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Nutritional profile of foods offered and consumed in a Belgian university canteen

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Abstract

Objective: To evaluate the nutritional profile of a lunch offered and consumed in a university canteen in Belgium.

Design: The qualitative and quantitative content of 4365 meals theoretically available and 330 meals consumed was recorded during five weekdays spread over three weeks. Meal combinations were evaluated using a scoring system based on recommendations for Na content, energy from fat, and fruit and vegetable portions.

Setting: University canteen in Belgium.

Results: Only a 5% of the meal combinations available and consumed complied with the three basic dietary recommendations for a hot lunch. The nutritional profile of the meals consumed was in line with that of the meals available.

Conclusions: Our results show how the nutritional profile of what is eaten is largely determined by what is offered. To ensure overall compliance with dietary recommendations, considerable changes on the supply side, i.e. an increase in fruit and vegetable portions and a reduction in salt and fat of the lunch, are needed first in our setting. Our assessment provides baseline data to pilot a nutrient profiling intervention and shows how a nutrient profiling system can be used for meal evaluation purposes.

Keywords
Canteen lunch
Young adults
Food choice
Catering
Nutrient profiling

A healthy diet is now accepted as a cornerstone to a healthy life. Given the epidemic proportions obesity and overweight have taken on worldwide, promoting good dietary practices has become an important part of health policy and the prevention of non-communicable diseases[1–3]. Out-of-home eating has increased considerably during past decades and has taken an important place in the habitual diet[4,5]. Various studies have shown that out-of-home eating is associated with higher energy intakes, due to its higher energy density[6–12] or larger portion sizes[12–17]. Hence, the catering sector is increasingly being recognised as a stakeholder to promote healthy diets and lifestyles[18]. In Europe, a number of countries have initiated partnerships with the mass catering sector in their national action plan for nutrition and physical activity[19].

Eating out-of-home presents additional nutritional challenges compared with eating at home. Different psychosocial and environmental factors determine what is eaten and customers too often have insufficient access to nutrition information to make an informed choice[20].

When entering university, many Belgian students leave their family environment and reside in a room in the university town. The university canteen is an important contributor to out-of-home consumption of a main meal for students. A previous survey in Ghent University indicated that students take a hot lunch 1·5 times weekly in the student canteens. Only 5% of the students never eat in the student canteens and 22% visit these at least twice weekly to have a hot lunch[21]. Belgian guidelines recommend that hot meals in schools and worksites supply an average of 3703 kJ (885 kcal), thereby providing 30% to 35% of the daily energy intake of adults. A lunch for adults should supply 36 g protein, 34 g fat and 115 g carbohydrates. In addition, the main meal of the day should cater for a minimum of 200 g vegetables[22]. No specific guidelines are issued for salt content in lunches but the Belgian dietary recommendations for adults advise moderation of salt intake, with a maximum intake of 3500 mg Na/d[23].

It has been shown in other contexts that school canteens can contribute to create an obesogenic

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environment[24–26], but can also represent an opportunity to improve students' diet[27,28]. The purpose of the present study was to carry out a nutritional assessment of the lunches available and consumed by canteen customers in Ghent University. The outcome of the study is expected to be used for meal planning purposes and to pilot a nutrition promotion intervention in the canteen.

Methods

The present study took place in the canteen of the Faculty of Bioscience Engineering of Ghent University in November 2004. The canteen menu is representative for other canteens of Ghent University, as the same suppliers cater for all canteens and menus are standardised. In 2004, the canteen served a hot meal to 246 customers on average each day. Meals served in the canteen are combinations of a protein, vegetable, carbohydrate and sauce component. These components are standardised portions which can be freely combined by the customers. Every day, canteen customers can choose out of at least four protein components, including a fish and vegetarian one. The vegetable choices include two cooked vegetable portions and two types of salad. The starch component offers standard five choices: rice, cooked potato, mashed potato, French fries and croquettes. Customers can choose out of four or five sauces each day. All extra food such as additional portions, fruit, soft drinks and dressings or deserts must be paid for, but salt and pepper are freely available at the counter.

The study was conducted on five different weekdays, spread randomly over three weeks. Data collection was done in a period of regular activity (not just before or after a holiday, not during an examination period) to reflect as much as possible a usual consumption pattern. Systematic sampling was applied for operational reasons. After paying for their meal and before consuming the food, every fifth canteen visitor who took a hot lunch was invited to participate. *Post hoc* calculations show that the sample size and standard deviations of the measurements allow a precision of 113 kJ (27·0 kcal) in the energy estimates and is able to detect differences between men and women of 351 kJ (84 kcal) with a power of 90 % and significance level of 5 %.

Each tray of the participants was labelled with a number and a digital picture was taken to obtain a qualitative composition of the plate chosen. At the same time, the participants were asked to report their age, gender, height, weight and pregnancy. All information was self-reported in order to minimise inconvenience for the customers. After eating, the plates were collected and all leftovers were weighed using a digital kitchen balance (type Phillips HR 2389 and HR 2393) up to 1 g. The quantity of each food component served minus its leftovers was used to estimate the amount of food consumed by the participants.

The quantity of each food component served is known with a fair level of accuracy as portion sizes are standardised. Specific receptacles are used to serve the portions, i.e. spoon, cup, number of croquettes, etc. Average portion sizes for each item on the menu were used to quantify the amount of food served. The portion sizes were obtained from measurements of menus served and displayed and specifications of the producer. The portion sizes of each meal component are specified by the canteen administration. The routine nature of serving food in the canteen further limits variation in portion sizes. The accuracy of standardised portion sizes was verified on a daily basis by random weight measurements of meal components served. Regarding nutrient content, all food served in the canteen is prepared commercially according to recipes which are standardised by the producer and the canteen administration. Food composition data (energy, carbohydrates, protein, total fat and Na) of the meals were obtained from the technical files of the supplier. In the case of fruit or dishes where no Na content was specified, the Belgian food composition data[29] and the Belgian online database of trade names (www.internubel.be) were used.

All interviews and weight recordings were carried out by a trained team of graduate students of a postgraduate course in food science and nutrition using pre-tested questionnaires. The study received ethical approval from Ghent University. All participants had the purpose of the study explained to them, received an information leaflet and provided written consent before participating. There was no exclusion criterion. However, the food intake of pregnant women, teenagers (age <16 years) and elderly customers (age >60 years) was not used in the analysis.

We simulated what meal combinations were theoretically available to the customers during the days of our study. To do so, the theoretical meal combinations offered were first calculated on a daily basis by multiplying the number of protein choices, the number of carbohydrate choices and the number of vegetable choices on that particular day. Those meal combinations were further multiplied with all sauces available. The total number of meal combinations in the study period was the sum of the meal combinations per day. Pizza and macaroni were not combined with other meal components since they are served as a single item. Protein components that were served with a sauce were not combined with additional sauce since this combination is not offered. None of the theoretical meals contained food items that would require extra payment by the customers. In total 4365 theoretical meals were obtained. The nutrient content of these meal combinations was then calculated using average portion sizes.

We appraised the overall quality of the meal offered using a cumulative scoring system. International accepted criteria for the nutritional evaluation of foods are currently not available. We used total fruit and vegetable

content, Na and energy supplied by fat to evaluate the nutritional characteristics of the meals. Belgian guidelines do not specify upper boundaries for energy contribution from fat. For our evaluation, we used a threshold of 35% energy from fat which was used for the evaluation of school foods in the UK[30,31]. For fruits and vegetables, we used the recommended 200 g for hot lunches in Belgium as a benchmark. To evaluate Na content, we used the WHO population nutrient intake goals of 2000 mg Na/d[2], which corresponds to 57% of the Belgian recommendations for daily Na intake. One point was given if the meal complied with one of the following recommendations: (i) the meal supplies less than 2000 mg Na; (ii) less than 35% of the energy of the total meal originates from fat; and (iii) more than 200 g vegetables are supplied by the meal.

Data were entered and processed using the software ESHA Food Processor for Microsoft Windows version 8·4·0 (ESHA Research, Salem, OR, USA) and further analysed using Microsoft Excel version 2003 (Microsoft Corporation, Redmond, WA, USA) and Intercooled Stata version 8·0 (Statacorp, College Station, TX, USA). A standard *t* test was used for continuous variables. In the case of severe departure from normality, the non-parametric Mann–Whitney *U* test was used to compare means. A χ^2 test was used to compare the proportions between categories. The alpha error was set at 5% and all tests were two-sided. No specific analysis was made for repeated measurements as subjects with multiple visits were a minority in the sample.

Results

Subjects

Meals from pregnant women (*n* 5) and visitors older than 60 (*n* 8) or younger than 16 (*n* 16) were excluded from the analysis. Data of three meals were lost because the plates could not be retrieved after completing the lunch. In total 330 meals were included in the study, of which 64% were from male customers. Data were predominately supplied by young adults with mean age of 26·1 (SD 7·7) years. The mean BMI based on self-reported weight and height was 22·3 (SD 3·1) kg/m^2 and 1·9% of the participants were obese (BMI ≥ 30·0 kg/m^2). Mean age and the prevalence of obesity were not significantly different between male and female customers ($P = 0·12$ and 0·71, respectively) but the mean BMI of males was higher than that of females ($P = 0·0001$).

Meal choices offered

Compared with the Belgian recommendations, the theoretical meal combinations supplied too much protein and fat and insufficient carbohydrates (Table 1). The average Na content of the meal combinations was 1268·7 (SD 809·7) mg, which is 63% of the WHO daily recommendations. The average energy density of the meals was 707 (SD 405) kJ/100 g (169·0 (SD 96·8) kcal/100 g) and Na density was 372·9 (SD 201·9) mg/1000 kJ (1560·2 (SD 844·7) mg/1000 kcal). On average, the combinations of meal components supplied 40·2 (SD 13·3)% of energy from fat. Of the meal combinations theoretically available, 64·0% contained more than 35% of energy from fat, 17·9% of the combinations supplied more than 2000 mg Na and 86·2% of the meals contained less than 200 g vegetables.

Most theoretical meal combinations complied with none or only one of the three basic nutritional recommendations (Table 2). The number of meal combinations that were in line with all recommendations was marginal. None of the combinations that complied with all three criteria contained pizza, macaroni, fries or croquettes. Seventy-one per cent of the optimal combinations contained the vegetarian protein choice.

Meal combinations consumed

A large share of the meals consumed contained fried potatoes as the carbohydrate component (Table 3). Meals consumed by men contained more fried potatoes (French fries and croquettes) and a larger proportion of meals chosen by men contained fried potatoes. In a quarter of the meals, extra salt was added. Very few meals contained

Table 1 Nutritional profile of the lunch offered in the canteen and consumed by men and women and comparison with the Belgian recommendations for a hot lunch: Ghent University, November 2004

		Theoretical meals			Meals chosen by the customer							
		All (*n* 4365)			All (*n* 330)			Men (*n* 210)		Women (*n* 120)		
	BR*	Mean	SD	% of BR	Mean	SD	% of BR	Mean	SD	Mean	SD	*P*
Total protein in the meal (g)	36	42·1	14·2	117	40·0	17·2	111	42·1	18·6	36·3	13·7	<0·01†
Total carbohydrates in the meal (g)	115	72·2	32·8	63	77·4	36·6	67	82·7	38·7	68·2	30·5	<0·01†
Total fat in the meal (g)	34	42·3	29·3	124	36·9	23·5	108	39·1	23·7	32·9	22·7	0·02‡
Total fruit and vegetable portion (g)	200	146·6	82·4	73	138·5	79·6	69	138·3	80·1	138·9	79·0	0·95‡
Total energy in the meal (kJ)	3703	3546	1671	96	3426	1465	93	3643	1525	3046	1272	<0·01†
Total energy in the meal (kcal)	885	847·6	399·4	96	818·9	350·1	93	870·8	364·5	728·0	304·0	<0·01†

*Belgian Recommendations for a hot lunch[22].
†Independent samples *t* test comparing meals from male and female customers.
‡Mann–Whitney *U* test comparing meals from male and female customers.

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Table 2 Percentage and profile of meal combinations offered and chosen that comply with a combination of three recommendations*: Ghent University, November 2004

	Meal combinations offered					Meal combinations chosen				
	n	%	Energy from fat (%)	Vegetables (g)	Na (mg)	*n*	%	Energy from fat (%)	Vegetables (g)	Na (mg)
None of the recommendations met	602	13·8	51·8	132·6	2632·0	23	7·0	64·8	138·1	2601·6
One recommendation met	1999	45·8	47·9	129·1	1116·8	183	55·5	60·1	115·3	1202·8
Two recommendations met	1550	35·5	28·2	153·8	933·7	109	33·0	24·7	140·5	980·4
Three recommendations met	214	4·9	23·9	297·4	1294·1	15	4·5	16·9	271·1	1357·0

*Recommendations used here are: <2000 mg Na, <35 % of energy from fat, >200 g vegetables.

Table 3 Mean portion sizes consumed and the proportion of customers choosing these: Ghent University, November 2004

	Percentage and number of meals							Portion size (g)						
	All (*n* 330)		Men (*n* 210)		Women (*n* 120)			All		Men		Women		
	%	*n*	%	*n*	%	*n*	*P**	Mean	SD	Mean	SD	Mean	SD	*P*†
Protein component														
Red meat‡	28·5	94	31·5	66	23	28	0·12	199·3	143·2	211·1	140·5	171·7	148·1	0·08
Fish	30	99	26	55	37	44	0·05	155·0	27·5	156·4	23·8	153·2	31·6	0·86
Poultry	29	96	30·5	64	27	32	0·53	152·6	92·1	162·1	103·9	133·6	59·1	0·32
Vegetarian dish	12·5	41	12	25	13	16	0·73	204·2	156·7	199·7	161·1	211·2	154·4	0·68
No protein component	0	0	0	0	0	0	–	–	–	–	–	–	–	–
Carbohydrate component§														
Rice	22	72	21	45	23	27	0·58	155·8	33·6	161·8	34·9	146·3	29·7	0·66
Cooked or mashed potatoes	31	102	28	58	37	44	0·08	200·9	43·0	210·1	44·4	200·6	41·6	0·81
Pasta	4	14	4	8	5	6	0·58	279·5	50·4	292·8	31·8	261·8	67·2	0·37
Deep-fried potatoes	42	139	48	100	33	39	0·01	183·2	36·3	186·3	37·8	175·1	31·5	0·04
No carbohydrate component	2	6	1	2	3	4	0·12	–	–	–	–	–	–	–
Vegetables														
Raw vegetables	35	116	38	79	31	37	0·28	62·3	19·8	61·3	16·6	64·6	25·4	0·98
Soup	19	62	24	51	9	11	<0·01	388·0	57·1	389·7	61·9	380·0	24·8	0·89
Cooked vegetables	60	198	59	123	62	75	0·42	184·0	46·7	185·3	46·0	181·7	48·2	0·32
No vegetables or soup	7	22	7	14	7	8	0·97	–	–	–	–	–	–	–
Fruit														
Fruit incl. lemons‖	12	41	11	24	14	17	0·49	50·1	50·9	58·4	52·2	38·4	48·2	0·09
Fruit excl. lemons	5	16	6	12	3	4	0·43	105·6	39·0	101·9	39·7	117·0	39·9	0·76
Other														
Sweet deserts¶	8	27	9	19	7	8	0·54	80·1	63·7	88·1	67·6	61·4	52·4	0·45
Gravy or sauces	44	145	46	96	39	49	0·49	50·2	25·1	50·1	24·1	50·4	27·2	0·89
Extra salad dressings**	15	51	14	30	18	21	0·39	19·4	5·3	18·9	3·3	20·1	7·3	0·59
Extra salt portion	25	82	27	57	21	25	0·24	1·1	0·7	1·2	0·7	0·9	0·4	0·05

*χ^2 test comparing the proportion of males and females who chose the particular meal component.
†Mann–Whitney *U* test comparing mean weight of the portion sizes for men and women.
‡When excluding the meat added in the macaroni (*n* 14), the portion size of the meat is 229·3 (SD 134·2) g.
§Percentages of customers who took carbohydrates do not add up to 100 % since some (*n* 3) customers took 2 or more starchy components.
‖A piece of lemon was automatically given to all customers who chose fish on one day of sampling. Since this was not their active choice, the portion size of the fruit was reported with and without these lemons.
¶Includes yoghurts, soya yoghurts, pastry and cakes.
**Includes mayonnaise, vinegar, ketchup and tartar sauces.

fruits and some meals contained no vegetables apart from those in the soup. More male customers took soup compared with female peers. Forty-one per cent of the meals contained food items that required extra payment. Seventeen per cent of the meals consumed contained more than 2000 mg Na. The average Na content was 1233·9 (879·8) mg, which is 62 % of the WHO recommended intake level. The Na density of the meals was 388·6 (SD 270·5) mg/1000 kJ (1626·1 (SD 1131·6) mg/1000 kcal). On average, 37·5 (SD 14·0) % of the energy in the meals was supplied by fat.

Compared with the Belgian recommendations for a hot lunch, protein and fat were supplied in excess (Table 1). Respectively 50 % and 51 % of the meals consumed had contents of protein and fat higher than the advised total content, while this occurred in only 13 % of the meals for carbohydrates. Sixty per cent of the meals consumed provided more than 35 % of energy from fat. Meals chosen by male customers had a higher weight and supplied more macronutrients and Na compared with meals chosen by women (Table 1 and Table 4). Thirteen per cent of meals consumed contained 200 g or more of fruit

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Table 4 Nutritional characteristics the lunch consumed by men and women: Ghent University, November 2004

	All (*n* 330)		Men (*n* 210)		Women (*n* 120)		
	Mean	SD	Mean	95 % CI	Mean	95% CI	*P*
Total weight of the meal (g)	673·2	254·4	717·3	681·3, 753·4	596·0	557·1, 634·8	<0.01*
Weight of the food not consumed (g)	40·8	63·5	34·0	26·3, 41·7	52·9	39·9, 65·9	0.01†
Energy density of the meal (kJ/100 g)	542	224	543	512, 573	541	501, 581	0.95†
Energy density of the meal (kcal/100 g)	129·5	53·5	129·7	122·3, 137·0	129·3	119·8, 138·8	0.95†
Total energy from fat in the meal (%)	46·8	30·0	46·3	42·5, 50.1	47·7	41·7, 53·7	0.02†
Total Na in the meal (mg)	1233·0	879·8	1336·0	1251·8, 1456·2	1055·2	902·0, 1208·3	<0.01*

*Independent samples *t* test comparing meals from male and female customers.
†Mann–Whitney *U* test comparing meals from male and female customers.

or vegetables. The energy density of the meals consumed, however, was not significantly different.

Only fifteen meals out of the 330 consumed had a profile that complied with all recommendations (Table 2). Those meal choices were mainly the vegetarian options (*n* 7), a protein choice with a large vegetable component such as chicory in ham (*n* 2) or meals where additional fruits or vegetables (*n* 3) or a large portion of vegetables (*n* 3) was purchased.

Profiles of meals consumed compared with those theoretical available

The macronutrient characteristics of the meals chosen were largely in concordance with the theoretical meal combinations (Table 1). The percentage contribution of energy from fat in meals consumed was, however, somewhat lower compared with the theoretical meal combinations. The meals consumed also had a lower amount of vegetables and total energy.

Table 2 shows how the nutritional profile of the meals chosen is in line with that of the meals offered. The portion size of fruits and vegetables was the criterion most difficult to comply with in the meals consumed. In the theoretical meal combinations, the energy supplied by fat limited most combinations to obtain the highest score.

Discussion

The present study was carried out in one specific university canteen as a case study for other canteens of Ghent University and other universities in Belgium, and in preparation for an intervention to improve students' diet. One of its strengths is the accurate measurement of meals served and consumed in a free-living environment. To ensure high compliance during the busy canteen shift, our survey methodology was tailored to minimise the inconvenience for customers.

We applied a simple way of profiling the meal combinations based on common discriminating recommendations for canteen meals. Given the absence of internationally accepted recommendations we used basic recommendations for percentage of energy supplied by fat from the UK, WHO population daily nutrient intake goals for Na and the threshold value of 200 g vegetables from the Belgian guidelines for hot lunch. A comprehensive evaluation of foods requires some prioritisation and we chose three nutritional characteristics that are commonly challenging in the diet of the West European population. Currently, nutrient profile systems for single food items are being developed and tested. Since the primary objective of our scoring system was not intended as a nutrition profiling system, we did not attempt to compare classification properties.

On average, the total energy content of the meals available and consumed was in line with the Belgian recommendations. It should be noted that actual consumption is likely to be higher than our estimate. As our main aim was to compare the meals served and consumed at the canteen, we did not aim to collect information on drinks or other foods taken into canteen. In our study, meals consumed by male customers supplied more energy and energy from fat compared with those consumed by women. Male customers consumed more food than female customers. A factor contributing to the higher energy intake may have been the apparent different consumption pattern of fried potatoes. Meals taken by men contained fried potatoes more frequently and the portion size of the fries was larger compared with women's meals. The fried potatoes were predominantly French fries which have an energy density of 1452 kJ/100 g (347 kcal/100 g), almost three times that of the average of the complete lunch consumed. The other source of fried potatoes was croquettes, containing 891 kJ/100 g (213 kcal/100 g). Meals taken by women contained less fried potatoes compared with men. Additionally, we found no meal combinations with deep-fried potatoes complying with the three criteria. Various studies have shown associations between intake of fried food and BMI[32,33]. Strategies to improve the choice of starch component should consequently be at the centre stage of interventions to improve healthy eating in our setting.

Our results confirm previous findings of nutrition assessments of out-of-home meals with regard to energy from fat and Na content. Meals in secondary schools in England provided 41 % of energy from fat[31]. Compared with fast foods sold by well-known outlets[10] however, the overall energy density of the lunches in the present

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study was considerably lower. Salt was offered and consumed in excess. The Na density of our meals consumed and offered is comparable to that of school meals in the USA in 1995 (376·7 mg/1000 kJ, 1576 mg/1000 kcal)[34].

The vegetable portion in half of the lunches consumed was too small to comply with the recommendations for a hot lunch and few customers purchased extra portions. Fruits are not included in the menu and have to be purchased separately. One of the key recommendations resulting from our study is to explore the effect of providing extra fruits and vegetables in the canteen, which has proved a successful intervention in Denmark[35].

The present data show how the profile of the meals chosen clearly followed that of the meals provided. Therefore the nutritional profile of the meals consumed depended not only on the choices made by customers. Only 5 % of the meals available complied with our optimal nutritional profile, which makes it quite improbable to make an optimal choice in the absence of any guidance. The profile of the meals taken by the customers shows how choice of a protein component that already contains a vegetable part is almost a prerequisite to comply with the recommendations if no extra portions of vegetables are purchased. In our canteen, healthy food choices required additional efforts by the customer. Too many meal choices are simply too rich in fat and Na and contain insufficient vegetables and fruits. Given the alarming incidence of obesity in industrialised countries, mass catering clearly has a direct role in the promotion and facilitation of healthy food choices. Given the importance of lunch as a main meal of the day, optimising the nutritional profile of a canteen lunch opens a window of opportunity to improve diets of many young adults. In our setting, most customers finished their plates and simply ate what was offered. Roos *et al.* showed how eating in staff canteens may lead to increased consumption of vegetables in Finland[36]. However, Finland has had recommendations for canteen lunch in place since 1970 and the nutritional importance of workplace lunch is well recognised[37,38].

Labelling based on nutrient profiling is believed to be a promising way to introduce an informed choice among consumers, thereby triggering healthy choices of food items[39]. In the present study we showed how profiling can also be used as an evaluation instrument in canteens. Our findings pave the way for a nutrient profile system in our setting, in particular to promote the choice of vegetables and starch component. At the same time and more importantly, the findings highlight the need to introduce changes in the meals offered before working on customers' choices in our setting. Energy supply from macronutrients needs to be more balanced and portion sizes of fruits and vegetables in the canteen should increase. In our context, these modifications may bring us a long way in promoting a genuinely healthy diet. Such promotion, however, will require adherence of the food providers. In the set-up of the study, we requested recipe details from the producers to allow us to compute a more detailed nutrition profile of the food served. No recipes were supplied. At present in Belgium, compulsory nutrition information on the technical files is limited to energy, macronutrients and Na. Hence, our nutritional assessment of the lunch remained restricted to this. Our findings underline the public health significance of mass catering. If the mass catering sector is to be a partner in nutrition policy however, this lack of detailed nutritional information will seriously hamper evaluating such policy.

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