Validation of food based nutrient criteria to assess school meal quality in Swedish primary schools

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Abstract

Background: The importance of healthy school meals have in Sweden been highlighted with a new legislation from 2011 requiring nutritious school meals. In order for primary schools and municipalities to evaluate the quality of school meals, a web-based system has been developed with the purpose of evaluating multilevel aspects of food provision in schools. This study aimed at validating the food based nutrient criteria (FBNC) in the instrument, including fat quality, fiber, iron and vitamin D and additionally investigate the inter-rater reliability of the system by comparing the agreement between two independent raters.
Method: The FBNC were validated against a nutritional analysis of school lunch menus and agreement was estimated using the measures of Cohen's weighed kappa, sensitivity and specificity. The inter-rater reliability was analysed for both categorical and continuous variables using the same measures, and additionally the intra-class correlation coefficient.
Results: The agreement of the FBNC was moderate or above for iron and fat quality ($\kappa \geq 0.5$) with a three grade category scale and the fiber and vitamin D criteria had high sensitivity and specificity ($\geq$93%) on a two grade scale. The inter-rater reliability of the instrument was of moderate to substantial agreement for the FBNC ($\kappa \geq 0.5$) and of substantial or higher agreement for a majority of the continuous variables (mean ICC 0.62).
Conclusions: This validation study suggests that the following system can be used for assessment of school meals in Swedish primary schools. A larger study sample is recommended to increase the strength of the κ-values, however this report point towards good agreement between a nutritional analysis and a nutrient assessment using the instrument. The agreement between raters was satisfactory suggesting that questions are understandable and answered truthfully. With this instrument, Sweden can be the first country to record comprehensive data on multilevel aspects of school meals, which can act as a base for research, such as investigating the long term effects of school food provision on health and educational outcomes.

Introduction

A nutritious diet is vital for optimal health and development, and studies have revealed that healthy dietary habits that are established during childhood are likely to be sustained throughout life (1, 2). Children tend to spend many hours of the day in school and this is consequently an important setting to establish healthy eating behaviors. A sufficient food intake at lunchtime is an important factor in order to cover the energy needs throughout the day and reach the recommended daily intake (RDI) of essential vitamins and minerals. School meals may also have additional positive influences on children such as; developing healthy food habits, develop taste and liking, improve social behavior and acting against social inequality. However, an overview of studies in the area demonstrated inconclusive results on the effects of school food service on learning and cognition as well as for weight reduction and weight maintenance (3). Long-term effects of school food provision are difficult to evaluate but the effects of healthy dietary habits throughout life in for example the prevention of non-communicable diseases are evident (4). Florence et al. (5) showed in a large study of grade 5 students in Canada, that the overall diet quality was associated with improved academic performance even when socioeconomic factors and additional confounders were controlled for. Similar results were observed among Swedish 15-year old students, although the direction of causality comparing dietary habits and educational achievement was unclear (6). Data also suggests that multi-level school based strategies involving nutrition and including physical activity and parental engagement is particularly successful in combating overweight, a condition which is increasing with alarming rate among children in the western societies (7).

The arrangement of school meal services vary considerably between countries. Sweden, Finland and Estonia are unique in the world in serving free, meals to all school children regardless of the family's socioeconomic status. The requirement has in Sweden further increased, with a legislation that came into effect in July 2011, proposing that school meals also should be nutritious and in line with the Swedish Nutrition Recommendations (SNR), however specific guidelines are lacking so far (8, 9). In order for primary schools and municipalities in Sweden to evaluate the quality of school meals a web-based system has been developed by researchers at Karolinska Institutet. This instrument, called SkolmatSverige (School Food Sweden), consists of a web-based questionnaire including questions on food choice and provision, nutritional adequacy, food safety, service and pedagogic lunch as well as environmental impact, organization and policy. The intention with the instrument is to cover several domains of the concept of meal quality and to evaluate nutrient quality and additional factors in an accurate and user-friendly way.

A nutrient analysis program is a common instrument used to estimate the average nutrition value of a diet. This method is considered accurate although time consuming. The nutritional quality assessment using the SkolmatSverige tool is intended to act as an alternative or a complement to a nutritional analysis by including detailed questions on food choices and serving frequencies. Since conducting a nutritional analysis requires skilled users it is not commonly performed by catering managers at school or municipality level. A recent survey revealed that a majority (99 %) of municipality catering managers believed that nutritious school food is important/very important while only 53 % registered that they perform nutritional analyses on a regular basis to evaluate the nutrient content of the lunch menus (10). These data indicate that the interest for nutritious school food exists, although an appropriate tool to use by school catering managers and canteen staff is lacking. SkolmatSverige is developed to be user-friendly, and to give instant feedback to the responder with suggestions on how to improve school meal quality.

There is a tendency of increased consumption of energy dense foods, particularly high in saturated fat and sugar, among children during school hours, both in Sweden and abroad (11, 12). This calls for investments in developing national guidelines, particularly directed to school food services. In England the government introduced food- and nutrient-based standards for school meals in 2008. A review by Evans et al. (13) investigating the differences in nutrient quality of school lunches and packed lunches brought from home found that the nutrition quality of school meals was better than the quality of packed lunches. The difference increased further after the introduction of food-based standards, even though the increase was not significant. In Sweden the National Food Agency (NFA) has developed guidelines for good school meal practice; however specific nutrient and food-based criteria are missing (14). SkolmatSverige is designed to assess the nutrients identified as being of concern in the diet of Swedish children and nutrients that have been highlighted as particularly important on the national agenda (12). These food-based nutrient criteria (FBNC) include fat quality, fiber, iron and vitamin D. A nation-wide pilot-study to assess the instrument among schools was performed in the spring of 2011 and SkolmatSverige was received well (15). A validation study of the nutrient criteria of the instrument was also performed at this point of time showing good validity of the criteria for fat quality, fiber and vitamin D, while the iron criterion demonstrated poor validity (16). The menus analysed were compromised of one meal with two versions of hypothetical accompaniments and did not include vegetarian options. An additional study looking at the agreement of school catering manager's results from SkolmatSverige and recorded available food served in the canteen showed acceptable agreement for most items (17). Following these studies the system has been under revision

and changes to improve the understanding of the questionnaire and the criteria for assessment of the nutrient quality have been made.

The aim of this study is to estimate the validity of the FBNC in the updated version of the instrument. This will be evaluated against a nutritional analysis of a sample of school meals, including both main meals and vegetarian options. An additional aim is to compare inter-rater reliability between the author and the school catering managers with regard to answering the questionnaire.

Material and methods

Recruitment of participants
The participating schools were selected from municipalities in greater Stockholm. Schools situated in the Stockholm municipality were excluded due to the risk of having participated in the pilot-study. Municipalities with schools offering centrally developed lunch menus were also excluded in order to ensure variability in the school menus. From remaining eligible municipalities Norrtälje and Nacka were chosen on the basis that they had a high proportion of in-house kitchens (cooking facilities within the school) and thus likely to have adequate information on recipes and ingredients, and additionally situated within travel distance from Stockholm city. The schools from each municipality were listed in alphabetic order and the school catering managers from each school were contacted from the top to the bottom of the list. Smaller schools, with four or less grades, were excluded but the sample included both public and private schools. Seven schools were contacted from each municipality.

Collection of lunch menus
The school catering managers from each school were contacted and informed about the purpose of the study. In order to retrieve detailed information on the school meals they were asked to document the types and amounts of ingredients used in a four week menu, including the main meal and the vegetarian option when this was available. They were also asked to document the content of the average salad bar as well as drinks and other accompaniments offered. The schools were informed that their participation was anonymous and that they would receive results from the nutritional analysis and the evaluation report from SkolmatSverige at the end of the study. After the four week period of documentation a visit to the school was organized and the recipes were retrieved and reviewed during an interview with each school catering manager.

Nutritional analysis
The nutritional analysis was performed in MASHIE, a web-based diet planning program commonly used by restaurants or catering facilities. Foods and accompaniments with specified amounts and portions were entered in the system. For processed foods the product database DABAS was used. For a majority of these products only the energy and macronutrient content were listed and data on vitamin- and mineral content were insufficient. Since the validation study includes fat quality (i.e. saturated fat), fiber, iron and vitamin D these components were mandatory data for each food except in products with known negligible amounts of any of these components. If insufficient data were retrieved, an equivalent product/food was chosen from the NFA database with complete nutrient composition data. In cases where the content of any macronutrient in the original food differed more than 20 % from the best suitable substitute, the food producer was contacted and complete data on nutrient content for the specific product was asked for. The amount of salt used in the cooking procedure was in many cases difficult to estimate for the school catering managers and was consequently left out in some of the nutritional analyses.

The estimated average salad bar for each school was constructed based on information from the school catering managers and on the basis that each child is offered 125 grams of fruit and vegetables per day, the recommended fruit and vegetable intake during lunch according to the NFA (14). In cases were a different salad bar was offered each day this was entered separately in the nutritional analysis. Included in the assessment as accompaniments was also 1 deciliter of milk per portion, in the fat percentage that the school offered, 22.5 grams of bread, divided on the types offered by the school, and 7.5 grams of margarine/spread. The nutritional analysis was performed on the main meal with accompaniments and the vegetarian meal with accompaniments separately. The results were given in amounts per person per day based on the average value from the four week period. The criteria of interest; fat quality, fiber, iron and vitamin D were documented for each 4 week menu and data were divided into three categories; fulfill recommended intake levels according to SNR, almost fulfill SNR standards or does not fulfill SNR standards (Table 1). The criteria were set on the basis that a lunch should contribute with 30 % of RDI for these nutrients. The intervals for the lower criteria were established in the previous validation study and considered suitable for the assessment of nutritional quality according to these parameters. Saturated fat was used as a marker for fat quality and recommendations are a maximum intake of 10 E % from this energy source.

With the purpose of investigating the ability of the instrument to assess menus with two main meals each day a combination of menus was performed. Original menus with main meals were randomly combined two by two to attain new menus with two main meals each. The mean of the two meals was used. An additional aim was to increase the sample size and thus the nutritional variation within the menus.

Table 1 Nutrient recommendations for lunch and the corresponding requirements (in parenthesis) for children age 10-13. The definition for almost and does not fulfill SNR standards was arbitrarily defined.

Criteria	Fulfill SNR standards	Almost fulfill SNR standards	Does not fulfill SNR standards
Fat quality (saturated fat)	≤ 10 E%	10-11 E %	> 11 E %
Fiber	≥ 30 % of RDI (≥ 6 g)	25 – 30 % of RDI (5-6 g)	< 25 % of RDI (< 5 g)
Iron	≥ 30 % of RDI (≥ 3.3 mg)	25 – 30 % of RDI (2.75-3.3 mg)	< 25 % of RDI (< 2.75 mg)
Vitamin D	≥ 30 % of RDI (≥ 2.25 µg)	25 – 30 % of RDI (1.875-2.25 µg)	< 25 % of RDI (< 1.875 µg)

SNR, Swedish Nutrition Recommendations
RDI, Recommended Daily Intake

Completion of the SkolmatSverige instrument

The web-based instrument was completed by school catering managers within seven days after the visit to the school and all results were automatically stored. The answers to the questions in the instrument were based on the same time period as the nutritional analysis referred to. Schools offering only one meal for all students every day completed the instrument according to this, while schools offering both the main meal and the vegetarian option to all students registered that two meals were offered every day.

The instrument was also completed by the author for each school separately based on the four week menus. These answers were classified as the reference and used for the validation study since, when an objective rater is applied; the potential influence of user error is eliminated. For schools that offered a main meal and a vegetarian option SkolmatSverige was completed in three ways; as if the school offered both meals to all students, as if the school only offered

the main meal to the students and as if the school only offered the vegetarian meal. Only the alternative that corresponded to the school catering managers' answers were used in the study of inter-rater reliability. The questions analysed included; serving frequency of processed food including fish, minced meat and chicken, serving frequency of iron rich vegetarian meals, oily fish, sausage and meat containing meals as well as the use of high fat cheese and fatty dairy products in cooking.

Kommentar [WU1]: Flytta ner

For the combined menus with two main meals the instrument was completed as if it were for a school offering both dishes. The components of the salad bar were computed as the average from the two combined schools, and if the type of milk and margarine/spread served as accompaniments differed between the schools all options were recorded in the instrument.

Statistical analyses

Data were analysed using Statistical Package for Social Sciences (SPSS), version 20.0. To estimate the level of agreement between the nutritional analysis and SkolmatSverige the kappa (κ) coefficient was used. Kappa is a measure of "true" agreement and takes into account the agreement that would happen by chance. For categorical, ordinal, data weighted kappa is appropriate to use since this method emphasizes the difference between ratings, i.e. that the severity is greater with a disagreement between category 1 and 3 than between 1 and 2 (18, 19). Different methods for weighting exist and can give slightly different κ-values. For this purpose quadratic weighting was considered the best method and the method most suitable when comparing the results with the previous validation study of SkolmatSverige (16). Data were divided into three categories; fulfill SNR standards, almost fulfill SNR standards and does not fulfill SNR standards according to Table 1 and Supplementary table 3. For the interpretation of the κ-values the Altman's scale was used where ≤0=poor agreement, 0.01-0.20=slight agreement, 0.21-0.40=fair agreement, 0.41-0.60=moderate agreement, 0.61-0.80=substantial agreement and 0.81-1.0=almost perfect agreement (20).

Kommentar [WU2]: Ändring här enligt Emma. Vad?

The validity of the FBNC was also estimated with regard to sensitivity and specificity. Data were divided into two categories; fulfills SNR standards and does not fulfill SNR standards. The second category included the menus that for the kappa analysis were categorized as almost fulfilling SNR or does not fulfill SNR. Sensitivity is defined as the proportion of menus actually fulfilling SNR which is also identified as doing so with the instrument, and is a measure of the ability of the instrument to correctly classify the menu as fulfilling the recommendations. Specificity is on the contrary the proportion of menus not fulfilling SNR which also fail according to the instrument and is a measure of the ability of the instrument to correctly classify the menu as not fulfilling the recommendations. Kappa analysis and sensitivity/specificity tests were performed on the total number of menus and on the menus with only one main meal served per day.

For the inter-rater reliability study, kappa statistics were used to estimate the agreement of the FBNC between the raters. For continuous variables, i.e. questions regarding serving frequency within the four week period, the Intra-class Correlation Coefficient (ICC), interpreted according to Altman's scale, was determined in combination with the performance of sign tests. Significance levels were set at $P < 0.05$.

Kommentar [WU3]: Ok att skriva så?

Results

Study sample

A total number of 14 schools were contacted; 13 schools agreed to participate of which one chose to resign from the study due to lack of time and resources. The final 12 schools were evenly distributed in the municipality of Nacka and Norrtälje. All schools provided information on their main meal and 4 of the schools also presented data on the vegetarian option. This resulted in a total of 16 complete 4 week menus. Additionally 12 new menus were composed by a combination of the 12 original menus with main meals.

Nutritional analysis

The results from the nutritional analysis of the 16 original menus demonstrated four menus with energy levels above the recommended interval and two of these were categorized as having unrealistically large portion sizes. To limit the risk of falsely high levels of nutrients the portion sizes were cut by 25 % (from 4.25 MJ to 3.19 MJ) for the first menu and 7 % (from 3.44 MJ to 3.21 MJ) for the second menu. The subsequent numbers, after the adjustments, are presented in Table 2 and illustrate the percentage of lunch menus fulfilling SNR standards based on a reference population of 10-13 year olds and on the recommendation that energy providing nutrients should cover at least 25 % of the daily energy need and other nutrients should provide at least 30 % of RDI for this age group (Supplementary table 1).

Kommentar [WU4]: Förklara!

Almost all menus fulfilled the energy standards but the energy distribution did in 94 % of the cases not follow the dietary guidelines. In general a too high proportion of fat and an insufficient quantity of carbohydrates were documented. All schools did however fulfill the fiber criteria. For vitamin D and saturated fat, levels were significantly lower for vegetarian meals ($p=0.004$ and $p=0.03$), while fiber levels were significantly higher in vegetarian meals compared to main meals ($p<0.01$). Overall vitamin D, iron, zinc and selenium were nutrients specifically low in the vegetarian menus. For complete data see Supplementary table 2.

Table 2 Percentage of lunch menus fulfilling SNR standards for children 10-13 years. N=16 (12 menus with main meals, 4 menus with vegetarian meals)

Nutrient	% (N) of all menus fulfilling SNR standards	% (N) of main meals fulfilling SNR standards	% (N) of vegetarian meals fulfilling SNR standards
Energy	88 (14)	83 (10)	100 (4)
Protein	100 (16)	100 (12)	100 (4)
Carbohydrates	19 (3)	0 (0)	75 (3)
Fat	19 (3)	17 (2)	25 (1)
Saturated fat	25 (4)	17 (2)	50 (2)
Monounsaturated fat	56 (9)	58 (7)	50 (2)
Polyunsaturated fat	75 (12)	75 (9)	75 (3)
Fiber	100 (16)	100 (12)	100 (4)
Vitamin D	0 (0)	0 (0)	0 (0)
Iron	44 (7)	50 (6)	25 (1)
Sodium	13 (2)	8.3 (1)	25 (1)
Folate	100 (16)	100 (12)	100 (4)
Vitamin C	100 (16)	100 (12)	100 (4)
Calcium	63 (10)	58 (7)	75 (3)
Zinc	81 (13)	92 (11)	50 (2)
Selenium	38 (6)	50 (6)	0 (0)

SNR, Swedish Nutrition Recommendations

Validation of the FBNC

The estimated validity of the four FBNC is presented in Table 3. The crosstabs indicate symmetrical imbalance in the results, particularly for vitamin D and fiber, due to the low nutrient variability in the menus. A majority of zero counts in the cells gives rise to difficulties in obtaining valid κ-values and consequently only κ-values for fat quality and iron should be considered. These ranged from moderate (iron) to substantial (fat quality) agreement. The sensitivity could not be calculated for vitamin D as no menus fulfilled the criteria. A similar scenario was seen for fiber but in this case the specificity could not be estimated due to the fact that all menus fulfilled the SNR criteria for fiber. The sensitivity was substantial for iron and fiber (79 % and 93 % respectively) while the specificity was perfect for vitamin D and fat quality (100 %).

Table 3 Validation of the food-based nutrient criteria in SkolmatSverige compared to a nutritional analysis of school lunch menus. N=28

FBNC				Cohens weighed κ (three categories)	Accuracy (three categories)	Sensitivity (two categories)	Specificity (two categories)
Vitamin D	Fulfill SNR, Nutritional analysis						
Fulfill SNR, SkolmatSverige	Yes	Almost	No				
Yes	0	0	0	0.1	0.68	N.A	1.0
Almost	0	2	5				
No	0	4	17				
Fiber	Fulfil SNR, Nutritional analysis						
Fulfill SNR, SkolmatSverige	Yes	Almost	No				
Yes	26	0	0	N.A	0.93	0.93	N.A
Almost	2	0	0				
No	0	0	0				
Fat quality[1]	Fulfill SNR, Nutritional analysis						
Fulfill SNR, SkolmatSverige	Yes	Almost	No				
Yes	2	0	0	0.67	0.82	0.50	1.0
Almost	1	1	1				
No	1	2	20				
Iron	Fulfill SNR, Nutritional analysis						
Fulfill SNR, SkolmatSverige	Yes	Almost	No				
Yes	11	6	0	0.50	0.61	0.79	0.57
Almost	3	5	0				
No	0	2	1				

FBNC, Food-Based Nutrient Criteria. SNR, Swedish Nutritional Recommendations. NA, Not Applicable. Calculation not possible due to a majority of cells with zero counts

[1] Based on energy % saturated fat

Kommentar [WU5]: Förklara!

Kommentar [WU6]: Ta bort?

A majority of the menus were classified in the same category according to SkolmatSverige and nutritional analysis and the accuracy ranged from 61-93 %. The results were in line with the analysis performed on only the 12 menus with one main meal each day, although the κ-value was somewhat higher for fat quality (0.86) in that study sample (data not shown).

Inter-rater reliability

The inter-rater reliability of the instrument was analysed on answers from the 12 schools (Table 4). In the comparison of the assessment of the FBNC the best agreement was seen with questions regarding fiber and iron. Only one case of misclassification was registered for the fiber criteria and consequently no κ-value could be attained due to the low variability and the large number of cells with zero counts. Remaining κ-values indicates moderate to substantial agreement between the raters (0.50-0.68).

For questions regarding serving frequency and use of certain ingredients in cooking the agreement ranged from slight to almost perfect (ICC 0.19-0.91), although a majority (67 %) was of substantial or higher agreement (ICC 0.61-0.91). Sign tests indicate that there were no significant differences between the raters ($p>0.05$) but the majority of positive differences indicate that the school catering managers on average over-report the parameters compared to the author.

Table 4 Inter-rater reliability for the food-based nutrient criteria and continuous variables. N=12

	Kappa	Accuracy	Sensitivity	Specificity	ICC	(95% CI)	Sign test	
							P-value	Direction[1]
FBNC								
Fat quality	0.50	0.67	0.50	0.90				
Iron	0.63	0.83	0.88	0.75				
Vitamin D	0.68	0.67	NA	0.75				
Fiber	NA	0.92	1.0	NA				
Serving frequency of								
Processed fish products					0.74	(0.34-0.92)	1.0	+
Processed minced meat products					0.67	(0.18-0.89)	1.0	+
Processed chicken products					0.19	(-0.44-0.68)	1.0	0
Iron rich vegetarian meals					0.79	(0.44-0.61)	0.45	+
Oily fish					0.61	(0.11-0.87)	0.13	+
Sausage					0.75	(0.34-0.92)	0.25	+
Meat-containing main dishes					0.91	(0.69-0.97)	0.22	-
Use of high-fat cheese in cooking					0.33	(-0.18-0.73)	0.51	+
Use of high-fat dairy products in cooking					0.60	(0.58-0.86)	0.13	+

FBNC, Food-Based Nutrient Criteria

ICC, Intra-class Correlation Coefficient

NA, Not Applicable. Calculation not possible due to a majority of cells with zero counts

[1]+ equals a majority of numbers of over-reporting by school catering managers, - equals a majority of numbers of under-reporting by school catering managers

Kommentar [WU7]: Ev lägg till accuracy/total agreement för reliability frågor

Discussion

This study looked at the validity of the FBNC in a web-based instrument with the purpose of measuring the quality of school food provision in Swedish compulsory schools. The agreement of the FBNC was moderate or above for two criteria (iron and fat quality) when using a three grade category scale and the two remaining criteria (fiber and vitamin D) proved to have high sensitivity and specificity on a two grade scale. The inter-rater reliability of the instrument was also investigated proving moderate to substantial agreement for the FBNC and substantial or higher agreement for a majority of continuous variables. The results from this study will indicate if further adjustments to the FBNC have to be made and if questions have to be modified to increase the understanding of the instrument.

Kommentar [WU8]: Förtydliga graderingen i t.ex. metoddelen

Study sample and data collection

The participating schools were selected from two different municipalities in order to potentially increase the variation of lunch meals. The main goal was to assure that different schools offered different lunch menus, and participants therefore had to fulfill the criteria of having in-house school kitchens. Interviews with school catering managers revealed that each school had a high degree of freedom when composing lunch menus resulting in high variability of menus. The experience and educational background varied among the school catering managers but an overall positive response to participate in the study was seen and the drop-out rate was only 8 % (1 out of 13 schools), limiting the selection bias. The sample may however be from two municipalities with particular interest in school food and not representative for the whole nation. Since the main purpose of this study was validate the FBNC of a web-based instrument against a nutritional analysis, the main importance was to receive complete information on ingredients and foods used in the food preparation. The recipes from school catering managers were of varying quality and some schools did not normally work with pre-written recipes and were not accustomed to documenting amounts. During the interview the menus were gone through in detail and potential gaps in the recipes were covered. In some cases the subjects had difficulties recalling amounts of salt and cooking fat used in the preparation. These were then estimated, but salt added when boiling pasta/potatoes/rice was not registered in the analysis and as a consequence the sodium content in the meals is slightly under-estimated.

Kommentar [WU9]: Okej att skriva så?

Validity of nutrient criteria

According to the nutritional analysis all menus fulfilled the fiber criteria but two menus were classified as almost fulfilling the criteria with the instrument. These menus were both from the same school and the misclassification was probably due to two reasons. Firstly, the fact that the particular school used plenty of fiber-rich vegetables in cooking, and secondly because of a poor selection of coarse vegetables and pulses in the salad bar. The instrument has a weakness in measuring vegetable content in the main meal and this may result in an underestimation of the fiber content. Fiber is evaluated according to types and amounts of accompaniments, including the salad bar and bread, and the frequency of served wholegrain pasta, rice, couscous and similar carbohydrate rich staple foods (Supplementary table 3). The instrument is designed so that different fiber-rich foods have different input on the fiber criteria. A salad bar rich in coarse vegetables and pulses weighs more than if the school serves for example wholegrain pasta. Consequently a poor salad selection will have higher negative impact on fiber points than the type of pasta served. This may be the main reason for the misclassification since this particular school got low points due to a poor selection of vegetables on the salad bar but had a high vegetable content in the meals. It was however considered important to retain the weighting in order to highlight the importance of the National Food Agency's advice regarding vegetable selection on salad bars, and the fact that vegetables are a main contributor to fiber. A misclassification in the other direction could be

considered more severe since there would be a risk of approving a school that actually does not fulfill the fiber recommendations. When comparing this study with the previous validation study the cut-off point for recommended intake of fiber at lunchtime was different.(16). In that study the recommendations were set at 7.35 g (based on the mean value of a recommended fiber intake at lunch) while the chosen cut-off level was set at 6.0 g for this study (based on the minimum value of a recommended fiber intake at lunch). Since all menus proved to have a fiber-level above 7.35 g they also fulfilled the recommendations according to the previous definition.

For vitamin D a low κ-value was seen even though 100 % specificity was recorded. The limitations with kappa are apparent when an uneven distribution and a large number of cells with zero counts are present (18). Prevalence is namely a factor that affects the magnitude of kappa. If the prevalence of a rating in one direction e.g. does not fulfill SNR, is very high the chance agreement is also going to be high and consequently the κ-value will decrease (18). The measurements of sensitivity and specificity were considered an appropriate complement to weighed kappa to give a clear indication if menus actually fulfilling/not fulfilling SNR standards also were correctly doing so with the instrument.

The relatively high κ-value for fat quality combined with 100 % specificity demonstrates that the instrument has a good ability to estimate the fat quality of school meals and based on this sample the likelihood of the instrument approving a school that actually does not fulfill the recommendations for saturated fat is low. The 50 % sensitivity is based on two menus that are misclassified. These menus also happened to be vegetarian menus indicating that the instrument may have difficulties in estimating the fat quality in vegetarian meals; a larger study sample is however needed to investigate this matter. A larger sample size may have increased the variation in fat quality and increased the number of schools meeting the recommendations for saturated fat. Dietary surveys among Swedish school children have however revealed an excessively high consumption of saturated fat indicating that the fat quality of school lunches may in general be poor and that a larger sample may therefore not improve the variation (12).

Unfortunately only four schools reported data on vegetarian meals, limiting the possibility of performing separate analyses on these data. To maximize the sample size and due to the fact that the instrument is designed to be able to evaluate the nutritional quality of all meals, including vegetarian meals, these menus were included in the analysis. As mentioned, the ability of the instrument to assess vegetarian meals may be inferior to the ability of the system to assess meat-containing dishes and thus affect the validity negatively. However, when looking at each criterion, after excluding the vegetarian menus, only the κ-value for fat quality was higher. A follow-up study including only vegetarian meals is however desirable to be able to draw conclusions on the instrument's ability to estimate the total nutrition quality in a larger sample. Since, at the time being, it is not common with schools offering only vegetarian food it might be more relevant to analyse a larger sample of schools offering both vegetarian and meat-containing dishes.

Kommentar [WU10]: When? Förtydliga!

Iron was identified as the FBNC with lowest validity, in agreement with the previous validation study, although an improvement was seen (16). Following the first validation study the iron criteria was revised and more questions including iron-rich foods were added to improve the sensitivity of the instrument. As a result the sensitivity increased for this analysis, but on the contrary the specificity decreased and the instrument had a tendency to approve schools not fulfilling the criteria. This may however not be a major problem since iron was found to be underestimated or missing for some food products in DABAS, even after

Kommentar [WU11]: Ändra ord!

requiring data from food manufacturers. A nutritional analysis including semi-processed foods may therefore have a tendency to under-report the true iron content of a meal.

With the aim to increase the variability of the data-set 12 menus were combined into 12 additional menus. The level of agreement did not change compared to an analysis of only the original 12 menus. This suggests that SkolmatSverige has a good capacity to estimate the nutrition quality of school meals compromised of more than one dish per day.

Kommentar [WU12]: Skriv syfte till detta tidigare!

Inter-rater reliability

The agreement between raters was studied in order to assess the similarity of two independent raters that were assumed to have the same background information….Since the purpose of the instrument is to estimate if the school fulfill SNR standards according to the FBNC the agreement of the points achieved for each FBNC were analysed between the raters. Nine additional parameters were chosen including questions resulting in continuous variables in order to find out if certain questions were particularly difficult to answer. The inter-rater agreement for the continuous variables indicates that a majority of the parameters had good agreement when comparing the two raters. However, the ICC for the serving frequency of processed chicken products and the use of high fat cheese in cooking were low, demonstrating that these questions may be difficult to answer. The question regarding cheese in cooking requires a high level of involvement by the rater since recipes have to be gone through in detail. This is however also required for the question regarding high-fat dairy products but results from this analysis indicate that use of dairy products may be easier to record than the use of cheese in cooking. An explanation could be that cheese is often used as a topping or flavoring to dishes and amounts are therefore not properly recalled. The low ICC for processed chicken, nonetheless the non-significant result using a sign test illustrates the weakness of a sign test since this only look at the number of positive and negative differences between two raters and does not take into account the absolute difference. No systematic difference between the raters was recorded for this parameter. The sign test was however considered an important test in order to record over- or under-reporting and visualize the direction of this. The low level of agreement for this particular question may be due to the poor definition of processed chicken products. Most schools receive pre-cooked chicken to their kitchens and school catering managers may classify this as processed foods; however no difference in the number of over- and under-reporting was seen and a larger sample size is warranted to draw any further conclusions. The question will be clarified in the instrument to increase the understanding of the issue, but a vital point is that this question and remaining questions regarding processed foods are not included in the nutritional assessment and will therefore not affect the school's ability to reach the nutrition recommendations. It is interesting to document the higher level of over-reporting by school catering managers irrespective if they are healthy or not. The tendency in dietary recordings is otherwise known to be correlated to energy under-reporting (21, 22).

Nutritional analysis

The number of participating schools was limited to 12 schools to be able to perform accurate and detailed nutritional analyses within the time frame of the project. Although different menus were offered in all schools the final variation in the nutrient content was low. The low variation and relatively small data sample will have a negative effect on the magnitude of kappa. In a larger sample we would probably retrieve higher κ-values due to a higher probability of increased nutrient variation, although the accuracy may not be improved. The nutrient quality of these menus were in line with the latest national food survey on Swedish children, showing a high intake of saturated fat and salt and a low intake of vitamin D (12). Problems occurred when nutrient data was missing for many processed foods and similar

products were not found in the National Food Agency database. It is a source of major error if using only the energy providing nutrients of the food product in the analysis since this will result in an under-estimation of the nutrient content. It is also problematic if the food product is exchanged to a similar product to obtain full nutrient data when in fact the nutrient composition may not be equivalent to the original food. With the new legislation requiring nutritious school meals a demand on food producers to report full nutrition data on their products is desirable. When contacting manufactures, some companies did not have the information required and in some cases the values given by the manufactures did not correspond to values seen in MASHIE. Amounts were always controlled if reasonable and at the end of the analysis all components had the required nutrient data, although some data were taken from similar products, which allow for conclusions about nutrient content for all menus. A slight under-reporting of iron-levels may be present since iron content in processed foods in some cases was difficult to retrieve. This problem is although limited in this study but will be enlarged if the analysis is performed by a person with less knowledge in nutrition and with limited time to complete the analysis. This thorough work is a strength for this study and an additional advantage is that the analysis was performed over a four week period which should provide a good estimate of an average daily nutrient intake at lunch and cover a variety of dishes and ingredients.

Kommentar [WU13]: Ta bort??

The data obtained on ingredients were considered sufficient, with the exception of salt used in cooking and amounts of fat used for frying or to grease roasting pans. Two menus were however particularly high in energy (up to 25% above recommendations). This may be due to a mistake in the recall of the number of portions prepared or that the reference population used in this study did not correspond with the average age of the children in the school. The decision to cut nutrient values with 25 % was taken to avoid that the nutrient intake would be over-estimated and that the school would fulfill the SNR guidelines without actually doing so. By cutting the nutrient values by this much it may however have affected the comparison with the instrument slightly, since questions regarding amounts may have been over-reported in the instrument compared to the analysis.

Even though milk was included as an accompaniment in the analysis, in contrast to the previous validation study, the recommended intake of vitamin D proved still difficult to reach (16). When increasing the amount of milk in the analysis, from 1 to 2 deciliters, the number of menus reaching the recommended intake at lunch increased from 0 to 31 % indicating that fortified milk is a good source for vitamin D but still insufficient to meet the guidelines. Since water is also recommended as a mealtime beverage it is desirable that schools should be able to fulfill vitamin D recommendations without including milk in the analysis, explaining why only 1 deciliter per person was used in this study, and highlighting the importance of including other foods rich in vitamin D. If servings of fatty fish would increase, the likelihood of reaching recommended levels would increase substantially. Only two schools in the survey had fatty fish on the menu and these were also the menus with the highest content of the vitamin. The generally poor levels are in line with the low levels registered in the latest nation-wide dietary survey on children and the most recent assessment of school lunches in 191 Swedish primary schools (12, 15).

Looking at the nutritional quality, vegetarian meals were better than main meals in some aspects. The fat quality was better, the energy distribution was more equal to guidelines and fiber and calcium content higher. The vitamin D content was however lower, probably due to the exclusion of fatty fish, as were iron levels. This highlights the importance of improving the knowledge in meal planning of vegetarian meals to fulfill nutritional requirements but also suggest that a mixed diet, incorporating more vegetarian meals in school lunches, may be

beneficial for the overall nutrient value. The small study sample does however not allow for any general conclusions on the diet quality of Swedish school food, particularly in regards to vegetarian meals.

Strengths and limitations

This study contributed important knowledge to the development of the SkolmatSverige instrument and had the advantage of comparing an accurate nutritional assessment with the results from the instrument, making it a suitable validation study. By using real menus collected in person the sample reflects true data on school food composition and conclusions on the nutrition quality of the menus could be drawn. This was additionally beneficial since school catering managers always could be contacted during the procedure if specific information was missing. To eliminate the source of error that appear when the school answers the instrument the rating of a neutral person was instead used as reference. The purpose of the instrument is of course to be able to assess this when a school acts as a user and this study also investigated this matter by assessing the inter-rater reliability. The main disadvantage of this study is however the small sample size, which resulted in difficulties to analyse validity due to low variation in the nutrition quality of the menus. Priority was given to perform accurate nutritional analyses and due to this time-consuming work the dataset had to be limited. The sample size does not allow for conclusions about nutritional quality of school food nation-wide and the participating schools may not be representative for all Swedish schools. The sample size could have manipulatively been enlarged further by more combinations of menus but this would probably not increase the variation in nutrition quality since the original data would be constant and a combination of menus did in this study not change the results. Although a nutritional analysis is considered a valid method it is not completely reliable, since a number of errors are hidden in the system; such as lack of information on all nutrients, numbers based on aged chemical analyses and the personal error that exist when data is entered into a nutrient analysis program. Overall, this study adds to previous research and was valuable for the further development of the instrument.

The future of the instrument

Data on school meals and school performance is scarce, and an association between the factors is difficult to prove (23, 3). With this instrument Sweden can be the first country to record comprehensive information on a variety of aspects in regards to school meal quality which can act as a base for research, such as investigating the long term effects of school food provision on health and educational outcomes. For many years it has been evident in high income countries that educational status is positively correlated to health status. Recently the WHO concluded that there is also a causal relationship in the other direction, that a better health status improves educational outcomes (23). Currie (24) continues on the same line saying that even in relatively well nourished populations improved nutrition may enhance cognitive development. These results demonstrate the importance of highlighting health, including optimal nutrition, in order to optimize children's school performance. This instrument can collect and store nation-wide data on various aspects of school food provision and the data can be linked to other national registers on child educational achievements and research on child health, in order to investigate the relationship further. Moreover, the nutritional quality of school lunch consumption has been suggested as a good marker for the overall dietary pattern and nutrition quality in adolescents indicating the value of measuring intake at lunchtime to identify children in risk of having an overall poor diet (25). The FBNC will be validated again when the instrument is launched and a larger quantity of data is available.

Another benefit with the instrument is that it can easily be re-designed to suit other food systems in the society; such as food provision in pre-school, at hospitals or elderly homes, as well as transferred to other countries. Although the instrument assesses nutritional quality only according to four nutrients these seem to reflect the whole nutritional content well. If official standards on other nutrients will be published the instrument may be further developed to include these, however the length of the questionnaire is a limitation to this.

With the new legislation on nutritious school lunches the aspect of ensuring that all Swedish schools have a high quality food provision has been emphasized. At the time being there are big differences between compulsory schools regarding variety and quality of school food provision. This instrument can assist in evaluating their organization, give guidelines in how to improve the system and put this important issue on the agenda. A healthy, nutritious school meal may not compensate for an overall unhealthy diet, but it is an action in the right direction to combat health inequalities in the society. By guaranteeing high quality school food provision to all children, with food that is healthy, tasty and attractive, it is likely that children with poor nutrition will improve their nutritional status.

Conclusions

In conclusion, the validity of the FBNC are considered acceptable with valid κ-values above 0.5 for two criteria and high sensitivity and specificity for the other two criteria. The small sample is a limitation, however the accuracy points towards good agreement between the nutritional analysis and an assessment of the nutritional quality using the FBNC of the SkolmatSverige instrument. Investigating the agreement between raters also proved acceptable, suggesting that similar conclusions on nutritional quality would be drawn when using the answers from the school catering managers. The instrument is thus, after some revision and slight adjustments, ready to be launched nation-wide.

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References

1. Baranowski T, Mendelein J, Resnicow K, Frank E, Weber Cullen K, Baranowski J. Physical Activity and Nutrition in Children and Youth: An Owerview of obesity prevention. Prev Med. 2000;31:1-10.
2. Wardle J, Herrera ML, Cooke L, Gibson EL. Modifying children´s food preferences: the effects of exposure and reward on acceptance of an unfamiliar vegetable. Eur J Clin Nutr. 2003;57:341-48.
3. Nordic Council of Ministers. Kost i skole og barnehage og betydningen for helse og læring. Copenhagen; 2011:534.
4. World Health Organization. Global status report on noncommunicable diseases 2010. Italy; 2011.
5. Florence MD, Asbridge M, Veugelers PJ. Diet Quality and Academic Performance. J Sch Health. 2008;78:209-15.
6. Rasmussen F, Eriksson M, Bokedal C, Schäfer Elinder L. Fysisk aktivitet, matvanor, övervikt och självkänsla bland ungdomar. COMPASS – en studie i sydvästra Storstockholm. Stockholm: Samhällsmedicin, Stockholms läns landsting och Statens folhälsoinstitut; 2004:1.
7. Waters E, de Silva-Sanigorski A, Hall BJ, Brown T, Campbell KJ, Gao Y et al. Interventions for preventing obesity in children. Cochrane Database Syst Rev. 2011;12:CD001871.
8. Sveriges riksdag [The Swedish Parliament]. Den nya skollagen - för kunskap, valfrihet och trygghet. Rule: Proposition 2009/10:165.
9. Livsmedelsverket [National Food Agency]. Svenska näringsrekommendationer. Uppsala: Livsmedelverket; 2005.
10. Skolmatens vänner. Skolmatens Vänners kartläggning av Sveriges kommuner gällande de måltider som idag serveras på landets grundskolor och förskolor April-maj 2011 [Internet]. 2011. Available from: http://www.skolmatensvanner.se/pdf/kostchefer_om_skolmat_2011_del_1.pdf
11. World Health Organization. Fact sheet 5 - Childhood obesity surveillance in the WHO European Region.
12. Enghardt Barbieri H, Pearson M, Becker W. Riksmaten - barn 2003. Livsmedels- och näringsintag bland barn i Sverige. Uppsala: Livsmedelsverket; 2003.
13. Evans CE, Cleghorn CL, Greenwood DC, Cade JE. A comparison of British school meals and packed lunches from 1990 to 2007: meta-analysis by lunch type. Br J Nutr. 2010;104:474-87.
14. Livsmedelsverket [National Food Agency]. Bra mat i skolan. Uppsala: Livsmedelsverket; 2007.
15. Patterson E, Lilja K, Schäfer Elinder L. Kartläggning av svenska skolmåltider – resultat från SkolmatSveriges nationella baslinjestudie före den nya skollagen. Stockholm: Karolinska Institutet; 2012 [cited 2012 May 3]. Available from: http://www.skolmatsverige.se/node/816
16. Lilja K. Validering av kvalitetskriterier för bedömning av skollunchens näringsinnehåll – en del i utvecklingen av SkolmatSveriges webbaserade verktyg [Master thesis]. Stockholm: Karolinska Institutet; 2011 [cited 2012 April 26]. Available from: http://www.folkhalsoguiden.se/upload/Valideringsstudie,%20ett%20samarbete%20mellan%20Stockholms%20Universitet%20och%20Karolinska%20Institutet.pdf
17. Simma M. En valideringsstudie av IT-verktyget SkolmatSverige [Master thesis]. Stockholm: Karolinska Institutet; 2011 [cited 2012 April 26]. Available from: http://www.folkhalsoguiden.se/upload/Validering,%20ett%20samarbete%20mellan%20Ume%C3%A5%20Universitet%20och%20Karolinska%20Institutet.pdf
18. Sim J, Wright CC. The kappa statistic in reliability studies: use, interpretation, and sample size requirements. Phys Ther. 2005;85:257-68.
19. Elfving B, Liljequist D. Reliabilitet, reproducerbarhet och överensstämmelse.
20. Altman DG. Practical statistics for medical research. 7th ed. London: Chapman & Hall;1990.
21. Poslusna K, Ruprich J, de Vries JH, Jakubikova M, van't Veer P. Misreporting of energy and micronutrient intake estimated by food records and 24 hour recalls, control and adjustment methods in practice. Br J Nutr. 2009;101:73-85.
22. Rennie KL, Coward A, Jebb SA. Estimating under-reporting of energy intake in dietary surveys using an individualised method. Br J Nutr. 2007;97:1169-76.
23. Suhrcke M, de Paz Nieves C. The impact of health and health behaviors on educational outcomes in high-income countries: a review of the evidence. Copenhagen: WHO Regional Office for Europe; 2011.
24. Currie J. Healthy, Wealthy, and Wise: Socioeconomic Status, Poor Health in Childhood, and Human Capital Development. JEL. 2009;47:87-122.
25. Tilles-Tirkkonen T, Pentikäinen S, Lappi J, Karhunen L, Poutanen K, Mykkänen H. The quality of school lunch consumed reflects overall eating patterns in 11-16-year-old schoolchildren in Finland. Public Health Nutr. 2011;14:1-7.

Supplementary table 1 Proposed energy- and nutrient standards for school lunches in three age groups. The reference population used in the present study is children aged 10-13.

Energy/Nutrient	6-9 years	10-13 years	14-17 years
Energy (MJ)	1.9-2.7 (2.3)	2.3-3.2 (2.8)	2.7-3.8 (3.3)
Energy (kcal)	460-650 (550)	550-770 (670)	650-910 (790)
Protein (E%)	10-20 (15)	10-20 (15)	10-20 (15)
Fat (E%)	25-35 (30)	25-35 (30)	25-35 (30)
Saturated fat (E%)	Maximum 10	Maximum 10	Maximum 10
Monounsaturated fat (E%)	10-15	10-15	10-15
Polyunsaturated fat (E%)	5-10	5-10	5-10
Carbohydrates (E%)	50-60 (55)	50-60 (55)	50-60 (55)
Fiber (g)	Minimum 5	Minimum 6	Minimum 7
Vitamin C (mg)	12	15	22.5
Vitamin D (µg)	2.25	2.25	2.25
Folate (µg)	39	60	90
Iron (mg)	2.7	3.3	4.5
Zinc (mg)	2.1	3.3	3.6
Calcium (mg)	210	270	270
Selenium (µg)	9	12	15
Sodium (mg)	Maximum 690	Maximum 690	Maximum 690

Supplementary table 2 Nutrient data from original school menus

Menu[1]	Energy MJ (kcal)	Protein g (E%)	Fat g (E%)	Saturated fat g (E%)	Monounsaturated fatty acids g (E%)	Polyunsaturated fatty acids g (E%)	Carbohydrates g (E%)	Fiber g	Vit. D µg	Folate µg	Ascorbic acid mg	Sodium g	Calcium mg	Iron mg	Zinc mg	Selenium µg
A1[2]	2,72 (651)	25,9 (16,1)	30,0 (40,8)	9,6 (13,0)	10,3 (14,0)	4,2 (5,7)	66,6 (43,9)	7,9	2,0	66,7	54,4	1,0	245,8	3,1	3,5	8,6
B1[2]	3,18 (762)	27,4 (14,6)	39,5 (45,9)	13,2 (15,4)	14,8 (17,1)	6,5 (7,5)	70,9 (39,9)	8,0	1,1	91,7	67,8	1,4	284,5	3,3	3,6	11,8
C1[2]	3,21 (768)	31,8 (16,9)	30,8 (35,5)	10,0 (11,5)	10,6 (12,2)	4,7 (5,4)	87,0 (48,4)	9,3	1,7	92,5	46,5	1,5	288,1	3,8	4,1	12,0
D1[2]	2,38 (571)	26,9 (19,2)	21,1 (32,8)	8,3 (12,9)	6,9 (10,7)	2,7 (4,1)	63,8 (48,3)	8,2	1,7	96,5	28,9	7,2	224,6	2,8	3,6	13,1
E1[2]	3,21 (768)	29,4 (15,5)	33,3 (38,3)	8,5 (9,8)	14,0 (16,1)	6,2 (7,2)	83,1 (46,8)	11,5	2,0	103,8	43,0	1,2	303,5	3,8	3,9	13,3
F1[2]	3,18 (762)	31,4 (16,7)	36,6 (42,6)	13,1 (15,3)	12,8 (14,9)	5,2 (6,0)	73,2 (41,2)	8,4	2,1	88,0	51,0	1,5	282,5	3,7	4	9,7
G1[2]	3,04 (726)	24,5 (13,7)	40,0 (48,7)	11,2 (13,7)	17,5 (21,3)	7,5 (9,1)	63,9 (38,1)	8,9	1,9	100,3	53,8	7,4	231,8	2,9	3,5	10,3
H1[2]	3,19 (763)	29,8 (15,9)	31,0 (35,9)	10,7 (12,4)	9,5 (11,0)	4,3 (5,0)	87,3 (48,1)	6,3	1,4	94,5	42,1	1,4	267,5	3,2	3,8	13,7
I1[2]	2,83 (681)	33,0 (19,8)	24,9 (32,6)	8,0 (10,4)	7,4 (9,7)	3,6 (4,7)	77,1 (49,0)	9,7	1,7	111,3	51,8	1,0	278,0	3,4	3,7	12,1
J1[2]	2,71 (649)	25,4 (15,9)	30,4 (41,4)	7,8 (10,7)	8,3 (11,3)	3,1 (4,3)	65,4 (43,6)	9,0	1,8	86,7	73,2	7,4	244,9	4,0	3,4	10,9
K1[2]	2,99 (716)	32,7 (18,6)	30,1 (37,3)	12,7 (15,7)	9,7 (12,0)	4,6 (5,7)	74,3 (44,8)	9,5	1,8	108,1	62,8	8,8	302,6	3,6	4,7	13,8
L1[2]	3,00 (717)	27,5 (15,6)	31,8 (39,3)	7,8 (9,6)	12,9 (16,0)	5,8 (7,1)	77,2 (46,0)	8,6	1,6	75,4	39,7	6,0	288,6	2,9	3,3	12,5

Supplementary table 3 Point system for the food based nutrient criteria in SkolmatSverige

Criteria	Sub criteria	2 points	1 point	0 points	Category weighed/comment
Fat quality	Fatty fish is served	3 days in 4 weeks or more often	2 days in 4 weeks	Less than 2 days in 4 weeks	
	Type of spread served	Keyhole labeled light margarine (maximum 41% fat) or keyhole labeled margarine + light margarine	Light margarine (maximum 43% fat) other sorts may also be served	Margarine/fat blend/butter (minimum 43% fat) as main product	
	Source of cooking fat	Only liquid margarine/oils	Both solid fats/butter and liquid margarine/oils	Only solid fats/butter	
	Dressing based on oil is served	Every day	1-4 days per week	Less than 1 day per week	
	Dressing with dairy products above 15% fat is served	Never	1-3 times/month	Once a week or more often	
	Sausage is served	Maximum 3 days in 4 weeks	4 days in 4 weeks	5 days in 4 weeks or more often	x2
	Keyhole labeled sausage (maximum 10% fat) is served	At least 50% of the times/alternatively sausage is not served		Less than 50% of the times	
	Dairy products with 30% fat or above is used for cooking in amounts of 2 kg or more per 100 portions	Never	1-3 days in 4 weeks	4 days in 4 weeks or more often	
	Cheese with 20% fat or above is used for cooking in amounts of 2 kg or more per 100 portions	Never	1-3 days in 4 weeks	4 days in 4 weeks or more often	
	Type of milk as beverage	Low fat milk every day. Skimmed milk/standard milk maximum 3 times/month	Alt 1: Semi-skimmed milk 1-4 times/week or more often, low fat milk may be served, standard milk maximum 3 times/month. Alt 2: Low fat milk 1-4 times/week and other types less often.	Standard milk minimum once a week, other types may be served.	
	TOTAL POINTS FAT QUALITY	**16-22 p (probably fulfill SNR standards)**	**14-15 p (may have problems fulfilling SNR standards, a nutritional analysis is recommended)**	**0-13 p (probably not fulfill SNR standards, a nutritional analysis is recommended)**	

Criteria	Sub criteria	2 points	1 point	0 points	Category weighed/comment
Iron	Black pudding/liver is served	1 day in 4 weeks or more often		Less than 1 day in 4 weeks	x2
	Meat, fish or poultry is served	16-20 days in 4 weeks	12-15 days in 4 weeks	0-14 days in 4 weeks	x2
	Percentage of vegetarian options with iron rich protein source (e.g. pulses, soy protein, eggs as main ingredient)	80-100%	60-79%	Less than 60%	x2 These points will not be included in the total points if vegetarian meals are served less than 4 times in 4 weeks
	Pulses in the salad bar	2 or more types	1 type	Not served	
	Whole grain pasta is served	At least 50% of the times		Less than 50% of the times	x0.5
	Whole grain bread is served	At least 50% of the times		Less than 50% of the times	
	TOTAL POINTS IRON	**8-18 p (probably fulfill SNR standards)**	**6-7 p (may have problems fulfilling SNR standards, a nutritional analysis is recommended)**	**0-5 p (probably not fulfill SNR standards, a nutritional analysis is recommended)**	
Vitamin D	Fatty fish is served	3 days in 4 weeks or more often	2 days in 4 weeks	Less than 2 days in 4 weeks	x4, 1 day in 4 weeks = 0.5 points
	Fat for cooking is fortified with vitamin D	Always	Not always, but at least 50% of the times	Less than 50% of the times	
	Spreads are fortified with vitamin D	Always	Not always, but at least 50% of the times	Less than 50% of the times	
	Milk as beverage is fortified with vitamin D	Always	Not always, but at least 50% of the times	Less than 50% of the times	
	Milk for cooking is fortified with vitamin D	Always	Not always, but at least 50% of the times	Less than 50% of the times	
	TOTAL POINTS VITAMIN D	**10-16 p (probably fulfill SNR standards)**	**8-9 p (may have problems fulfilling SNR standards, a nutritional analysis is recommended)**	**0-7 (probably not fulfill SNR standards, a nutritional analysis is recommended)**	

Criteria	Sub criteria	2 points	1 point	0 points	Category weighed/comment
Fiber and wholegrain	The content of the salad bar includes	At least 3 types of coarse vegetables (pulses included)	2 types of coarse vegetables (pulses included)	Less than 2 types of coarse vegetables (pulses included)	x4
	Whole grain pasta is served	At least 50% of the times	Sometimes, but less than 50% of the times	never/is not served	
	Whole grain rice is served	At least 50% of the times	Sometimes, but less than 50% of the times	never/is not served	
	Whole grain bread is served	At least 50% of the times		Less than 50% of the times/is not served	
	Bulgur, quinoa, pearl barley, wheat berries or whole grain couscous is served	4 days in 4 weeks or more often	1-3 days in 4 weeks	Not served the last 4 weeks	
	TOTAL POINTS FIBER AND WHOLEGRAIN	**10-16 p (probably fulfill SNR standards)**	**7-9 p (may have problems fulfilling SNR standards, a nutritional analysis is recommended)**	**0-6 (probably not fulfill SNR standards, a nutritional analysis is recommended)**	