Study protocol with statistical analysis plan

Fostering Sustainable Dietary Habits Through Optimized School Meals - an intervention study in Uppsala, Sweden

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Introduction

Radical changes to food production and consumption are needed to ensure the attainment of Agenda 2030 for Sustainable Development and fulfillment of the Paris Agreement (1). Public school meals have been highlighted as a suitable setting for children to internalize sustainable dietary habits, which may persist throughout life (2). Planning of school meals must take many aspects into account: health promotion, environmental impact, acceptability by the consumers and affordability to those paying for the meals. Currently many schools use organic products, recycle food packaging and aim to reduce food waste, but environmental impacts like greenhouse gas emissions (GHGE) have so far not received much attention.

In Sweden, fully subsidized lunches are served daily in primary schools to all 1.3 million children aged 6 to 15 (3). Due to their reach and scale (approximately 230 million meals/year at an annual cost of around 6 billion SEK), school meals have great potential to increase children's knowledge about health and sustainability, foster sustainable dietary habits and to enable sustainable public procurement.

This study builds on a previously published strategy for how to optimize, plan and implement nutritiously adequate, affordable, acceptable and more climate friendly meals in Swedish primary schools (4). In line with this strategy, the present study aims to: a) Apply linear programming to develop a GHGE-reduced, nutritionally adequate, and affordable four-week lunch menu plan optimized for minimum deviation from the current food supply; and b) evaluate the climate impact of the menu, effects on food waste, food consumption, and pupils' satisfaction with school lunches. Our hypothesis is that school meals can be optimized to be nutritious and more climate friendly, without negatively affecting acceptance, food waste and cost in this context.

Methods

Design

A pre-post design will be used to compare the effect of an optimized menu to the baseline menu on daily food waste and consumption at school level. For a baseline period of four weeks children in primary schools will receive a baseline menu. After a one-week break (winter break), the optimized four-week menu will be served (intervention period).

Recruitment of schools

During the fall of 2019, a meeting was held with the public meal administration in the municipality of Uppsala. The research team described the OPTIMAT project, including the previously developed strategy for optimizing and implementing more climate friendly lunches in schools (4). Following this meeting, the municipality agreed to take part in the project. The municipality's meal planner proposed four primary schools for the study, presently having the highest food related GHGE in public meals in the municipality. To be eligible, the intervention schools were required to have on-site kitchens as well as being able to provide electronic recipes for a standard four-week menu. All proposed schools fulfilled these criteria and approved participation.

Optimization

Recipes for an original (baseline) four-week school lunch menu plan previously served at the recruited schools were obtained through the municipality's electronic meal planning system. The foods included and amounts are considered as the baseline food supply. Each food item included has a code that can be coupled to the Swedish national food database and a national climate database for foods containing life cycle data for each food item (5). This baseline food supply will be optimized using linear programming. The optimized food list, not including new foods or excluding any foods from the baseline list, will be handed to the municipality's meal planner who develops a new menu plan for the intervention using all foods on the optimized list.

Outcomes

To assess the effect of the new menu plan, data on food waste and consumption will be collected daily in each intervention school four weeks before (baseline) as well as during the four-week intervention with a one-week brake between measurement periods. Measurements were carried out according to a method for measuring food waste and consumption in school restaurants that was based on School Food Sweden's method for measuring school lunch waste and consumption [1]. The method requires daily weighting (using school kitchen scales) of all food prepared in the kitchen (prepared food); the share of the prepared food that is not eaten and has to be thrown away (serving waste); the share that can be saved (leftover food); and plate waste. The number of plates used daily by the pupils in the school restaurant will also be recorded. These measurements will be made daily by the personnel in the school kitchens during the baseline as well as during the intervention period. Based on these measurements, the total food consumption (kg) will be calculated as the total amount of food prepared in the kitchen (kg) minus the total amount of prepared food that is not eaten and has to be thrown away (serving waste in kg), the total amount of plate waste (kg), and the total amount of leftover food (kg). Plate waste per pupil (g) will be calculated for each day by dividing the total amount of plate waste by the total number of plates used. Similarly, the consumption per pupil (g) will calculated for each day by dividing the total consumption by the total number of plates used.

Total plate waste, plate waste per pupil, serving waste, total consumption, and consumption per pupil will be considered as the primary outcomes as they are regarded as directly related to the pupils' acceptability of the new menu.

Data on school meal satisfaction will also be collected through an anonymous online questionnaire at baseline and during the last week of the intervention period. Pupils in grades 5 and 8 will answer the questionnaire containing ten questions related to the school lunch. Five of the ten multiple-choice questions specifically cover their general (i.e. not for that specific day of week) sense of satisfaction with the school lunch. The questions include how often they consider that the school lunch tastes good, how many days per week on average they eat it, how often they usually feel full after having eaten lunch, and how often they throw away food. They are also asked to provide an overall rating of the school lunch.

Statistical analysis

A pre-post design will be employed to assess the effect of implementing an optimized lunch menu on daily food waste and consumption at school level. Data will be analyzed by interrupted time series analysis assessing mean and slope differences in daily food waste and consumption between the two periods (6). School lunch satisfaction before and after introduction of the new menu plan will be compared by means of Pearson's X2 test.

References

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