M, Sahota P, Braybrook D, Coan S, McLeod H. Food choice architecture: An intervention in a secondary school and its impact on students' plant-based food choices. *Nutrients*. 2015;7(6):4426-37.

40. Foster GD, Karpyn A, Wojtanowski AC, Davis E, Weiss S, Brensinger C, et al. Placement and promotion strategies to increase sales of healthier products in supermarkets in low-income, ethnically diverse neighborhoods: a randomized controlled trial. *The American journal of clinical nutrition*. 2014;99(6):1359-68.
41. Hanks AS, Just DR, Smith LE, Wansink B. Healthy convenience: nudging students toward healthier choices in the lunchroom. *Journal of Public Health*. 2012;34(3):370-6.
42. Van Kleef E, Otten K, van Trijp HCM. Healthy snacks at the checkout counter: A lab and field study on the impact of shelf arrangement and assortment structure on consumer choices. *BMC public health*. 2012;12(1):1072.
43. Mazza MC, Dynan L, Siegel RM, Tucker AL. Nudging healthier choices in a hospital cafeteria: Results from a field study. *Health promotion practice*. 2018;19(6):925-34.
44. Ogawa Y, Tanabe N, Honda A, Azuma T, Seki N, Suzuki T, et al. Point-of-purchase health information encourages customers to purchase vegetables: objective analysis by using a point-of-sales system. *Environmental health and preventive medicine*. 2011;16(4):239.
45. Pulos E, Leng K. Evaluation of a voluntary menu-labeling program in full-service restaurants. *American Journal of Public Health*. 2010;100(6):1035-9.
46. Turnwald BP, Boles DZ, Crum AJ. Association between indulgent descriptions and vegetable consumption: twisted carrots and dynamite beets. *JAMA internal medicine*. 2017;177(8):1216-8.
47. Vitale M, Bianchi MA, Rapetti V, Pepe JM, Giacco A, Giacco R, et al. A nutritional intervention programme at a worksite canteen to promote a healthful lifestyle inspired by the traditional Mediterranean diet. *International journal of food sciences and nutrition*. 2018;69(1):117-24.
48. Vyth EL, Steenhuis IHM, Heymans MW, Roodenburg AJC, Brug J, Seidell JC. Influence of placement of a nutrition logo on cafeteria menu items on lunchtime food choices at Dutch work sites. *Journal of the American Dietetic Association*. 2011;111(1):131-6.
49. de Wijk RA, Maaskant AJ, Polet IA, Holthuysen NTE, van Kleef E, Vingerhoeds MH. An in-store experiment on the effect of accessibility on sales of wholegrain and white bread in supermarkets. *PloS one*. 2016;11(3):e0151915.
50. Wilson AL, Bogomolova S, Buckley JD. Lack of efficacy of a salience nudge for substituting selection of lower-calorie for higher-calorie milk in the work place. *Nutrients*. 2015;7(6):4336-44.

TABLES AND FIGURE LEGENDS

Table 1: Overview of studies found in the literature search

Authors	Country	Study design	Setting	Intervention	Measurement	Outcome
Adams et al. (2005) (35)	USA	Cross-sectional	4 primary school cafeterias	1 day at each school. Assessing the difference between self-service salad bar and portioned fruit and vegetable servings	Weighing the amount of fruit and vegetables	Providing a self-service salad bar is not associated with higher fruit and vegetable intake
Auchincloss et al. (2013) (36)	USA	Cross-sectional	Full-service restaurant	Menu-labelling (displaying calories, sodium, fat and carbohydrates)	Transaction receipts and surveys	Menu-labelling was associated with improved food choices among some of the customers
Brissette et al. (2013) (37)	USA	Cross-sectional	Fast food restaurants	Introducing calorie information	Interviewing customers and collecting receipts	Introducing calorie information, purchase strategies and calorie awareness seems to help in choosing lower calorie products
Bucher et al. (2016) (16)	International	Systematic review	Field studies and laboratory	Changing food positions	Consumption and sales data	16 of 18 studies showed positive effects after manipulating food position
Chapman et al. (2012) (38)	United Kingdom	Intervention	University canteen	Study 1: Manipulating the location and availability Study 2: restricting types of bread	Sales data	Changes in availability and location could encourage people to buy the healthier options
Chu et al. (2009) (21)	USA	Quasi-experimental	Study dining centre	Introducing nutritional labels	Daily sales data	Mean energy (kcal) intake reduced, without lower overall sales
Ensaff et al. (2015) (39)	United Kingdom	Intervention	School canteen	6-week intervention in choice architecture on fruit, fruit salad, vegetarian daily meals and sandwiches	Transactions	Introducing choice architecture increased the purchases of the preferred products

Foster et al. (2014) (40)	USA	RCT ¹	8 urban supermarkets	A 6-month, instore marketing intervention promoting sales of healthier options via placement, signage and product availability	Weekly sales data	Sales data of several healthier products increased after placement strategies
Hanks et al. (2012) (41)	USA	Experimental design	School cafeteria	16-week design, first 8 weeks baseline, second 8 weeks intervention. Displaying healthier foods and flavoured milk.	Purchase and consumption data	A convenience line with healthier options encouraged students to choose the healthier options
Van Kleef et al. (2012) (42)	Netherlands	Two-factor experimental design	Hospital staff restaurant	Manipulating assortment and shelf layout via displays with healthy and unhealthy snacks near the checkout	Daily sales data and questionnaire	Increasing availability of healthy snacks and consenting access to unhealthy snacks is a promising strategy
Mazza et al. (2018) (43)	USA	Unknown	Hospital workplace cafeteria	Introducing traffic light labelling in combination with other interventions	Cash register receipts of beverages and chips	Small but consistent higher purchases of healthier food
Ogawa et al. (2011) (44)	Japan	Intervention	Two supermarkets	Point-of-purchase information for vegetables for 60 days	Daily sales data	Point-of-purchase information could stimulate people to buy and perhaps consume more vegetables
Pulos et al. (2010) (45)	USA	Unknown	Full-service restaurants	Adding nutritional information to menus	Sales data 30 days before and 30 days after intervention	Customers changed their choice and thereby lowered the overall calorie intake
Steenhuis et al. (2004) (22)	Netherlands	Pre-test – post-test	Workplace cafeteria	Food labelling, increased availability and educational programme	Self-administered food frequency questionnaire. Sales data	Overall no effect. Beneficial effect in those who believed they ate a high-fat diet. Sales data showed significant effects on desserts, but not on other products
Turnwald et al. (2017) (46)	USA	Unknown	University cafeteria	Labelling vegetables as flavourful, with	Unknown	The purchases of vegetables increased

				exciting and indulgent signs.		significantly, while no alterations were made in preparations
Thorndike et al. (2016) (31)	USA	RCT ¹	Hospital cafeteria	3 intervention arms in a hospital. Green, yellow and red labelling of food products	Sales data	Social norms and limited financial stimulus increased employees' healthy food choices over the short-term
Velema (2018) (25)	Netherlands	RCT ¹	30 workplace cafeterias	12-week intervention period. 14 strategies were introduced at the same time based on product, price, placement and promotion	3 collection methods: sales data, workplace cafeteria scan and online questionnaire	Significantly positive effects in 3 of 7 product groups: sandwiches, cheese as bread filling and fruit
Vitale et al. (2018) (47)	Italy	Intervention	Workplace canteens of food companies	Introducing Mediterranean diet via panels and flyers and by changing portion sizes	Self-administered 24 hr recall questionnaires	Significantly higher purchase of wholegrain cereals, legumes, white meat and fish. Significantly lower purchase of refined cereals, red and processed meat, eggs and cheese
Vyth et al. (2011) (48)	Netherlands	RCT ¹	Workplace cafeterias	Healthy logos assigned to healthy products	Daily sales data for 9 weeks and questionnaires	Intervention did not influence food choices
de Wijk et al. (2016) (49)	Netherlands	Experimental	2 supermarkets	Changing the locations of wholegrain bread, dark wheat bread, wheat bread, light wheat bread and white bread over 6 and 4 weeks	Sales data	No effects were found on sales data after changing the locations of bread
Wilson et al. (2015) (50)	Australia	Experimental	University-based research institute	Salience nudge (signage) promoting a change in milk selection from full-cream to low-fat	Daily milk selection recorded	Salience nudging promoted a temporary increase in low-fat milk selection, but also increased selection of full-cream milk, suggesting that nudging was not effective in promoting healthier milk choices

¹ Randomized controlled trial

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Table 2: Cut-off values for products

Products	Cut-off values
Sandwiches including filling¹	DF: $\geq 1.3\text{g}/100\text{g}$ EN: 350 – 600 kcal SF: $\leq 9\text{en}\%$
Slices of plain bread, baguettes, buns, croissants, crackers and sandwiches excluding filling	Only whole-wheat
Bread fillings – cheese¹	AS: no added sugar SF: $\leq 12\text{g}/100\text{g}$ Sodium: $\leq 900\text{g}/100\text{g}$ TFA: no trans fatty acids
Bread fillings – meat¹	AS: $\leq 2.5\text{g}/100\text{g}$ SF: $\leq 4\text{g}/100\text{g}$ Sodium: $\leq 900\text{mg}/100\text{g}$ FTA: no added trans fatty acids
Beverages – water¹	AS: no added sugar SF: $\leq 1.0\text{g}/100\text{g}$ Sodium: $\leq 20\text{mg}/100\text{ml}$ TFA: $\leq 0.1\text{g}/100\text{g}$
Beverages – dairy drinks¹	AS: no added sugar SF: $\leq 0.5\text{g}/100\text{g}$ Sodium: $\leq 100\text{mg}/100\text{g}$ TFA: no added trans fatty acids
Beverages – soft drinks¹	AS: no added sugar EN: $\leq 4\text{kcal}/100\text{ml}$ Sodium: $\leq 20\text{mg}/100\text{g}$ TFA: no added trans fatty acids

AS: added sugar, DF: dietary fibre, EN: energy, SF: saturated fat, TFA: trans fatty acids

¹ Based on Dutch Healthy Food Guidelines (26)

Table 3: Products sold during lunch at the workplace cafeteria

	T0	T1	T2
Photographs (n)	297	305	303
Soup	92 (14.3%)	105 (16.8%)	104 (15.8%)
Slices of plain bread	89 (13.8%)	81 (13.0%)	107 (16.2%)
Beverages	73 (11.4%)	90 (14.4%)	79 (12.0%)
Sandwiches	84 (13.1%)	57 (9.1%)	52 (7.9%)
Hot snacks	61 (9.5%)	67 (10.7%)	59 (8.9%)
Bread fillings	66 (10.3%)	48 (7.7%)	69 (10.5%)
Hot meals	45 (7.0%)	57 (9.1%)	70 (10.6%)
Salad bar products	50 (7.8%)	49 (7.9%)	39 (5.9%)
Salad boxes	44 (6.8%)	28 (4.5%)	39 (5.9%)
Dressings	27 (4.2%)	30 (4.8%)	34 (5.2%)
Dairy	10 (1.6%)	10 (1.6%)	6 (0.9%)
Fruit	2 (0.3%)	2 (0.3%)	2 (0.3%)
Total	643	624	660

Data is shown as absolute values (%)

Table 4: Product purchases during the intervention

	T0	T1	T2	p-value*
Sandwiches				0.638
Healthy sandwiches	40 (47.6%)	23 (40.4%)	25 (48.1%)	
Unhealthy sandwiches	44 (52.4%)	34 (59.6%)	27 (51.9%)	
Sandwiches				0.533
Whole-wheat sandwiches	7 (8.3%)	9 (15.8%)	9 (17.3%)	
Brown sandwiches	10 (11.9%)	5 (8.8%)	6 (11.5%)	
White sandwiches	67 (79.8%)	43 (75.4%)	37 (71.2%)	
Slices of plain bread				0.112
Whole-wheat bread	15 (16.9%)	20 (24.7%)	26 (24.3%)	
Brown bread	28 (31.5%)	16 (19.8%)	37 (34.6%)	
White bread	46 (51.7%)	45 (55.6%)	44 (41.1%)	
Sandwiches and slices of plain bread together				0.012
Whole-wheat bread	22 (12.7%)	29 (21.0%)	35 (22.0%)	
Brown bread	38 (22.0%)	21 (12.5%)	43 (27.0%)	
White bread	113 (65.3%)	88 (63.8%)	81 (50.9%)	
Bread fillings				0.325
Healthy bread fillings	31 (47.0%)	18 (37.5%)	36 (51.4%)	
Unhealthy bread fillings	35 (53.0%)	30 (62.5%)	34 (48.6%)	
Beverages				0.109
Healthy beverages	58 (86.6%)	66 (74.2%)	67 (83.8%)	
Unhealthy beverages	9 (13.4%)	23 (25.8%)	13 (16.3%)	

Data is shown as absolute values (%)

*P-value is obtained by Chi-Square tests

Figure 1: Ratio of whole-wheat, brown and white bread during the intervention

