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Original article

Improved meal presentation increases food intake and decreases readmission rate in hospitalized patients

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SUMMARY

Background: Reduced food intake is a frequent problem at a hospital setting, being a cause and/or consequence of malnutrition. Food presentation can affect food intake and induce nutritional benefit.
Objectives: To investigate the effect of improved meal presentation supported by gastronomy expertise on the food intake in adults hospitalized in internal medicine departments.
Design: Controlled before and after study.
Methods: Two hundred and six newly hospitalized patients in internal medicine departments were included and divided in two groups, a) control: receiving the standard lunch from the hospital and b) experimental: receiving a lunch improved in terms of presentation by the advices received by the Institut Paul Bocuse, Ecully, Lyon, France together with the hospital kitchen of the Beilinson Hospital, without change in the composition of the meal. The amount of food left at the participants' plates was estimated using the Digital Imaging Method, which consisted in photographing the plates immediately to previous tray collection by the researcher. In addition, the nutritionDay questionnaire was used to measure other variables concerned to their food intake during hospitalization. Charlson Comorbidity Index was calculated.
Results: There was no significant difference between the groups regarding demography or Charlson Comorbidity Index. Patients who received the meal with the improved presentation showed significantly higher food intake than those who received the standard meal, despite reported loss in appetite. Participants from the experimental group left on their plate less starch (0.19 ± 0.30 vs. $0.52 + 0.41$) ($p < 0.05$) and less from the main course than the control group ($0.18 + 0.31$ vs. $0.46 + 0.41$) ($p < 0.05$). However, both of the groups left the same amount of vegetables ($0.37 + 0.36$ vs. $0.29 + 0.35$) ($p > 0.05$). Both of the groups were asked how hungry they were before the meal and no significance was shown. More participants from the experimental group reported their meal to be tasty in comparison to those in the control group (49.5% vs. 33.7% $p < 0.005$). Length of stay was not different but readmission rate decreased significantly in the study group ($p < 0.02$) from 31.2% to 13.5%.
Conclusion: Improvement of meal presentation at a hospital setting can increase food intake, reduce waste food substantially and reduce readmission rate to hospital.

Abbreviations: BMI, Body Mass Index; CCI, Charlson Comorbidity Index; CI, Confidence interval; LOS, Length of stay; NS, Not significant; *n*, Number of observations; ONS, Oral nutritional supplements; P, Probability; SD, Standard deviation.

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1. Introduction

The role of nutrition in health and disease has been well identified. Hospital malnutrition is frequently both a cause and consequence of disease [1–3]. It is estimated to occur in up to 85% of patients [4–6], depending on the screening tool implemented and the clinical setting [7]. Ill patients are assumed to have higher nutrition needs than healthy subjects [2–5,8,9], the reason is that disease can induce metabolic and/or psychological disorders, which may increase nutritional requirements (fever, catabolism, anxiety), and/or decrease food intake (anorexia, gastrointestinal dysfunction, physical disability). Depression, apathy, withdrawal or disinterest in food, physical problems with chewing and swallowing, inability to feed themselves, side effects of medication or disease state, all increase risk of poor dietary intake during the hospital stay [8]. An international audit process has been proposed to perform prevalence study of malnutrition in hospitals and has shown a malnutrition prevalence of around 45% and a close relationship between lunch eating and clinical outcome (length of stay, mortality) using multivariate analysis [1,2].

Further hospital malnutrition can be attributed to mediocre hospital meal service including unsatisfactory quality and flexibility of hospital catering [10]. Poor food quality, inadequate food availability, lack of nutrition training and knowledge among medical and nursing staff are some environmental causes of reduced oral intake [2,11,12].

Hospital food provision contributes significantly to patient well-being and recovery, supporting them physically and emotionally during their confinement [13]. Therefore, improving hospital menus and the mealtime atmosphere may improve food intake and help meet patient nutritional requirements [14,15].

It has been shown that meal appearance stated by patients was important for generating or maintaining appetite. Appetizing meals were often described as being small portions carefully arranged on the plate [6]. In addition, some patients with poor appetite found that the aroma of particular foods promoted their desire to eat [16]. Regarding taste, most patients preferred natural flavors [17]. Variety was found to be another factor associated with a positive hospital meal service experience, together with motivation to eat [18], pleasure and comfort to ensure survival [6]. Food presentation is the major factor in food intake, ceteris paribus, nutritional benefit [13,19]. Ordinary food is vital to prevent or correct undernutrition. Yet little importance has been attached to food as a means of restoring health [20]. Hospital catering has not been well-researched; however, it is the platform for initiating innovative nutrition support [21], including the development of creative and attractive food to promote patient dietary intake, especially among those patients identified as being at increased nutritional risk.

1.1. Objective

The aim of this study was to use the expertise of a well known gastronomy center to improve the presentation of a hospital meal while preserving the same cost and to study modifications in food intake and clinical outcome using the Nutrition Day Questionnaire.

2. Methods

2.1. Study population

Adults newly hospitalized in Internal Medicine Departments F and G, Rabin Medical Center, Beilinson Hospital, from April 21 to May 16, 2013 and from July 1 to July 23 respectively, were included in the present study (n = 206). The prospective open labeled, non randomized controlled study was approved by the IRB of the Rabin Medical Center. Patients receiving partial or total enteral or parenteral nutrition supplementation, patients with dementia or otherwise cognitively impaired were excluded because they were requested to respond to a food service satisfaction questionnaire in the framework of the project.

Food intake was measured resting food wastage from trays collected immediately after the patients finished their meal, using the Digital Imaging Method [22] and from the collection of the nutritionDay questionnaire after the completion of the meal [23].

2.2. Institut Paul Bocuse and Beilinson Hospital's participation

The regular meals of the hospital were reproduced at the Institut Paul Bocuse, Ecully, Lyon, France and suggested a new presentation of the dishes served at lunch time at the Beilinson hospital. In total 19 recipes, using same ingredients, were improved in terms of presentation and reproduced by the chef of the hospital in a training given by the Institut. An example of one of the dishes as they were served before and after the improvement is shown in Fig. 1.

2.3. Digital imaging method: image acquisition

Patient trays were photographed approximately 45 min after luncheon meal delivery, immediately prior to lunch tray collection. Each main meal plate was digitally captured and labeled using a Canon PowerShot A495 10.0 mega pixel camera. Images were all taken with the photographer standing in front of the tray, shooting down, so that the main meal plate was centered and occupied the entire frame. Each image was numbered, date and time stamped, and stored in jpg format on a computer. Food intake was estimated from each of the digital images which were viewed using PowerPoint (Microsoft USA).

2.4. Rating method

Each rater independently viewed each of the digital images in PowerPoint and completed the modified Comstock scale to assess food waste [24]. In this method, the rater indicated the proportion of the menu item remaining on the plate: 0%, 25%, 50%, 75%, 90% or 100%. This rating was undertaken for each of the following meal components: vegetable, starch and main course.

Furthermore, total eaten amount was calculated, resting from 100%, the sum of what was left on the plate of the three components of the dish: vegetable, starch and main course (divided by 3).

2.5. NutritionDay questionnaire

The nutritionDay questionnaire was used to assess patient nutrition intake and status. The questionnaire for each patient regarding medical, anthropometric and demographic data was completed by the study investigator. The section of food intake of the questionnaire has two subsections. The first subsection examines functional and nutrition status and was completed by the patient. The second subsection examines dietary intake and was completed by the patient at the conclusion of each meal [23,25].

2.6. Length of stay (LOS)

A short hospital stay was set at 2 days of hospitalization, an average hospital stay was set from 3 to 7 days a long hospital stay

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Fig. 1. Standard schnitzel served regularly at the Beilinson Hospital vs. Improved schnitzel served during the experiment at the Beilinson.

from 8 to 10 days and a very long hospital stay was above 10 days of hospitalization.

2.7. Age score

Age was categorized in 4 scores: Score 0 (<40 years), Score 1 (41–50 years), Score 2 (51–60 years), Score 3 (61–70 years) and Score 4 (71–80 years).

2.8. Charlson Comorbidity Index

The Charlson Comorbidity Index (CCI) is the most extensively studied comorbidity index for predicting mortality [24–26]. It assesses whether a patient will live long enough to benefit from a specific screening measure or medical intervention. CCI score was calculated according to the clinical condition of the patient, 1 to 6 points were scored for each comorbidity component, 1) Myocardial Infarction, 2) Congestive Heart Failure, 3) Peripheral Vascular Disease, 4) Cerebrovascular disease, 5) Dementia, 6) COPD, 7) Connective Tissue Disease, 8) Peptic Ulcer Disease, 9) Diabetes Mellitus, 10) Moderate to Severe Chronic Kidney Disease, 11) Hemiplegia, 12) Leukemia, 13) Malignant Lymphoma, 14) Solid Tumor, 15) Liver Disease and 16) Aids [25]. According to the present comorbidities, CCI score was categorized in a scale from 0 to 4. No comorbidity was shown as 0, low comorbidity as 1, mild comorbidity as 2, moderate/severe comorbidity as 3 and severe as 4.

2.9. Data analysis

Data were stored in Excel (Microsoft, USA) and analyzed on SPSS v21 (SPSS Inc., USA). Statistical significance was set at $p < 0.05$.

Descriptive statistics were calculated for all variables. Mann–Whitney and T-Tests were performed to analyze the significance between the study variables. Multivariate analyses of variance, adjusted for potential confounders like age and department, examined the associations of food intake per group and outcomes like length of stay, if discharged, still in hospital or death and readmission rate after 30 days of inclusion to the study.

3. Results

3.1. Demography

Descriptive statistics for gender and age parameters are presented in Table 1. Valid data were available for 206 subjects (115 M: 91 F); while not significant differences were shown, neither in mean age nor in age score, similar values were obtained when the groups were compared per participant department.

According to the Nutrition Day questionnaire results, Body Mass Index (BMI) mean was 26.7 ± 5.2 kg/m^2. More patients from the study group reported unintentional weight loss 3 months previous to hospitalization in comparison to the control 44% vs. 34%, whereas 6% and 16% respectively lost more than 5 kg in the period of time.

3.2. Diet

Figure 2 shows that participants from the experimental group left on their plate less starch (0.19 ± 0.30 vs. 0.52 ± 0.41) ($p < 0.05$) and less from the main course than the control group (0.18 ± 0.31 vs. 0.46 ± 0.41) ($p < 0.05$). However, both of the groups left the same amount of vegetables (0.37 ± 0.36 vs. 0.29 ± 0.35) ($p > 0.05$).

With a 95% confidence interval level, the total eaten amount consumed was 19% significantly higher in the experimental group

Table 1
Demographic characteristics of participants.

Characteristic	Control group	Experimental group	p
Gender			NS
Female	42 (46.2%)/91 (100%)	49 (53.8%)/91 (100%)	
Male	59 (51.3%)/115 (100%)	56 (48.7%)/115 (100%)	
Age (years) (mean + SD)	65.85 + 17.09	64.62 + 18.70	NS
Age score			NS
0 (<40 years)	10 (40%)/25 (100%)	15 (60%)/25 (100%)	
1 (41–50 years)	8 (47.1%)/17 (100%)	9 (52.9%)/17 (100%)	
2 (51–60 years)	12 (50%)/24 (100%)	12 (50%)/24 (100%)	
3 (61–70 years)	24 (49%)/49 (100%)	25 (51%)/49 (100%)	
4 (71–80 years)	47 (52.2%)/90 (100%)	43 (47.8%)/90 (100%)	

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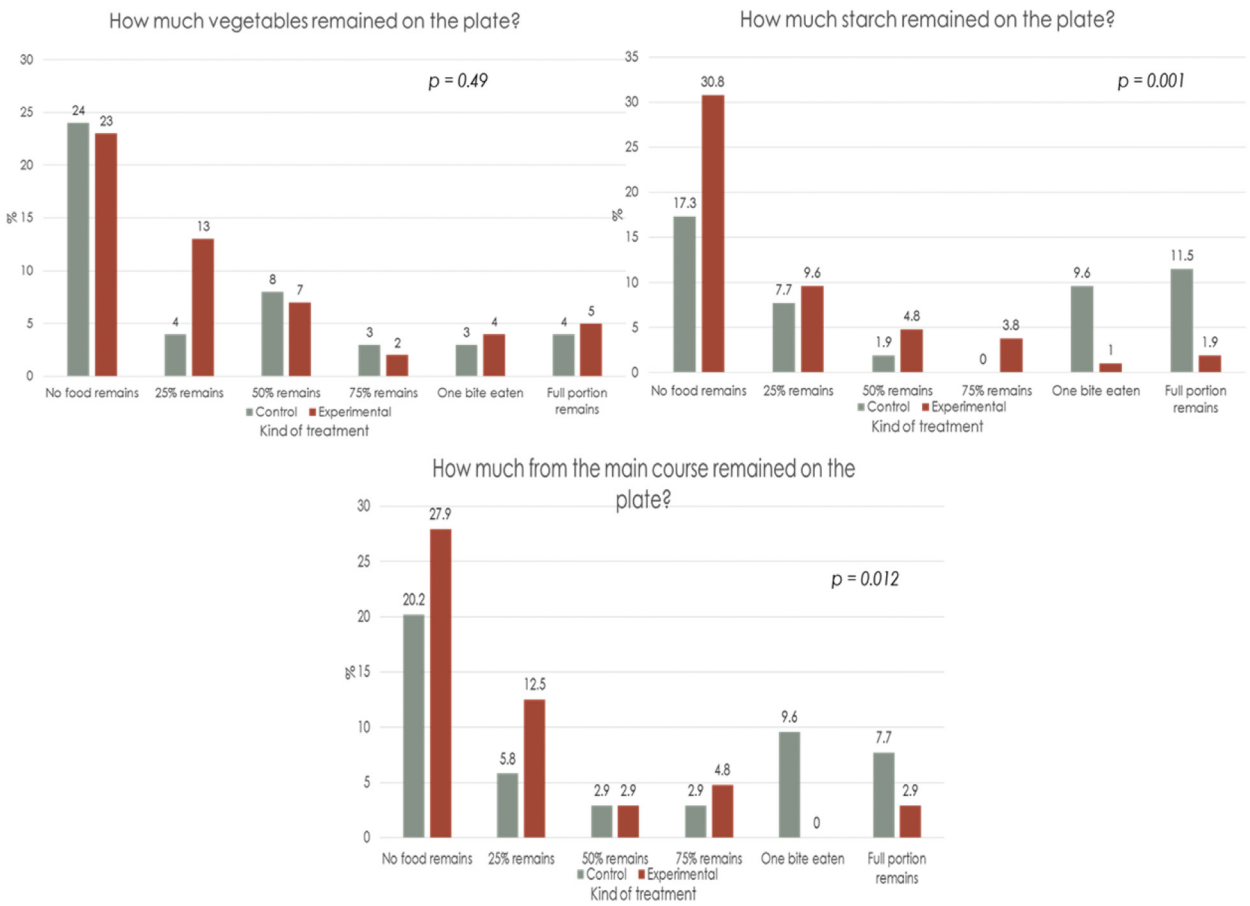

Fig. 2. How much food was left on the plate?.

in comparison to the control group (0.77 ± 0.25 vs. 0.58 ± 0.31) (Fig. 3). No difference in intake was observed in the different age categories, showing that intake was increased in the study group regardless of the age categories.

All patients were asked if hungry or not before the meal and no significance was found between their levels of appetite; 4.8% hungry = 47.6%experimental vs. 43.8% control, not hungry = 3.8% experimental vs. 4.8% control ($p > 0.05$). More participants from the experimental group referred their meal to be tasty in comparison to those in the control group (49.5% vs. 33.7% $p < 0.05$). In addition, the most common reason for eating less before hospitalization was loss of appetite (32.7% control, 39.8% experimental ($p < 0.05$)). During hospitalization, as shown in Fig. 4, the eating less reason was "I do not like the taste" (52% control vs. 24% experimental ($p < 0.05$)) followed by "I do not like the smell" (36% control, 18% experimental ($p < 0.05$)) and "I was not hungry" (22% control, 18% experimental ($p > 0.05$)).

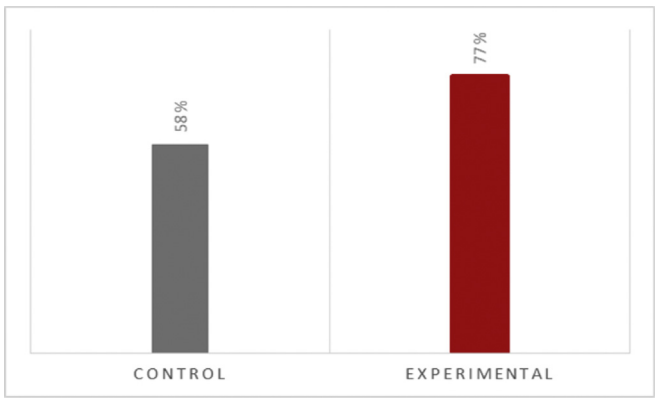

Fig. 3. Total amount eaten by the participants.

3.3. Outcomes

Regarding length of stay, results are shown in Table 2. There was no significance between the length of stay means of each of the groups (5.25 ± 4.8 vs. 4.67 ± 5.60 days) ($p = 0.50$). However, the group distribution suggests a tend to reduce length of stay if improved meal is consumed.

Although there was no significant difference in length of stay; readmission rate decreased significantly in the study group ($p < 0.02$) from 31.5% to 13.5%. The readmission rate was calculated 30 days after the inclusion of each patient to the study. Table 3 shows the distribution of participants who were readmitted between the groups.

A multivariate analysis of variance, adjusted for potential confounders, examined the associations of food intake per group and outcomes like, readmission rate to hospital, length of stay during hospitalization; kind of diet and department were also evaluated. The variables were significantly associated to dietary intake ($p > 0.0001$) (Table 3).

In order to investigate whether the extend of disease of the participants influenced the dietary intake and the outcomes or not, the Charlson Comorbidity Index was carried out and both of the

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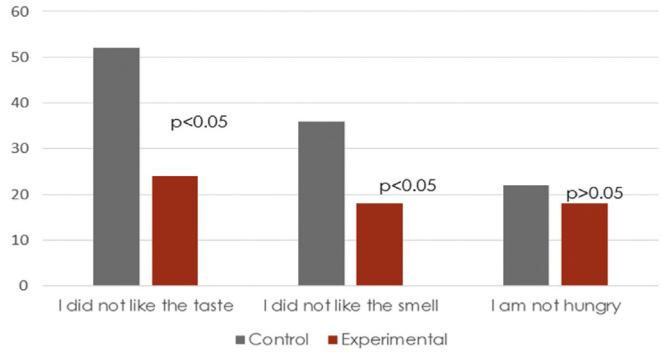

Fig. 4. Most common reasons for not eating hospital food.

Table 2
Length of stay.

	Control group	Experimental group	*p* value
	Mean + SD	Mean + SD	
LOS[a]	5.25 + 4.82	4.67 + 5.63	0.50
LOS[a] (days)			
2	29 (43.3%)/67 (100%)	38 (56.7%)/67 (100%)	0.07
3–7	50 (48.1%)/104 (100%)	54 (51.9%)/104 (100%)	
8–10	8 (57.1%)/14 (100%)	6 (42.9%)/14 (100%)	
>10	13 (65%)/20 (100%)	7(35%)/20 (100%)	

[a] LOS = Length of stay.

Table 3
Multivariate analysis of food intake and outcomes.

n = 204	AR[a] (95% CI)	*p* value
Corrected Model		0.0001
Department	0.15	
Kind of treatment	0.17	
Kind of diet	0.54	
Length of stay	0.10	
Readmission rate	0.09	

[a] Adjusted R squared, computed using alpha = 0.05.

groups shown no significant difference in terms of comorbidity (Table 4). The most frequent comorbidity in both of the groups was diabetes and cardiovascular disease.

4. Discussion

Our study shows that improved oral intake by improved presentation is improving clinical outcome in hospitalized patients. It has been demonstrated that addition of oral nutritional supplements (ONS) is improving clinical outcome [26,28].The decrease in readmission has also been shown and is decreasing significantly costs [26]. The associations between food intake and hospital malnutrition have been examined extensively in the past years [4–6,9,10]. However, there is little accurate data about the relations of improvement of meal presentation to increase food intake in hospitalized patients [11]. In this study, we enjoyed from an unique association between the hospital kitchen chefs and the institute Paul Bocuse culinary expertise to adapt the hospital menu conserving the same ingredients and the same budget but improving the presentation significantly. The patient questionnaires evaluated various parameters and despite a significant decrease in appetite due to multiple etiologies, the study group like the smell and the taste better. The consequence was a significant increase (19% more) in intake mainly in terms of main course and starch and not in vegetables. Other centers have experienced an improvement in outcome when increasing oral intake. Johansen et al. [27] gave to patients a daily attention from the team consisting of: (1) motivation of patient and staff, (2) adjusting the nutritional plan by estimation of protein- and energy requirements and ordering food in collaboration with the patient and (3) securing the supply of food ordered. In patients experiencing complications, the increased nutritional intake decreased the length of stay and the need for IV support significantly.

Dickinson et al. [28] described many factors influencing the patient experience of mealtimes. They included the institutional and organizational aspects of mealtimes related to resources, food supply and institutional routines and timing, the mealtime care and nursing priorities related to patient choice but also mealtime care and organization and finally the eating environment composed of social, aesthetics and physical aspects. Our study changed mainly the aesthetics of the presentation but did not modify the other aspects of the meal care. Other improved parts could even improve more the oral intake of hospitalized patients, as shown by the same authors in the nursing [29]. For staff, mealtimes were no longer perceived to be a chore or task which is to be delegated or avoided if at all possible. Staff was actively engaged in mealtime work. Patients enjoyed the food they are served and there were people available to help them to eat when they need assistance. Food was carefully presented, in an appetizing way, to maximize enjoyment. But this study did not evaluated the food intake of patients but only the change in staff attitudes.

Our study has two more particularities: it improves through digital imaging the limited information currently available by showing dietary intake among hospitalized patients. This tool has been used by others [30] and shown to be valid. It also benefit from the worldwide used Nutrition Day Questionnaire to assess the patient care, the patient intake and its outcome up to 28 days. This valid tool showed already a strong association between oral intake assessed by the plate assessment and morbidity/mortality [1,2]. However, our study has some limitations: it did not evaluate precisely energy and protein intake, since we focused in quantity overall. It may be that increased intake at lunch interfere with intake at other meals. Second, self-reported answers were obtained from the nutritionDay questionnaire which may have led to under or overestimation of responses. And last but not least, even using the digital imaging method prior to collection trays, nothing can assure us whether a relative of the participant helped him eat the

Table 4
Charlson Comorbidity Index between the groups.

CCI[a]	Control group	Experimental group	*p* value
0 (No comorbidity)	12 (57.1%)/21 (100%)	9 (42.9%)/21 (100%)	>0.05
1 (Low comorbidity)	32 (43.8%)/73 (100%)	41(56.2%)/73 (100%)	
2 (Mild comorbidity)	32(48.5%)/66 (100%)	34(51.5)/66 (100%)	
3 (Moderate/severe comorbidity)	17 (58.6%)/29 (100%)	12(41.4%)/29 (100%)	
4 (Severe comorbidity)	6 (46.2%)/13 (100%)	7(53.8%)/13 (100%)	

[a] CCI = Charlson Comorbidity Index.

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dish or not. Because of all these limitations we analyzed the outcomes very carefully.

4.1. Conclusions

The present study confirmed that "the first taste is always with the eyes", the results have shown that the improvement of meal presentation using culinary expertise at a hospital setting, without any extra financial investment, influenced the participants' visual perception towards the dish that was served during their hospitalization, provoking a significantly increase in food intake, leading to a substantially waste food reduction and readmission rate to hospital in the following 30 days after discharge.

These findings contribute to the emerging literature of meal presentation importance, encouraging the need to further exploit and systematically enhance the consumers' expectations about their food perception to enrich their meal experience at the hospital. Likewise, it was confirmed that these findings are similar to previous results using oral nutritional supplements and require additional research to confirm the validity of the outcomes, including a longer multicenter study.

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Author's contributions

The work presented here was carried out in collaboration amongst all authors who co-worked in the realization of the experiment. DAN helped design the study, collected data, estimated dietary intake, analyzed data and participated in writing and reviewing the final paper. MB helped design the study, estimated dietary intake and participated in analyzing data, interpreting results, writing and reviewing the paper. IK, AE, KC, MG, SF, ML participated in study design, AG helped design the study and data interpretation, SK and MM participated in analyzing data, PS participated in study design, data interpretation, in writing and reviewing the final paper.

Conflict of interest

The authors declare that they have no conflict of interest.

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