

# Effectiveness of a Canteen Take Away concept in promoting healthy eating patterns among employees

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## Abstract

*Objective:* To investigate the effectiveness of a relatively novel concept of providing employees with healthy ready-to-heat meals to bring home to their families, here referred to as Canteen Take Away (CTA).

*Design:* Employees' dietary intake on two weekdays when they received free CTA was compared with that on weekdays when they did not receive CTA. Four non-consecutive 24 h dietary recalls were applied to assess dietary intake on a daily basis. Moreover, a digital photographic method was used to assess evening meal intake for three consecutive weeks. Data were analysed using a mixed-effects model.

*Setting:* A financial worksite offering CTA.

*Subjects:* Twenty-seven employees.

*Results:* Overall dietary quality as expressed by the energy density of the food (excluding beverages) was found to be significantly lower on days consuming CTA meals compared to days not consuming CTA with regard to evening meal intake (average difference:  $-187$  (95% CI  $-225, -149$ ) kJ/100 g) and on a daily basis (average difference:  $-77$  (95% CI  $-132, -21$ ) kJ/100 g). Other favourable differences included increased vegetable intake (average difference:  $83$  (95% CI  $67, 98$ ) g/evening meal,  $109$  (95% CI  $62, 155$ ) g/d).

*Conclusion:* The present study shows that providing healthy take-away dinners has potential for promoting healthy dietary habits among employees. This reinforces the importance of availability and convenience as effective tools to promote healthy eating habits.

**Keywords**  
Worksite  
Health promotion  
Dinner meals  
Nutrition

The prevention of obesity has become a major public health target. Focus has shifted from considering obesity, nutrition and health as mainly private issues to recognizing the responsibility of society in creating environments and conditions that may support and promote healthy eating habits and an active lifestyle<sup>(1–3)</sup>. Consequently, settings like worksites and schools have received increasing attention as important health-promoting platforms<sup>(3,4)</sup>, and many private and public companies are showing interest in investing in health-promoting initiatives to protect and develop their human resources<sup>(5)</sup>.

Health-promoting initiatives aimed at increasing the availability and accessibility of healthy food at the worksite have been shown in some environments to provide an efficient and sustainable approach to improving employees' dietary habits (e.g. free available fruit and serving more fruit and vegetables at worksite canteens)<sup>(6–8)</sup>. Moreover, these kinds of environmental-level initiatives may not be restricted to a self-selected subset of motivated individuals

who choose to participate in worksite health promotion programmes but rather has the potential to impact the entire worksite population<sup>(9)</sup>.

Health-promoting initiatives across the settings of the worksite and the home environment provide new opportunities for enabling and promoting a healthy eating pattern. A previous study found that involving the family to create a supportive home environment in addition to a supportive worksite environment resulted in an increase in total fruit and vegetable intake among workers in the worksite-plus-family group compared with the control group<sup>(10)</sup>.

A direct way of reaching families is by providing employees with healthy ready-to-heat meals offered by the worksite to bring home to their family or elsewhere, at subsidized or market prices. This relatively novel concept, here referred to as healthy Canteen Take Away (CTA), seems to be growing in popularity among employees in Western countries<sup>(11)</sup>. Also, Heinen and Darling mention

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healthy dinners-to-go offered in the employees' café as an opportunity for employers to impact and help employees and their families to reduce and manage health risk factors such as obesity<sup>(5)</sup>. In Denmark we have gathered some information from twenty companies that have already some experience in operating CTA concepts. Different concepts were developed and adapted to the specific character of each worksite. The worksite canteens produce, pack and offer the CTA meals once, twice or several times per week. The employees order their take-away meals usually the day before and pay for and collect them at the canteen on their way home the next day.

To our knowledge the effectiveness of the CTA health-promoting concept in improving employees' dietary habits has not been described in the scientific literature. Possible nutritional health benefits may include improvement of the nutritional quality of the diet of employees and their families directly by the provision of healthy meals that may substitute less healthy meals, including other types of ready meals and fast food<sup>(12)</sup>, and in the long term influence the norms for healthy eating<sup>(13)</sup>. Lack of time to prepare healthy meals as well as habit are frequently reported barriers for not following nutritional recommendations, especially for those who intend to eat healthily but do not do so<sup>(14)</sup>. From the perspective of the employee another important argument for supplying CTA meals is as a way of tackling the work–family conflict<sup>(15)</sup>. CTA meals may reduce the time needed for shopping, cooking and cleaning at home, thereby helping employees in their daily life to balance work demands with personal and family commitments<sup>(16)</sup>.

The present study is a part of a bigger public–private partnership project aimed at identifying and disseminating solutions to practical challenges associated with setting up a take-away service in worksite canteens. Three research partners and twelve private and public partners are behind this project, including governmental institutions, labour unions and private companies. The aim of the present study was to investigate the effectiveness of a CTA concept in promoting healthy eating habits among employees by evaluating the nutritional quality of employees' evening meal intake and their total daily intake on weekdays when they received CTA compared to weekdays not receiving CTA.

## Methods

### *Recruitment and study design*

A financial worksite that offered CTA twice weekly (Wednesdays and Fridays) to 750 employees was invited to participate in the present study. About one-third of employees used the scheme regularly. The worksite had offered take-away meals from an in-house canteen to the employees and their families for almost 5 years, being one of the first companies to offer CTA in Denmark.

The employees may buy the CTA meals at a price equivalent to the cost of the raw materials and labour. The worksite also offers lunch meals in the canteen as well as free fruit. The worksite was encouraged to supply CTA meals during the study period that would follow generally recognized nutrition recommendations. The simple food-based Healthy Meal Index was provided to the canteen as a tool to evaluate the nutritional quality of the CTA meals. The Healthy Meal Index, as described in a previous paper, focuses on the contents of fruit and vegetables, fat content and quality and contents of wholegrain products and potatoes<sup>(17)</sup>. Furthermore, the worksite supported the participation of employees in the study by paying for time off work in order to receive instruction and to complete the dietary interviews. No health promotion activities were directly connected with the CTA project.

All employees working in the worksite were given the opportunity to participate in the present study by an announcement in the worksite's internal newsletter describing the study. Participants received CTA meals free of charge throughout the study period for themselves as well as for their families. Eligible for inclusion were healthy men and healthy non-pregnant women aged 18 years and older expecting to be present at the worksite throughout the 7-week study period (middle of October to the beginning of December 2008). The study was performed in accordance with the ethical standards of the Helsinki Declaration of 1975, as revised in 2008. Written, informed consent was obtained from all participants.

A total of thirty-four employees responded to the announcement. Out of these twenty-eight enrolled in the study. Reasons for not enrolling were either time pressure (four employees) or illness (two employees). Moreover, data from one participant were excluded from the analysis due to deliberate weight loss during the study. Thus, the number of participants included in analysis was twenty-seven.

During the study period the project team randomly selected two portions of each CTA meal provided and weighed each component separately to get a picture of the meals provided by the worksite (ten different CTA meals).

### *Dietary assessment and background information*

Two different dietary assessment instruments were applied for both CTA days and days not receiving CTA (non-CTA days). Four face-to-face 24 h dietary recalls were applied on non-consecutive days over the 7-week study period (different weeks) to measure total food intake during the previous weekday in order to get total dietary intake on CTA and on non-CTA days. Two of the 24 h dietary recalls were scheduled on Thursdays to get intakes during the previous day receiving CTA and two were equally scheduled on Tuesdays, Wednesdays and Fridays to measure the food intake during the previous day with no CTA provided. Due to employees having weekends off it was not possible to perform interviews on Saturdays to measure food intakes on Fridays. The 24 h dietary recall

questionnaire was a modified form of the dietary record questionnaire from the Danish National Dietary Survey 2000–2002<sup>(18)</sup>. For canteen lunch and take-away meals, recipes were provided by the canteen manager in order to obtain more precise estimates of intake.

Furthermore, a digital photographic method recording evening meal intake at weekdays for three consecutive weeks was applied to obtain more precise nutrition information on CTA meals in relation to non-CTA meals. Participants were randomly assigned to start the photographic recording from the beginning of either the second or the fourth week of the 7-week study period. Participants were provided with digital cameras and were instructed orally and given detailed written information on how to capture images of their evening meals served on plates (both CTA and non-CTA meals) for all weekdays in three consecutive weeks. The cameras were Nikon Coolpix S210 with electronic VR image stabilization and Motion Detection for sharp, steady results. Briefly, images should be taken before eating and again after finishing eating, including possible leftovers, using the auto function while seated at the table pointing the camera at a 45° angle towards the plates. A ruler was provided to be placed beside the plate as an internal reference in all images. The participants were asked to keep different meal components separate on the plate, and it was emphasized that images should be taken of all foods, including extra food portions, if necessary, on additional plates. Additionally, participants were provided with a notebook to record the recipes and ingredients given in either grams or common household measures like cups, spoons, slices, etc. The participants were repeatedly reminded by emails to pick up their CTA meals and to record their evening meal intake using the digital photographic method at weekdays throughout the 3-week recording period. An average of one evening meal for each participant (out of fifteen recording days) was not recorded, resulting in a compliance rate of 94%.

Two trained image analysts working within the area of food and nutrition estimated the weights of individual foods within the meals. Beverages were not included as food and drinks have differing effects on satiety and energy intake and in order to enhance comparability with other studies<sup>(19,20)</sup>. The validity of the digital photographic method was tested prior to the survey in another study against the weighed record method of nineteen participants' usual evening meals for five consecutive days. Correlation coefficients between the two methods for intake of major food groups and nutrients, including energy content and macronutrient distribution, were between 0.83 and 0.97. Comparable means and acceptable limits of agreement (mean difference  $\pm$  2 SD) were found with regard to macronutrient distribution, energy density and energy-adjusted foods<sup>(21)</sup>.

The software program General Intake Estimation Systems version 0.995f (2008-08.04; Danish Food Institute,

Technical University of Denmark, Soeborg, Denmark) and the Danish Food Composition Databank<sup>(22)</sup> were used to calculate food and nutrient intakes for both dietary assessment methods and for the CTA meals provided by the worksite. At the beginning of the study period height and body weight (participants without shoes and wearing light indoor clothing) were measured using a Soehnle (Backnang, Germany) Verona Quattrotronic digital scale (model 63686) to the nearest 0.1 kg, and a Soehnle 5001 Ultrasonic Height Measure to the nearest centimetre, respectively. BMR was estimated according to Schofield's equations<sup>(23)</sup> and the ratio of estimated energy intake (EI) to estimated BMR (EI:BMR) was calculated.

Background information such as gender, age, education and occupation was assessed using a questionnaire based on the questionnaire from the Danish National Dietary Survey 2000–2002<sup>(24)</sup>.

### **Statistical analysis**

Outcome variables from both the 24 h dietary recalls and the digital photographic method included fruit and vegetable intake (g/d and g/10 MJ, excluding potatoes and a maximum of 100 g of fruit juice daily in accordance with the Danish dietary guidelines<sup>(25)</sup>), dietary fibre intake (g/10 MJ), total energy intake (kJ) and energy density excluding beverages (kJ/100 g), and finally macronutrient intakes including total fat, saturated fat, protein, carbohydrate and added sugar (percentage of total energy intake, %E). First, all outcome variables were described univariately in terms of unadjusted mean differences between CTA and non-CTA meals. A multivariate analysis was then performed by means of a mixed-effects model, using SAS Enterprise Guide 4.0 (SAS Institute Inc., Cary, NC, USA). Evening meal type, i.e. CTA or non-CTA meals, was included as a fixed effect as well as gender, age, BMI and education (two levels: primary school/high school or university or equivalent). To adjust for dependency in repeated measures within subjects, random effects were added for employee. The interaction between time in the study and meal type was tested and found insignificant. Homogeneity of variance and normality of the residuals were examined using graphical methods. Given the multitude of statistical tests, a *P* value of <0.01 was taken in order to reduce the probability of false-positive findings.

## **Results**

### **Participants' characteristics**

Half of the participants (52%) were women. The mean age was 40 (SD 6, range 27–52) years and mean BMI was 24 (SD 2) kg/m<sup>2</sup>. Forty-one per cent of the participants were overweight whereas none were obese. Sixty-three per cent of the participants had completed a medium-term or long-term higher education. The majority of the participants lived with a partner and children (70%). The rest

lived alone (11%), with a partner or another adult (11%) or with children only (7%). Unfortunately we have no detailed information on the general employee profile of the worksite. However, according to personal communication with the canteen and personnel managers, the participants in the present study did not differ considerably from other employees at the worksite.

### Evening meal intake

The nutritional composition of the CTA meals provided by the worksite during the study is shown in Table 1. On average the provided meals contained 3.0 (SD 0.5) MJ with an average energy density of 520 (SD 134) kJ/100 g.

Employees' nutritional intakes from CTA and non-CTA meals assessed by the digital photographic method are shown in Table 2. The CTA meals consumed contained

**Table 1** Nutritional composition of the CTA meals provided during the study

	CTA meals (n 10)	
	Mean	SD
Energy (kJ)	2966	476
Energy density (kJ/100 g)	520	134
Carbohydrate (%E)	40.5	9.0
Protein (%E)	27.5	4.6
Fat (%E)	31.5	12.0
Saturated fat (%E)	9.5	3.8
Added sugar (%E)	0.5	1.7
Fibre (g/10 MJ)	38	7
Fruit and vegetables (g)*	234	69
Vegetables (g)*	216	69
Fruit (g)	35	16
Fruit and vegetables (g/10 MJ)	787	147
Vegetables (g/10 MJ)*	729	156
Fruit (g/10 MJ)	59	61

CTA, Canteen Take Away; %E, percentage of total energy intake.

\*Excluding potatoes.

on average 2.6 (SD 0.8) MJ, of which 30.3 (SD 11.0) % came from fat, and on average 200 (SD 71) g vegetables, corresponding to the average amount of vegetables found in the CTA meals provided by the company (234 (SD 69) g). The average energy density of the consumed meals was 462 (SD 60) kJ/100 g.

The results from the mixed-effects model analysis showed that the CTA meals contained on average 88 (95% CI 71, 104) g more fruit and vegetables and 18 (95% CI 15, 20) g more dietary fibre per 10 MJ compared to the non-CTA meals ( $P < 0.01$ ). Fat content was on average 7.8 (95% CI  $-10.3, -5.4$ ) %E lower for the CTA meals compared to the non-CTA meals, whereas energy density on average was 187 (95% CI  $-225, -149$ ) kJ/100 g lower compared to the non-CTA meals ( $P < 0.001$ ). A gender-related effect on energy intake was seen (0.7 MJ lower for women compared to men) as well as an age- and BMI-related effect on dietary fibre intake, with decreasing intake with increasing age and increasing BMI. Otherwise, there were no significant effects of gender, education, BMI or age.

### Daily dietary intake

For the assessment of under-reporting of energy intake, the EI:BMR ratio was determined for each participant. Average EI:BMR was 1.44 (SD 0.3) with three of the participants (11%) below the Goldberg cut-off value of 1.06 (4 d of dietary data; not shown)<sup>(26)</sup>. The data presented on total daily intake in Table 3 include the under-reporters, as removal of under-reporters did not change the overall trends observed. The results from the mixed-effects model analysis revealed that participants' intake of fruit and vegetables was significantly higher on days receiving CTA compared to days not receiving CTA when expressed as both g/d and g/10 MJ (Table 3). The intake of fruit and vegetables was on average 129 (95% CI 49, 210) g higher

**Table 2** Employees' evening meal intake on days receiving CTA and on days not receiving CTA (beverages not included) assessed by the digital photographic method

	CTA meals (n 144)		Non-CTA meals (n 236)		Unadjusted difference		Adjusted difference*		
	Mean	SD	Mean	SD	Mean	Mean	95% CI	P value	
Energy (kJ)	2557	802	3102	1598	-545	-544	-795, -293	<0.001	
Energy density (kJ/100 g)	462	60	648	227	-186	-187	-225, -149	<0.001	
Carbohydrate (%E)	41.8	9.0	40.8	13.0	1.0	0.9	-1.4, 3.2	0.45	
Protein (%E)	27.7	5.6	20.9	8.0	6.8	6.7	5.2, 8.2	<0.001	
Fat (%E)	30.3	11.0	38.2	12.3	-7.9	-7.8	-10.3, -5.4	<0.001	
Saturated fat (%E)	9.3	4.4	15.8	6.9	-6.5	-6.5	-8, -5	<0.001	
Added sugar (%E)	0.3	1.2	2.9	6.4	-2.7	-2.7	-4, -2	<0.001	
Fibre (g/10 MJ)	42	13	24	14	18	18	15, 20	<0.001	
Fruit and vegetables (g)†‡	217	78	129	89	88	88	71, 104	<0.001	
Vegetables (g)†	200	71	117	87	83	83	67, 98	<0.001	
Fruit (g)‡	16	30	12	28	5	5	-1, 11	0.09	
Fruit and vegetables (g/10 MJ)†‡	868	252	478	372	390	390	323, 458	<0.001	
Vegetables (g/10 MJ)†	807	250	444	380	363	363	295, 432	<0.001	
Fruit (g/10 MJ)‡	61	111	34	82	27	27	7, 46	0.01	

CTA, Canteen Take Away; %E, percentage of total energy intake.

\*Adjusted difference from a multivariate analysis performed by means of a mixed-effects model. Adjusted for gender, age, BMI and education.

†Excluding potatoes.

‡Including not more than 100 g fruit juice/person per d.

**Table 3** Employees' total daily intake on days receiving CTA and on days not receiving CTA assessed by 24 h dietary recalls

	CTA days (n 41)		Non-CTA days (n 67)		Unadjusted difference	Adjusted difference*		
	Mean	SD	Mean	SD	Mean	Mean	95 % CI	P value
Energy (kJ)	9881	3357	9581	3204	301	249	-693, 1190	0.60
Energy density (kJ/100 g)†	603	140	685	182	-82	-77	-132, -21	0.01
Carbohydrate (%E)	47.4	6.8	49.0	7.9	-1.6	-1.3	-3.9, 1.4	0.35
Protein (%E)	18.8	3.3	15.8	3.0	3.0	2.7	1.6, 3.8	<0.001
Fat (%E)	32.1	6.5	32.8	6.9	-0.7	-0.7	-3.1, 1.8	0.54
Saturated fat (%E)	12.1	3.6	13.6	3.7	-1.4	-1.4	-2.7, -0.1	0.03
Added sugar (%E)	5.6	5.0	6.7	5.1	-1.0	-0.7	-2.4, 1.1	0.45
Fibre (g/10 MJ)	32	10	29	10	3	3	0, 5	0.06
Fruit and vegetables (g)‡§	703	241	555	266	148	129	49, 210	0.002
Vegetables (g)‡	383	190	254	162	129	109	62, 155	<0.001
Fruit (g)§	320	203	301	204	20	20	-47, 86	0.56
Fruit and vegetables (g/10 MJ)‡§	784	379	615	321	169	146	56, 236	0.002
Vegetables (g/10 MJ)‡	440	330	285	242	155	125	61, 190	<0.001
Fruit (g/10 MJ)§	344	210	330	218	14	21	-49, 90	0.56

CTA, Canteen Take Away; %E, percentage of total energy intake.

\*Adjusted difference from a multivariate analysis performed by means of a mixed-effects model. Adjusted for gender, age, BMI and education.

†Excluding beverages.

‡Excluding potatoes.

§Including not more than 100 g fruit juice/person per d.

on CTA days compared to non-CTA days ( $P=0.002$ ). The difference in intake of vegetables alone was 109 (95 % CI 62, 155) g between meal types ( $P<0.001$ ). Moreover, energy density and protein content were significantly lower and higher, respectively, on days receiving CTA compared to non-CTA days (an average difference of  $-77$  (95 % CI  $-132, -21$ ) kJ/100 g on a daily basis,  $P=0.01$ , and an average difference of  $2.7$  (95 % CI  $1.6, 3.8$ ) %E on a daily basis,  $P<0.001$ , respectively). A gender-related effect was seen both for energy intake ( $2.9$  MJ lower for women compared to men) and energy-adjusted vegetable intake ( $269$  g/10 MJ higher for women compared to men). Moreover, a BMI-related effect was seen for fruit intake, with decreasing intake with increasing BMI (expressed both as g and g/10 MJ). Otherwise no significant effects were seen of gender, education, BMI or age.

## Discussion

The results showed that receiving CTA from the worksite was associated with a higher overall nutritional quality of evening meals compared to non-CTA meals when using energy density as a dietary quality marker<sup>(27)</sup>. Average energy density of the consumed CTA meals excluding beverages was  $462$  (SD  $60$ ) kJ/100 g, on average  $187$  (95 % CI  $-225, -149$ ) kJ/100 g lower than the consumed non-CTA meals. Also, compared to the non-CTA meals, the CTA meals showed other positive nutritional benefits, including a higher content of both dietary fibre and fruit and vegetables as well as a lower content of fat and saturated fat.

The differences observed in food and nutrient contents between the CTA and the non-CTA meals were generally reflected in dietary intakes across the whole day. The difference in intake of fruit and vegetables was on average

$129$  g/d between CTA and non-CTA days. Most of the difference in fruit and vegetable intake was accounted for by an increase of vegetable intake by  $109$  g, equalling about 1 serving. This is promising, as it is considered more challenging to increase vegetable intake compared with fruits, which require little preparation and have a sweet taste that appears to be preferred<sup>(28)</sup>.

The present study supports findings by Lachat *et al.* that providing fruit and vegetables from a university canteen led to a higher intake of fruit and vegetables among students both at lunch and on a daily basis<sup>(29)</sup>. Other studies have shown that an increase in the consumption of fast foods and an increase in the consumption of convenience or ready-prepared foods were associated with less healthy diets<sup>(30)</sup>. Bowman and Vinyard compared adults' mean dietary intake on days having fast food *v.* dietary intake on non-fast food days and found substantial differences in energy, energy density and macronutrient intakes in favour of the non-fast food days<sup>(31)</sup>. This seems to be in accordance with consumers' perception that ready meals and fast food are not seen as appropriate for dinner meals<sup>(32)</sup>.

In the present study we have no information on food intake of the participants' families. The evening meal often has special meaning in a family and is often considered as the most significant meal of the day<sup>(33)</sup>. It is likely that the evening meal intake of all participants' family members was influenced on days receiving CTA. A supportive home environment with access to healthy foods has been found to be an important determinant of healthy eating habits among children and adolescents<sup>(34,35)</sup>, and Jabs *et al.* argue that there is a need to develop healthful, affordable, child-acceptable, quickly prepared food that could help parents feel good about the way they feed their families<sup>(36)</sup>.

Providing take-away meals from the worksite could provide an alternative convenient and more nutritious food source<sup>(37)</sup> that consumers also might place more trust in compared to other ready meals from the industry<sup>(32)</sup>. However, the success of the CTA as a health-promoting activity relies on the actual quality of the meals including the nutritional quality. To match these expectations food service professionals need empowerment. Therefore, an important aim of the present public-private partnership was to develop and disseminate education and practical tools and conditions enabling the canteens to effectively implement and maintain a CTA service, including providing network opportunities and newsletters. Moreover, the simple Healthy Meal Index<sup>(17)</sup> was developed in order to help canteen personnel monitor and improve the nutritional quality of the meals offered without the use of nutrition calculation programs. Often, the canteen staff has neither the time nor the skills to perform complicated calculations<sup>(38)</sup>. Another important precondition for workers' adoption of healthy canteen meals is that they are willing to pay the price of these healthy meals, and hence that their perceived benefits exceed their perceived costs. If employees' willingness to pay does not match the extra costs of supplying such meals, additional financing could be motivated by external benefits for the employer or for society. Price responsiveness and cost-benefit analyses are being investigated by another research team in the partnership project and will be published later.

The methodology of the present study calls for caution when interpreting the results. The present study is an explorative study testing the effectiveness of a health promotion strategy under real-life conditions. This may help the adaptation and expansion of research to practice<sup>(39)</sup>. However, the lack of baseline data is a shortcoming as the provision of CTA may have positive or negative nutritional effects on the meal quality and quantity on the days before or after consumption. Participants served as their own control by comparing nutritional intake on days receiving CTA meals with days not receiving CTA. Also, we have no specific knowledge of the lunch eaten but only of the whole day intake. The knowledge of having CTA later could change the employees' food choice at lunch. The influence of these effects cannot be estimated. Also, the naturalistic experimental approach is often more difficult to manage and often lacks the control that is present in the laboratory<sup>(40)</sup>. Accordingly, participants in the present study could not be randomly selected and were not necessarily representative of the population as a whole. They were higher educated compared to the general population and probably more health conscious and had healthier lifestyles. This means that the ability to discriminate between nutritional intakes on different days receiving CTA or not receiving CTA could have been reduced to some degree. Moreover, extrapolation of the results to individuals with different occupational profiles cannot be done. The effects of the present study should be confirmed by a randomized intervention trial.

The present study is the first study to our knowledge to evaluate the effectiveness of the CTA concept in promoting healthy eating. The results are supported by two different dietary assessment methods: assessing total daily intake using 24 h recalls as well as dinner meal intake separately using a digital photographic method for recording in real time over a prolonged period of time. The limitations of 24 h recalls in capturing habitual intake at the individual level include a large day-to-day variation as well as possible under-reporting due to dependence on memory<sup>(41)</sup>. Another limitation of the 24 h recall is that socially desirable answers could be higher due to the presence of an interviewer. The mean EI:BMR of 1.4 in the present study likewise indicates that some under-reporting did occur. To avoid bias caused by either underestimation or different energy requirements, the amount of fruit and vegetables and nutrients were adjusted for energy intake and expressed either per 10 MJ or as percentage of total energy intake. More studies are needed to confirm the initial findings of the present study and to further develop feasible and effective environmental-level strategies for health promotion within and across the settings of everyday life.

In conclusion, the results from the present study suggest that providing healthy take-away dinners from the worksite has potential for promoting healthy dietary habits among employees. The nutritional quality of the employees' evening meals as well as the overall quality of their diet was significantly enhanced on days receiving CTA compared to days not receiving CTA. This reinforces the importance of availability and convenience as effective tools in promoting healthy eating habits and provides worksites with an important role in enabling and promoting healthy eating patterns even across the contexts of worksite and family.

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## References

1. Dorfman L & Wallack L (2007) Moving nutrition upstream: the case for reframing obesity. *J Nutr Educ Behav* **39**, S45–S50.
2. Elinder SL & Jansson M (2009) Obesogenic environments – aspects on measurement and indicators. *Public Health Nutr* **12**, 307–315.
3. World Health Organization (2007) *Second WHO European Action Plan for Food and Nutrition Policy 2007–2012*. Copenhagen: WHO Regional Office for Europe.
4. European Commission (2007) *White Paper on a Strategy for Europe on Nutrition, Overweight and Obesity Related Health Issues*. ENVI/6/50465. Brussels: European Commission.
5. Heinen L & Darling H (2009) Addressing obesity in the workplace: the role of employers. *Milbank Q* **87**, 101–122.
6. Alinia S, Lassen A & Tetens I (2007) Increased fruit intake and body weight management in healthy adults – a worksite intervention study. *Ann Nutr Metab* **51**, 356.
7. Lassen A, Thorsen AV, Trolle E *et al.* (2004) Successful strategies to increase the consumption of fruits and vegetables: results from the Danish ‘6 a day’ Work-site Canteen Model Study. *Public Health Nutr* **7**, 263–270.
8. Thorsen AV, Lassen AD, Tetens I *et al.* (2010) Long-term sustainability of a worksite canteen intervention of serving more fruit and vegetables. *Public Health Nutr* **13**, 1647–1652.
9. French SA (2005) Population approaches to promote healthful eating behaviors. In *Obesity Prevention and Public Health*, pp. 101–127 [D Crawford and RW Jeffery, editors]. New York: Oxford University Press.
10. Sorensen G, Stoddard A, Peterson K *et al.* (1999) Increasing fruit and vegetable consumption through worksites and families in the treatwell 5-a-day study. *Am J Clin Nutr* **89**, 54–60.
11. Wanjek C (2005) *Food at Work: Workplace Solutions for Malnutrition, Obesity and Chronic Diseases*. Geneva: International Labour Organization.
12. Jeffery RW, Baxter J, McGuire M *et al.* (2006) Are fast food restaurants an environmental risk factor for obesity? *Int J Behav Nutr Phys Act* **3**, 2.
13. Winston J, Johnson C & Wilson S (2008) Barriers to healthy eating by National Health Service (NHS) hospital doctors in the hospital setting: results of a cross-sectional survey. *BMC Res Notes* **1**, 69.
14. Groth MV, Sorensen MR, Biloft-Jensen A *et al.* (2009) *Danish Meal Habits, Attitudes, Motivations and Barriers for Healthy Eating 1995–2008*. Copenhagen: Technical University of Denmark, National Food Institute.
15. Roos E, Sarlio-Lahteenkorva S, Lallukka T *et al.* (2007) Associations of work–family conflicts with food habits and physical activity. *Public Health Nutr* **10**, 222–229.
16. Carnethon M, Whitsel LP, Franklin BA *et al.* (2009) Worksite wellness programs for cardiovascular disease prevention: a policy statement from the American Heart Association. *Circulation* **120**, 1725–1741.
17. Lassen AD, Biloft-Jensen A, Hansen GL *et al.* (2010) Development and validation of a new simple Healthy Meal Index for canteen meals. *Public Health Nutr* **13**, 1559–1565.
18. Biloft-Jensen A, Matthiessen J, Rasmussen LB *et al.* (2009) Validation of the Danish 7-day pre-coded food diary among adults: energy intake v. energy expenditure and recording length. *Br J Nutr* **102**, 1836–1846.
19. Johnson L, Wilks DC, Lindroos AK *et al.* (2009) Reflections from a systematic review of dietary energy density and weight gain: is the inclusion of drinks valid? *Obes Rev* **10**, 681–692.
20. Rolls BJ (2009) The relationship between dietary energy density and energy intake. *Physiol Behav* **97**, 609–615.
21. Lassen AD, Poulsen S, Ernst L *et al.* (2010) Evaluation of a digital method to assess evening meal intake in a free-living adult population. *Food Nutr Res* **54**, 5311.
22. Saxholt E, Christensen AT, Møller A *et al.* (2008) *Danish Food Composition Databank, Revision 7*. Soeborg: National Food Institute, Technical University of Denmark; available at <http://www.foodcomp.dk/>
23. Food and Agriculture Organization of the United Nations/World Health Organization/United Nations University (2004) *Human Energy Requirements: Report of a Joint FAO/WHO/UNU Expert Consultation*. Rome: FAO.
24. Andersen NL, Christensen T, Groth M *et al.* (2005) *Dietary Habits in Denmark 2000–2002. Main Results*. Copenhagen: Danish Institute for Food and Veterinary Research.
25. Astrup A, Andersen NL, Stender S *et al.* (2005) *Kostrådene 2005 (Dietary Guidelines 2005)*. Copenhagen: Danish Institute for Food and Veterinary Research & Danish Nutritional Council.
26. Goldberg GR, Black AE, Jebb SA *et al.* (1991) Critical evaluation of energy intake data using fundamental principles of energy physiology: 1. Derivation of cut-off limits to identify under-recording. *Eur J Clin Nutr* **45**, 569–581.
27. Patterson E, Warnberg J, Poortvliet E *et al.* (2010) Dietary energy density as a marker of dietary quality in Swedish children and adolescents: the European Youth Heart Study. *Eur J Clin Nutr* **64**, 356–363.
28. Satia JA, Kristal AR, Patterson RE *et al.* (2002) Psychosocial factors and dietary habits associated with vegetable consumption. *Nutrition* **18**, 247–254.
29. Lachat CK, Verstraeten R, De Meulenaer B *et al.* (2009) Availability of free fruits and vegetables at canteen lunch improves lunch and daily nutritional profiles: a randomised controlled trial. *Br J Nutr* **102**, 1030–1037.
30. Jabs J & Devine CM (2006) Time scarcity and food choices: an overview. *Appetite* **47**, 196–204.
31. Bowman SA & Vinyard BT (2004) Fast food consumption of US adults: impact on energy and nutrient intakes and overweight status. *J Am Coll Nutr* **23**, 163–168.
32. Prim M, Gustafsson I-B & Hall G (2007) The appropriateness of ready meals for dinner. *J Foodservice* **18**, 238–250.
33. Blake CE, Bisogni CA, Sobal J *et al.* (2008) How adults construct evening meals. Scripts for food choice. *Appetite* **51**, 654–662.
34. Pearson N, Biddle SJH & Gorely T (2009) Family correlates of fruit and vegetable consumption in children and adolescents: a systematic review. *Public Health Nutr* **12**, 267–283.
35. Woodruff SJ, Hanning RM, McGoldrick K *et al.* (2010) Healthy Eating Index-C is positively associated with family dinner frequency among students in grades 6–8 from Southern Ontario, Canada. *Eur J Clin Nutr* **64**, 454–460.
36. Jabs J, Devine CM, Bisogni CA *et al.* (2007) Trying to find the quickest way: employed mothers’ constructions of time for food. *J Nutr Educ Behav* **39**, 18–25.
37. Rydell SA, Harnack LJ, Oakes JM *et al.* (2008) Why eat at fast-food restaurants: reported reasons among frequent consumers. *J Am Diet Assoc* **108**, 2066–2070.
38. Guillard A (2001) Nutrient based quality control in public catering: need for revision. *J Food Eng* **56**, 189–193.
39. Bowen DJ, Kreuter M, Spring B *et al.* (2009) How we design feasibility studies. *Am J Prev Med* **36**, 452–457.
40. Meiselman H (2006) The impact of context and environment on consumer food choice. In *Understanding Consumers of Food Products*, pp. 67–92 [LJ Frewer and JCM van Trijp, editors]. Cambridge: Woodhead Publishing.
41. Palaniappan U, Cue RI, Payette H *et al.* (2003) Implications of day-to-day variability on measurements of usual food and nutrient intakes. *J Nutr* **133**, 232–235.