ORIGINAL ARTICLE

Small portion sizes in worksite cafeterias: do they help consumers to reduce their food intake?

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Background: Environmental interventions directed at portion size might help consumers to reduce their food intake.

Objective: To assess whether offering a smaller hot meal, in addition to the existing size, stimulates people to replace their large meal with a smaller meal.

Design: Longitudinal randomized controlled trial assessing the impact of introducing small portion sizes and pricing strategies on consumer choices.

Setting/participants: In all, 25 worksite cafeterias and a panel consisting of 308 consumers (mean age = 39.18 years, 50% women).

Intervention: A small portion size of hot meals was offered in addition to the existing size. The meals were either proportionally priced (that is, the price per gram was comparable regardless of the size) or value size pricing was employed.

Main outcome measures: Daily sales of small and the total number of meals, consumers' self-reported compensation behavior and frequency of purchasing small meals.

Results: The ratio of small meals sales in relation to large meals sales was 10.2%. No effect of proportional pricing was found $B = -0.11$ (0.33), $P = 0.74$, confidence interval (CI): -0.76 to 0.54). The consumer data indicated that 19.5% of the participants who had selected a small meal often-to-always purchased more products than usual in the worksite cafeteria. Small meal purchases were negatively related to being male ($B = -0.85$ (0.20), $P = 0.00$, CI: -1.24 to -0.46 , $n = 178$).

Conclusion: When offering a small meal in addition to the existing size, a percentage of consumers that is considered reasonable were inclined to replace the large meal with the small meal. Proportional prices did not have an additional effect. The possible occurrence of compensation behavior is an issue that merits further attention.

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Introduction

Both in the United States and Europe food portion sizes have increased in the past decades.^{1–3} Empirical studies have shown repeatedly that large portion sizes enhance people's food intake^{4–6} and are thereby a risk factor for obesity. As a result of marketing strategies such as value size pricing (that is, a lower price per unit for large portions than for small portions) consumers are stimulated to select a large portion⁶ and consider this a normal size. Interventions directed at portion size might help consumers to reduce their food intake.^{7,8}

Interventions directed at portion size could be targeted at individual consumers (that is, health education) or at altering the food environment in such a way that the healthy choice is made more easily available. This could be achieved by for instance offering smaller portion sizes or by keeping the prices per unit stable (that is, proportional pricing). Two studies have shown that decreasing portion sizes can decrease people's energy intake.^{9,10} However, the effectiveness of offering a smaller size *in addition to* the existing size is unclear. Furthermore, the results with respect to proportional pricing are inconclusive.^{11,12}

Worksite cafeterias seem suitable settings for assessing the effectiveness of interventions aimed at a healthier food environment because they offer the possibility to reach a large number of people, varying in for instance age and socioeconomic status, on a regular basis. Further, it is expected that interventions in worksite cafeterias are cost effective and sustainable.¹³ In Dutch worksite cafeterias,

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in general, only one size of a hot meal containing approximately 500 grams is offered. If not compensated for at a later moment, smaller hot meals (~300 g) could help employees to reduce their intake by approximately 242 calories in the case of, for instance, spaghetti Bolognese (consisting of 121 calories per 100 g).¹⁴ This could be especially relevant for women who have lower daily caloric requirements than men and people who are overweight or obese and want to control their weight.

We have shown that from both a consumer and a point-of-purchase perspective, offering consumers a smaller meal in addition to the existing size and proportional pricing are both feasible interventions to implement.^{15,16} This experimental field study, which is conducted in Dutch worksite cafeterias, assesses whether offering a smaller meal, in addition to the existing size, stimulates people to replace their large meal with a smaller meal. Furthermore, it is assessed whether there is an additional effect of proportional pricing; whether offering a small meal leads to compensatory food intake; which consumers are inclined to select the smaller meal; and what attitudes consumers have toward the availability of smaller meals.

Materials and methods

This longitudinal randomized controlled trial was conducted in 26 different worksite cafeterias. During the study, one worksite cafeteria in condition 2 was excluded from the study because it did not provide all the requested data. The VU Medical Center's Institutional Review Board approved this study on 4 January 2007.

Procedures and intervention

The 25 remaining worksites were randomly allocated to either:

- (1) Experimental condition 1 ($n=9$), in which a smaller portion (that is, about two-thirds of the size of the existing portion) was offered in addition to the existing portion and proportional pricing was employed (that is, the price was 65% of the existing size).
- (2) Experimental condition 2 ($n=8$), in which a smaller portion was added to the assortment and value size pricing (that is, a lower price per unit for large portions than for small portions) was employed (that is, the price was 80% of the existing size).
- (3) The control condition ($n=8$), in which only the existing size of the hot meal was available.

In both experimental conditions a small portion was offered. The difference between the two experimental conditions was that the price of the small meal in relation to the large meal differed. This was done in order to test

whether there was an additional effect of proportional pricing.

Not all meals were suitable for offering as a smaller size. When the meat or fish component was served as a unit that could not be reduced, the dish was not considered suitable for offering as a smaller size. Therefore, in most cases only combined dishes (for example, rice, chili and pasta) were reducible and offered in both a large and a small portion size. Prices for the large meal were kept the same as before the study.

At the counter where the meals were served, a display with pricing information was placed. Further, worksite cafeteria employees in the experimental conditions were instructed to ask each customer what size they wanted (that is, small or large) and to serve the small portion on a small plate so as to standardize the size. No other advertizing of the small meals took place.

Before the intervention period started, all the worksite cafeterias received an information card with pictures on which the protocol was clarified. During the intervention period, all the worksite cafeterias were visited at least once to check whether they were complying with the study protocol.

Recruitment and participants

Worksite cafeterias. First, various worksites were telephoned to ask whether there was a worksite cafeteria selling hot meals. If that was the case, the name of the manager was requested and a letter was sent introducing the study. After a week, the manager was contacted by telephone. When a worksite cafeteria agreed to participate, a representative of the research team visited the manager to clarify further the study procedures and the protocol. Worksite cafeterias could participate in the study if they sold on average 30 meals per day, offered a reducible meal at least twice per week, and were willing to be randomly allocated to a study condition and to follow the study protocol. Finally, they had to agree to provide their daily sales figures of hot meals and fried snacks. From the 99 worksite cafeterias that were eligible, 73 decided not to participate. Different reasons were mentioned, such as reorganization, participation in another study and a lack of time. The 25 participating worksite cafeterias (that is, 15 hospitals, 5 companies, 3 universities and 2 police departments) sold on average 104 hot meals per day and catered each for, on average, 569 guests per day. In general, worksite cafeterias had a menu cycle that changed every 6 weeks. Daily meals varied from Dutch to international (for example, Italian, Asian) cuisine. On average, reducible meals were offered 3.48 days per week ranging from 1 to 7 days.

Consumer panel. Before the study, during lunch and dinner hours visitors to the participating cafeterias were asked to complete a short questionnaire that was meant to recruit participants and to assess whether they were eligible for study participation (that is, eating a hot meal at the worksite cafeteria at least once a week).

A total number of 881 worksite cafeteria visitors met the inclusion criteria and provided a valid email address to indicate study participation (Figure 1). During the study period, four online questionnaires were sent to the 881 participants on the weekday following the day on which they had indicated that they normally eat a hot meal in their worksite cafeteria. Before the start of the intervention, questionnaire 1 was sent to the participants. During the intervention period, the three remaining questionnaires were administered (questionnaires 2, 3 and 4). If the participants did not respond, they were sent a reminder

exactly 1 week later. The participants who were included in the data analyses ($n = 308$) had to have completed questionnaire 1, questionnaire 2 and/or 3, and questionnaire 4. The number of participants that were included in the analysis ranged from 1 to 24 per worksite cafeteria. Table 1 gives an overview of the participants' characteristics. The prevalences of overweight and obesity were lower than in the Dutch population, in which 46.5% of adults are overweight and 11% are obese.¹⁷ Furthermore, compared with norm scores the participants' mean dietary restraint scores were above average.¹⁸

Figure 1 Flow diagram of the study.

Table 1 Descriptive statistics for participants of the consumer panel ($n = 308$)^a

	%	Mean (s.d.)	Range
Age ^a		39.18 (11.26)	18–79
Dietary restraint			
Women		2.93 (0.92)	1–4.90
Men		2.40 (0.89)	1–4.50
Sex ^a			
Male	50		
Weight status ^a			
Underweight	2.6		
Healthy weight	63.3		
Overweight	27.2		
Obese	6.9		
Educational level ^a			
Pre-primary educational level	0.3		
Primary level	3.6		
Lower secondary level	25.6		
Tertiary level	70.5		

^aNo significant differences in this characteristic were found between the participants who had only completed questionnaire 1 and the participants of the final study sample.

Measurements. Daily sales figures were collected 1 month before the intervention and during the 3-month intervention period. Worksite cafeterias recorded their sales during 4 consecutive months on a standardized sheet that was provided to them and emailed this to the research team. For the sales data, the main outcome variables were: total sales of hot meals and fried snacks (entire study period, all conditions). In the intervention period, the sales of the small reducible meals were measured in the experimental conditions. To account for differences in the number of customers between the worksite cafeterias, sales were calculated per 50 customers. Further, worksite cafeterias ranged from 1 to 5 days per week on which they offered reducible meals. Therefore, for each week mean daily sales (per 50 customers) were calculated.

The sales data were also used to account for compensatory food intake in the worksite cafeteria. As it was impossible to track the sales figures of all the products sold in the worksite cafeterias, only fried snacks were included in the study. Fried snacks were considered most relevant, as they are high in energy density and saturated fat and low in nutrients. A croquette (which is a typical Dutch snack) contains for instance 151 calories.¹⁹ For each week, the average daily sales figures of fried snacks per 50 customers were collected.

With respect to the consumer panel, the following measures were taken. The screening questionnaire that was handed out in the worksite cafeteria started with an introduction to the study. It stated that their worksite was conducting a study in collaboration with the VU University into customers' opinions and satisfaction with respect to the

hot meals. It did not mention that this study was related to health, obesity, or portion sizes. This questionnaire assessed *how frequently the respondents ate hot meals at the worksite cafeteria and on what day(s) they normally ate a hot meal in the worksite cafeteria*. Further, the respondents were asked to give their email address if they were willing to complete a number of online questionnaires.

Questionnaire 1 was mailed to the participants before the start of the intervention and consisted of questions on background characteristics (that is, *sex, age, educational level, height and body weight*).

Questionnaires 2 and 3 were emailed during the intervention period and assessed participants' *eating behavior at specific moments*. The participants were asked what they had consumed in their worksite cafeteria on the previous day. Subsequently, they were asked to report their consumption between lunchtime and the end of their working day, and between the end of their working day and dinner. The participants were also asked to provide specific information about the meal that they had eaten outside the worksite cafeteria (that is, *was this meal eaten at home, did the participant have a starter or a dessert and was the portion of this meal larger than usual?*).

In the last week of the intervention period, questionnaire 4 was sent to the participants. The participants in conditions 1 and 2 were asked to report *how often they had chosen a smaller portion size of the hot meal in their worksite cafeteria in the past months* and whether they *ate more than usual on days that they had chosen a smaller portion size*.

Further, the participants in all the conditions were asked about their *attitudes toward smaller portions* (for example, pleasantness, need, good–bad) with seven five-point Likert items ($\alpha = 0.94$). Participants were also asked to report to what extent they thought that the small meals corresponded to their energy requirements and contributed to maintaining a healthy weight.

Additionally, the *dietary restraint* (that is, the tendency to eat less than desired) scale derived from the Dutch Eating Behavior Questionnaire¹⁸ was included. The dietary restraint scale consists of 10 five-point Likert items ($\alpha = 0.93$).

Data analyses

Sales data. The sales percentage of the small hot meals in relation to the total sales of hot meals was calculated. Longitudinal data analysis was used to investigate:

- Whether the introduction of smaller meals would lead to a difference in total sales of hot meals between the experimental and control condition.
- The occurrence of compensation behavior by comparing the sales figures of fried hot snacks between the experimental conditions and the control condition.
- The impact of proportional pricing by comparing the sales of the smaller meals between condition 1 (proportional pricing) and condition 2 (value size pricing).

To account for the repeated measurements within worksite cafeterias, linear mixed models including random cafeteria effects (that is, random intercepts) were used. Level 1 covered the repeated measurements related to each cafeteria. Level 2 was used to explain the variation between cafeterias in outcome by including treatment condition as a covariate. We investigated, by comparing the residual maximum likelihood log-likelihoods of the mixed models, if it was necessary to allow the random effects to vary over time (that is, by also including random slopes). However, this was not necessary. If needed, we also adjusted for baseline differences. In those cases, in the models post-baseline values were used as the repeated measurements controlled for the baseline values. Interaction of treatment conditions with time were used to study if treatment effects changed over time.

Consumer panel. First, the proportion of participants who had chosen a smaller meal was assessed for questionnaires 2 and 3.

Second, it was assessed whether offering a smaller meal lead to compensatory food intake in the worksite cafeteria or at a later moment during the day. This was achieved by comparing participants' *eating behavior at specific moments* between the control condition (among participants who had eaten a hot meal in the worksite cafeteria on the previous day in questionnaire 2 and/or 3, $n = 104$) and the experimental conditions (among participants who had indicated that they had selected a *smaller meal* in the worksite cafeteria on the previous day in questionnaire 2 and/or 3, $n = 11$). In addition, percentages were calculated of participants' self-reported compensation behavior in questionnaire 4 ($n = 308$).

Third, to assess which consumers were inclined to select the smaller meal, participants' weight status, sex, age, dietary restraint and educational level were included as predictors in a linear regression analysis with the self-reported frequency of selecting smaller meals as the outcome variable (questionnaire 4, participants in the experimental conditions). The extent to which participants thought that the small portion corresponded to their energy requirements and contributed to maintaining a healthy weight were

also entered as predictors of the self-reported frequency of selecting smaller meals.

Fourth, descriptive statistics of the consumer attitudes toward the availability of smaller meals were calculated for participants in the experimental conditions.

For the analyses of the consumer data, multilevel logistic and multilevel linear mixed models were used to account for the clustering of the participants within worksite cafeterias. However, with the analyses of compensatory eating behavior in questionnaire 2 and/or 3, there was not enough statistical power to run multilevel models. Instead, Fisher's exact test was used.

Both the longitudinal analyses of the sales data and the multilevel analyses of the consumer data were carried out using Stata Software version 10 (StataCorp LP, College Station, TX, USA); SPSS version 17 was used for all other analyses (IBM Corporation, Somers, NY, USA). The sales and consumer data were collected and analyzed in 2009.

Results

Compliance with the study protocol

During the worksite cafeteria visits, it was witnessed that all the intervention worksites offered smaller meals in addition to the existing size. Further, 15 of the 17 intervention cafeterias communicated the price of both sizes at the point of choice. In one worksite cafeteria only the price for the smaller meal was communicated, and in one worksite cafeteria the prices were not clearly communicated. In both cafeterias, this was adjusted after the visit.

Does offering a smaller meal stimulate people to replace their large meal with a smaller meal?

The consumer data indicate that participants in the experimental conditions had a fairly positive attitude toward smaller portion sizes (mean = 3.69, s.d. = 0.07).

Further, Table 2 provides an overview of the average sales figures before and during the intervention. During the intervention period, a daily average of 1.43 (s.d. = 0.11) small meals per 50 customers was sold in the experimental

Table 2 Average number (s.d.) of meals and snacks sold per 50 costumers per day

Sales units	Experimental condition 1		Experimental condition 2		Control condition	
	Baseline	Intervention	Baseline	Intervention	Baseline	Intervention
Large meal ^a	—	10.27 (1.39) ($n = 112$)	—	8.61 (1.07) ($n = 101$)	—	—
Small meal ^a	—	1.23 (0.13) ($n = 112$)	—	1.66 (0.17) ($n = 101$)	—	—
Meals total	15.41 (1.56) ($n = 119$)	13.67 (1.45) ($n = 141$)	15.12 (1.56) ($n = 119$)	14.33 (1.50) ($n = 129$)	5.56 (0.22) ($n = 136$)	4.98 (0.20) ($n = 131$)
Fried snacks	9.16 (0.40) ($n = 85$)	9.54 (0.35) ($n = 109$)	11.14 (0.47) ($n = 85$)	9.67 (0.44) ($n = 95$)	10.72 (0.42) ($n = 119$)	11.21 (0.53) ($n = 114$)

^aFor the large and the small meals no baseline and control condition values were applicable.

conditions ($n = 213$). In that same period, the average sales of all the hot meals in the experimental conditions was 13.99 (s.d. = 1.04) per 50 customers per day ($n = 270$). Consequently, the proportion of small meals sales in relation to large meals sales was 10.2%. This percentage was in line with the consumer data that indicated that in questionnaire 2, 10.3% ($n = 6$) and in questionnaire 3, 12.7% ($n = 7$) of the participants chose the small meal.

In order to assess whether the small meal sales comprising of 10.2% of the total sales figures of hot meals were indeed caused by replacement of the large meal with the smaller meal, it was assessed whether during the intervention period, the sales figures of all hot meals were higher in the experimental conditions than in the control condition. No significant differences were found in the number of hot meals sold ($B = 1.15$ (1.43), $P = 0.42$, confidence interval (CI): -1.65 to 3.95). Further, no significant interaction effect with time was found.

Is there an additional effect of proportional pricing?

It was assessed whether proportional pricing had an additional effect on consumers' size choices. No significant differences in small meal sales were found over time between study condition 1 (proportional pricing) and study condition 2 (value size pricing) ($B = -0.11$ (0.33), $P = 0.74$, CI: -0.76 to 0.54). In addition, no interaction with time was found.

Further, the consumer data (questionnaire 4) showed that the self-reported frequency of small meal purchases did not differ over time between condition 1 and condition 2 ($B = -0.20$ (0.29), $P = 0.50$, CI: -0.77 to 0.38 , $n = 177$).

Does offering a smaller meal lead to compensatory food intake in the worksite cafeteria or at a later moment during the day?

Sales figures of fried snacks were assessed to account for compensatory food intake as a result of the intervention. No significant difference was found longitudinally between the experimental conditions and the control condition ($B = -0.89$ (1.11), $P = 0.42$, CI: -3.06 to 1.28). Further, no significant interaction with time was found.

On the other hand, the consumer data indicated that participants in the experimental conditions who had selected a smaller meal in the worksite cafeteria (in questionnaire 2 and/or 3) were more likely to have a starter before the meal that they ate outside the worksite cafeteria (27.3%, $n = 3$) than participants in the control condition (5.1%, $n = 3$) ($P = 0.05$, Fisher's exact) and to have a larger portion than usual of the meal that they ate outside the worksite cafeteria (27.3%, $n = 3$) than participants in the control condition (3.4%, $n = 2$) ($P = 0.03$, Fisher's exact). Finally, in questionnaire 4, 19.5% ($n = 14$) of the participants reported that they often-to-always purchased more products than usual in the worksite cafeteria on days that a smaller meal was chosen. In addition, 13.9% ($n = 10$) often-to-always had larger meals than usual on days when a smaller meal was chosen in the cafeteria, and 11.1% ($n = 8$) often-to-always ate more in between meals on these days.

Which consumers are inclined to select the smaller meal?

Table 3 shows that men reported a lower frequency of selecting a small meal than women. Second, dietary restraint was positively associated with selecting small meals. Third, compared with the lowest educational level, participants with an average or high level chose a small meal less frequently. Finally, there was a trend for body mass index having a positive association with a higher frequency of selecting a small meal in the worksite cafeteria.

Furthermore, higher endorsement scores on the statement that small portions corresponded to their energy requirements were associated with a higher self-reported frequency of small meal purchases. Finally, the extent to which participants thought that the small portion contributed to maintaining a healthy weight, significantly predicted the small portion purchase frequency.

Discussion

On the basis of both the sales and consumer data, it can be concluded that when offering a smaller meal in addition to

Table 3 Regression of self-reported frequency of small meal purchases on selected sociodemographic and cognitive predictors among consumers in the experimental conditions

	<i>B</i>	<i>s.e.</i>	<i>P</i>	<i>CI</i>	<i>n</i>
Sex (male)	-0.85	0.20	0.00	-1.24 to -0.46	178
Dietary restraint	0.36	0.11	0.00	0.015 to 0.58	178
Age	0.01	0.01	0.13	-0.00 to 0.03	178
BMI	0.04	0.02	0.09	-0.00 to 0.09	176
Average educational level ^a	-2.95	1.34	0.03	-5.59 to -0.32	178
High educational level ^a	-3.29	1.33	0.01	-5.91 to -0.68	178
Small portions correspond to my energy requirements ^b	0.63	0.07	0.00	0.50 to 0.76	178
Small portions contribute to maintaining a healthy weight ^b	0.41	0.08	0.00	0.26 to 0.56	178

Abbreviations: BMI, body mass index; CI, confidence interval. ^aReference category: low educational level. ^bEndorsement with this statement on a five-point Likert scale.

the existing size, a percentage of the consumers that is considered reasonable were inclined to replace the larger meal with the smaller meal. Especially, since for practical reasons the smaller portion could not be offered daily, this might have suppressed the consumer demand. As the intervention did not lead to increasing sales of the total number of hot meals, it is likely that consumers who previously bought the large meal replaced this by the small meal.

Second, employing proportional prices for the smaller meal did not have an additional effect. This is in line with another study evaluating the impact of proportional prices of fast-food items on consumer choices.¹¹ An explanation for the findings of both studies might be that the price differences between the portion sizes were too small. This might especially be the case in worksite cafeterias where prices are generally low.

Third, with respect to compensatory eating behavior, the results are more tentative. The sales figures indicate that consumers did not compensate for their small meal by purchasing fried snacks. However, compensation behavior may have occurred with respect to other foods of which the sales figures were not tracked. Furthermore, based on the consumer data, there are indications that compensatory food intake may have taken place. This corresponds with other studies demonstrating that compensatory food intake may occur.^{20–23} For people with a healthy weight, compensating for a small portion would not necessarily be problematic (especially if this would lead to a more varied consumption pattern). However, although the data with respect to compensatory eating behavior are limited, they could have important implications for people who are overweight or obese, who risk not benefiting from the intervention. So far, no studies assessing the effectiveness of environmental interventions are known that have taken compensatory food intake into account. Further research that addresses compensatory food intake (especially among people who are overweight or obese) is needed.

Fourth, participants in the experimental conditions had fairly positive attitudes toward smaller portion sizes. This is important, as consumer attitudes are relevant for a sustainable implementation of such interventions.²⁴

Finally, the consumer data indicated that, among others, women more often reported to have selected small meals than men. A similar statistical trend was found for participants with a higher body mass index. Although these findings are based on self-reported data and a social desirability bias cannot be ruled out, it is promising that the intervention seems to appeal to a relevant target population.

This study is the first study that assesses the effectiveness of offering a smaller portion size in addition to the existing size and pricing strategies on consumer behavior. Although it provides important data on its effectiveness, the study also has some limitations. A first limitation is that it is conceivable that consumers who normally did not buy hot meals in their worksite cafeteria started to do so as a result of the availability of smaller meals. Despite the fact that the

sales data do not point in that direction, we have no consumer data to rule out this possibility.

In addition, in order to assess compensation behavior, for practical reasons participants' eating behavior was measured at a number of specific moments rather than with a 24-h food recall, which would be more valid and reliable. Moreover, compensation behavior in the experimental conditions could only be measured among participants who had completed questionnaire 2 and/or 3 and had eaten a small meal on the day before completing the questionnaire. This resulted in low statistical power and it is therefore necessary to interpret the results with respect to compensation behavior with caution.

Furthermore, it is possible that, as a result of the relative low overweight and obesity prevalence, the study population had more favorable attitudes toward small portion sizes than the general Dutch population.

Finally, because of the drop-out of participants from the consumer panel, it is unsure whether the consumer data are representative of all the participating worksite cafeteria visitors. However, no significant differences in relevant background variables were found between the participants in the final sample and the participants who had only completed questionnaire 1.

For future studies in this area, it is recommended to collect both a broader range and more reliable consumer data. This could be achieved by recruiting a larger number of worksite cafeterias and by allocating more resources to compensate the participants for their time and effort. In that manner more extensive questionnaires could be administered and a higher response rate could be achieved. Additional consumer data could provide more insight in the mechanisms of compensatory behaviors.

On the basis of the results of this study it is concluded that offering smaller meals in addition to the existing size did help a relevant group of consumers to reduce their food intake. Therefore, this is a promising and feasible intervention that could also be extended to other point-of-purchase settings. Possibly, communicating that small portion sizes can help people to maintain a healthy weight might encourage more consumers to select small portions. Furthermore, in worksite cafeterias proportional pricing was not effective. However, it remains to be investigated whether this is also the case in settings where hot meals are more expensive. Finally, the possible occurrence of compensation behavior is an issue that merits further research.

Conflict of interest

The authors declare no conflict of interest.

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