Strengthening European Food Chain Sustainability by Quality and Procurement Policy

Deliverable 9.1:

Report evaluating the pilot initiative to improve the nutritional qualities of school meals catering procurement and assessment of benefits

March 2021

Contract number	678024
Project acronym	Strength2Food
Dissemination level	Public
Nature	R (Report)
Responsible Partner(s)	MPNTR, EUTA, BEL, ARILJE, BARILLA, UNED
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Keywords	School meals, public sector food procurement, healthy nutrition

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 678024[1].

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Table of contents

EXECUTIVE SUMMARY **6**

PART 1. PILOT SCHOOL MEALS INITIATIVES IN SERBIA TO STIMULATE SFSC **10**
LIST OF TABLES **11**
LIST OF FIGURES **12**
LIST OF ABBREVIATIONS AND ACRONYMS **14**
LIST OF APPENDICES **15**
1. INTRODUCTION **16**
2. COLLECTING INFORMATION ON ALL SERBIAN PRIMARY SCHOOLS **17**
2.1 Methodology 17
2.2 Findings from the questionnaire 17
3. COLLECTING INFORMATION ON PRIMARY SCHOOLS' FOOD PROCUREMENT **25**
3.1 Methodology 25
3.2 Findings from food procurement searches 26
4. COLLECTING INFORMATION ON PRIMARY SCHOOLS FROM VISITS **33**
4.1 Methodology for school visits 34
4.2 Findings from school visits 34
5. SELECTING SCHOOLS TO TAKE PART IN THE PROJECT **37**
6. SERBIAN STRENGTH2FOOD WEBSITE AND BARILLA VISITS **38**
6.1 Strength2Food website in Serbian 38
6.2 BARILLA cookery demonstrations for schools 40
7. MONITORING INSTRUMENTS FOR CHILDREN AND PARENTS **42**
7.1 Methodology for developing and using monitoring instruments 42
7.1.1 Monitoring instrument for children 42
7.1.2 Monitoring instrument for parents 43
7.1.3 Monitoring procedure and data processing 44
7.2 Monitoring instrument results 45
7.2.1 Children's instrument 45
7.2.2 Parent's instrument 58
7.2.3 Association of parents' views with their children's food preferences 64
7.3 Conclusions from the monitoring instruments 71
8. NORMATIVES AND FOOD DIARIES - ESTABLISHING WHAT CHILDREN ACTUALLY EAT **72**

8.1 Normatives (recipes) and menus for school meals 72
8.2 Food diaries for a week 74
9. CHILDREN'S NUTRITIONAL KNOWLEDGE 77
9.1 Methodology to assess children's nutritional knowledge 77
9.2 Analysis of children's nutritional knowledge 79
10. EXCEL MEAL PLANNER TOOL 83
10.1 Background to the Excel Meal Planner and sources of information 83
10.2 Meal Planner input information 84
10.3 Meal Planner output information 86
10.4 The Meal Planner in practice 87
11. STANDARDISED WINTER AND SUMMER LUNCH MENUS 88
11.1 Justification for standardising menus 88
11.2 Background information on the standardised menus 90
11.3 Structure and content of the standardised menu document 93
12. IMPACT OF COVID-19 PANDEMIC ON THE SCHOOL MEALS PILOT SCHEME IN SERBIA 97
13. OVERALL PROGRESS AND ACHIEVEMENTS 99
13.1 Overall progress and achievements from action research described above 99
13.2 Dependence of progress and achievements on other S2F project activities 102
13.2.1 Interactions with other Strength2Food WPs 102
13.2.2 Cross-fertilisation with WP9.5.1 103
13.3 Overall progress and achievements against objectives 103
14. RECOMMENDATIONS FROM OUR FINDINGS 105
14.1 Recommendations for schools and administrative staff 106
14.2 Recommendations for teachers 106
14.3 Recommendations for children 106
14.4 Recommendations for their parents 107
14.5 Recommendations for cooks and kitchen staff 107
14.6 Recommendations for policy makers 107
15. SUMMARY AND CONCLUSIONS 108
REFERENCES 111
APPENDICES 112

PART 2. PILOT SCHOOL MEALS INITIATIVES IN CROATIA IN SCHOOLS WITH GARDENS .. 116
LIST OF TABLES 117
LIST OF FIGURES 118
1. INTRODUCTION 119

2. SCHOOL FOOD POLICIES IN CROATIA 120
3. SELECTION AND DESCRIPTION OF THE SCHOOLS 123
3.1 Profile of school cases 123
3.2 Schools description 124
3.2.1 Schools with garden 124
3.2.2 Schools without garden 127
4. EXAMINING THE DIFFERENCES BETWEEN SCHOOLS WITH AND WITHOUT GARDEN 130
4.1 Description of activities in schools with gardens 130
4.2 Evaluation of menus between schools with and without garden 134
4.3 Assessment of fruit and vegetable availability in schools with and without garden 145
4.4 Students preference toward fruit and vegetable 151
4.5 Plate waste between schools with and without garden 154
4.6 Student preferences for fruit and vegetable dishes 156
5. EDUCATIONAL INTERVENTION IN SCHOOLS WITH AND WITHOUT GARDENS 159
5.1 Preferences toward fruit and vegetables after education 162
5.2.Student preference for new fruit and vegetable dishes after education 166
5.3.Quantity and frequency of fruit and vegetable consumption after education 166
6. PRACTICAL IMPLICATIONS 169
6.1. Taste of traditional kale meals 169
6.2 Implementation of new dishes 171
7. CONCLUSIONS 172
8. POLICY RECOMMENDATIONS 174
REFERENCES 176

EXECUTIVE SUMMARY

Part 1 - Pilot school meals initiatives in Serbia to stimulate SFSC

Part 1 aimed at improving food procurement in primary schools in Serbia to stimulate short food supply chains and improve meal nutritional quality. To achieve these objectives, action research was carried out to expand existing knowledge on Serbian school meal provision, collaborating with selected schools to provide resources and recommendations, and, ultimately, thereby to improve children's nutrition.

The first phase of the research explored the state of food procurement and meal provision in Serbia's primary schools. For this purpose, we collected data through school questionnaires and analysis of schools and government websites, to provide the Serbian partners, and especially the Ministry of Education, with information on school meal provision. The data gathered through the questionnaire and analysis of websites were key in identifying primary schools preparing their own meals in four broad regions, both in urban and rural areas of Serbia (Novi Sad, Belgrade, around Valjevo and around Arilje). Focusing on schools making their own meals allowed analysing schools with greater consumption of fresh foods, with more flexibility related to procurement choices, and with closer links between food production and consumption. In order to establish a relationship with school directors and identify suitable schools to work with, we conducted a total of 66 school visits between March and October 2017. School visits were a key step in understanding how meal provision worked in practice. As a result of the visits, around 27 schools were included in the pilot action, representing both urban and rural communities. A further 7 schools were included as a control group.

Working directly with schools, we aimed at improving children's nutrition through educational activities. In order to establish the impact of Strength2Food activities on children's eating habits, it was necessary to gather information on these habits first, and the extent to which these were influenced by parents' understanding of good nutrition. To do this, two questionnaires were designed - one for children and one for their parents. A total of 5245 questionnaires (either children or parents) were completed. The children's questionnaire produced comprehensive and detailed findings on children's preferences in relation to 90 types of food. Findings indicated which categories of food are preferred by children (generally food with low nutritional value) and which ones are disliked (generally food with high nutritional value). More importantly, the questionnaire aimed at establishing whether eating school meals had any influence on children's food preferences.

Findings indicated that school lunches may have a positive influence on schildren's food preferences, with a frequent tendency for these children to dislike fewer foods, to like more categories of foods, including vegetables, and also to have experienced a wider range of foods. This influence of school meals is likely to have a broader impact on food preferences, and to spill over into wider eating habits beyond school. In this sense, school meals have the potential to make an important contribution to children's nutrition and, as a consequence, overall health. The second questionnaire monitored parents' knowledge, attitude and practices towards food, as well as views towards their children's school meals. This showed that the majority of parents knew what a healthy diet is in theory; in practice, however, attitudes towards healthy food were diverse, and it was clear that many parents were not familiar with what their children were given for school meals.

A major objective of the two monitoring instruments was to examine the relationship between children's food preferences and their parents' practices regarding food. The overall picture showed that children's food preferences are influenced by parents' attitudes and practices towards food. In other words, parents' attitudes and habits play a fundamental role in children's preferences towards healthy food choices. Nevertheless, the parent's impact on children eating habits is also influenced by internal factors (i.e. the child's age) and external factors (i.e. poverty level, community size). As a consequence, it is difficult to identify aspects of parents' food practices that would be universally applicable for children of all ages and socio-economic environments. The only practice we found likely to have a positive impact on children's food preferences across a range of ages and socio-economic factors is parents and children eating meals together at the same time at home.

A further set of activities involved analysing schools' meal normatives and children's food diaries. Meal normatives showed no consistency across schools, with normatives varying from a one-week cycle to a four-week cycle. We also aimed at collecting data about what children ate outside school. For this, schools were requested to ask up to 50 children to complete a simple food diary for one week. In total, 419 children completed food diaries in 14 schools. The analysis of the food diaries revealed a lack of fruit in the diet of nearly a quarter of the children, which is of particular concern, especially in relation to the intake of fibre and vitamins.

As part of the process of establishing baseline information on children's knowledge and food habits in our target schools, we also tested children's nutritional knowledge in several of these schools, so to monitor the impact of Strength2Food activities. Eight different schools, from seven locations across the country were included in the sample. This data collection was impacted by Covid-19 related restrictions, as most classes were moved online. However, 573 responses were collected. It was encouraging to find that all children, regardless of their age, gender or location, recognised all fruits and vegetables included in the questionnaire as healthy.

To help schools adjust their menu normatives according to Ministry recommended quantities of energy, macro-, and micro-nutrients, a meal planner tool was prepared in Excel. The meal planner allows schools to enter meal ingredients and quantities for up to four meals per day and gives tabular and graphical outputs of energy, macronutrients, minerals, and vitamins, as well as meal costs and CO2 emissions for food production. Quantities of each ingredient used per week are given to help schools plan weekly food deliveries. The adoption by schools of a standardised set of menus would ensure that children receive a nutritionally well-balanced lunch at the lowest cost possible while reducing meal CO2 footprint and plate waste. The Meal Planner has been demonstrated to a few schools and was well-received within the Ministry, although a more widespread dissemination has been prevented by the Covid-19 pandemic restrictions.

Restrictions also meant that meetings with school personnel or other project stakeholders essentially ceased in March 2020. The pandemic has effectively brought an end to any major interactions with schools during the final project year. For this, more emphasis has been directed towards the Serbian Strength2Food website. To ensure Strength2Food educational resources were as widely accessible as possible to schools, teachers, cooks, children and children's parents, a dedicated Strength2Food website was established to provide all resources in Serbian, targeting each of those stakeholder groups, and giving news items and recommendations for each stakeholder group. Educational resources, including video animations, BARILLA menus and cookery demonstrations were all translated into Serbian, or given Serbian subtitles.

Lastly, recommendations have been prepared separately for schools and administrative staff, for teachers, children, and their parents, for cooks and kitchen staff and also for policy makers. These have been placed on the Serbian Strength2Food website. The resources developed during the project to help schools improve their meal nutritional quality (Excel Meal Planner and standardised menus), as well as other educational resources on the website targeting each of the schools' key stakeholder groups will be a lasting legacy of the project for use by MPNTR and Serbian schools.

Part 2 - Pilot school meals initiatives in Croatia in schools with gardens

Part 2 of the pilot action aimed to analyse the benefits of school gardens on school meal nutrition and children's awareness and acceptance of healthy eating habits. Specifically, our goal was to establish an effective strategy to support school food procurement policy to improve children's uptake and long-term acceptance of nutritious school meals. Procurement and delivery of school meals involve a number of different stakeholders. Although there are legal bases and guidelines for planning school meals, implementation is often very challenging in Croatia. Schools are required to follow the rules and regulations of public procurement, but at the same time have the freedom to create daily, weekly and monthly menus.

The research examined 2 types of schools (with and without gardens) and their environment of school nutrition (nutritional analysis of school meals, plate waste and frequency of consumption F&V). In terms of school meal nutrition, findings showed that a large proportion of daily menus from both types of schools are not nutritious enough according to national parameters. Half of the school menus in both schools with and without gardens revealed lower energy value than the one recommended by National guidelines, with low content of fibres and excessive saturated fat content. Furthermore, both in schools with and without a garden, school menus offered a smaller amount of the recommended amount of fruit and vegetables (55% to 69%). The reason why menus do not meet national recommendations could be linked to the lack of professional staff (like nutritionists) in schools. Therefore, school menu committees should create and implement new menus adapted to each kitchen infrastructure; coordinate activities related to the education of staff in charge of food preparation in primary schools; and monitor, control and evaluate the application of new menus.

Following nutritional analysis of school meals, we examined children's eating habits. Our results revealed no difference in fruit and vegetable preference among children in schools with and without gardens. Although plate waste was lower in schools without gardens, the amount of wasted food was alarming in both types of schools. Vegetables were among the highest rate of wasted food. Among the key reasons for plate waste, children indicated not eating at home and the lack of taste of some foods prepared at school. Conversely, lower levels of plate waste were found in schools that invested time in the preparation and presentation of the meals. The meal environment was also a further factor contributing to higher food intake and lower plate waste.

In this working package, the task was to improve the nutritional awareness and eating habits of children. Therefore nutritional intervention was introduced in both types of schools. The basis for the intervention was nutritional education, which was followed by nutritional improvement of school menus. New nutritious meals with higher quantities of fruit and vegetables were offered to children during school meals. While children usually prefer more traditional meals, they were open to trying new meals. Previous research shows that children accept the food that

is repeatedly offered to them; hence our expectation was that children in school with gardens had a greater preference for fruit and vegetables. Surprisingly, our results were different. Children in both types of school were found to have similar eating habits. This is probably because all extracurricular activities in the gardens are oriented to develop environmental awareness and learning the botany of the plants they grow, and none of the plants in the gardens are considered for eating. For this, children could not be exposed to taste them and therefore their willingness to taste fruits and vegetables could not be increased. Changing fruit and vegetable consumption in children is complex and our findings lend support to school-based vegetable gardens as a promising tool to improve knowledge and preferences embedded within a school culture promoting health and community frameworks. However, schools that do have gardens should better use those gardens for improving children eating habits, focusing on growing plants and vegetables suitable for consumption.

To establish an effective strategy to support school food procurement policy and to improve children's uptake and long-term acceptance of nutritious school meals, a number of recommendations were developed. First, it was clear that school meals should be planned better, and corrections to meal planning should be followed by education for both children and parents.

PART 1. PILOT SCHOOL MEALS INITIATIVES IN SERBIA TO STIMULATE SFSC

Deliverable 9.1.1 (March 2021)

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LIST OF TABLES

Table 1. Comparison of children's food preference scores. 50
Table 2. Coefficients for correlations between various food categories. 54
Table 3. Food categories and scores for testing association of parents' practices towards food with their children's food preferences. 66
Table 4. Selection of food categories with significant differences amongst settlement size. .. 76
Table 5. Participants in the research. 77
Table 6. Sources of the questions in the questionnaire. 78
Table 7. Children's frequencies of citing healthy and unhealthy food types 80
Table 8. Reasons why children thought particular foods were healthy 81
Table 9. Reasons why children thought particular foods were unhealthy 82
Table 10. Selection of the correct food which is high in a specific nutrient 82

LIST OF FIGURES

Figure 1. Map of Serbia showing the distribution of primary schools and the type of meal provision by each school. 18
Figure 2. Map of Serbia showing the type of meal provision - externally supplied or prepared in the school's kitchen with its own staff. 19
Figure 3. Frequency distributions for numbers of breakfasts, snacks and lunches per day in primary schools. 20
Figure 4. Distributions of prices charged for breakfast, snack and lunch in primary schools. 20
Figure 5. Frequency of foods that children like to eat for breakfast, snack and lunch. 21
Figure 6. Frequency of foods that children do not like to eat for breakfast, snack and lunch. 22
Figure 7. Number of schools giving a score from 0 (little agreement/importance) to 4 (strong agreement/importance) for 13 statements. 23
Figure 8. Respondents' free-form answers to the question on other priority goals for their school regarding meal nutrition 23
Figure 9. Frequency of reasons for initiatives to improve school meals failing 24
Figure 10. Relative food quantities procured in schools serving only breakfast 27
Figure 11. Relative food quantities procured in schools serving only snacks 27
Figure 12. Relative food quantities procured in schools serving only lunches 28
Figure 13. Lot number frequency for 115 primary schools 29
Figure 14. Monthly frequency for initiating food procurements. 31
Figure 15. Frequency of number of bids for lots in primary school food procurements. 32
Figure 16. The location of suppliers bidding for food procurement lots 33
Figure 17. Origin of foods procured by a Novi Sad school.. 36
Figure 18. Variation in contract unit prices for vegetables and fruit for four schools 37
Figure 19. Discussion of BARILLA personnel with school directors and kitchen staff 40
Figure 20. The BARILLA chef serving vegetable lasagne in the Novi Sad school. 41
Figure 21. Minimum, mean and maximum % for (top) sad smileys (don't like the food), (middle) happy smileys (like the food), and (bottom) "?" smileys (never tasted the food). 47
Figure 22. Comparison of food preferences for children in urban and rural schools.. 49
Figure 23. Effects of cooks' food serving frequency scores on food preferences for children having or not having school lunches. 52
Figure 24. Association between the nutritional score for food categories and individual foods and children food preferences.. 53
Figure 25. Food preference scores (sad smileys and happy smileys) compared for vegetables, fruit, pasta and rice dishes and soups. 56
Figure 26. Mean parent assessment scores for their knowledge of food, their attitudes towards food, their practices towards food and their views towards their children's school meals. 59
Figure 27. Statements showing clear differences in maximum and minimum assessments by parents according to urban-rural groups. 62
Figure 28. Percentage of correlations significant at $P<0.05$ between parent statement scores for their food practices and views on their child's school meals and child preference scores for a collection of 96 individual foods (68) and food categories (28). 66
Figure 29. Percentage of correlations significant at $P<0.05$ amongst parent statement scores for their food practices and views on their child's school meals and child preference scores for a range of vegetables and fruit food categories (38 items). 67
Figure 30. Percentage of correlations significant at $P<0.05$ amongst parent statement scores for their food practices and views on their child's school meals and child preference scores for a range of milk and yogurts (7 items). 68

Figure 31. Percentage of correlations significant at $P<0.05$ amongst parent statement scores for their food practices and views on their child's school meals and child preference scores for a range of main courses (containing meat) and various meats alone (18 items). 69
Figure 32. Percentage of correlations significant at $P<0.05$ amongst parent statement scores for their food practices and views on their child's school meals and child preference scores for a range of typically non-Serbian pasta and rice dishes (16 items). 70
Figure 33. Lunch kcal for 14 target schools. 73
Figure 34. Actual (IPH) and normative meal total energy (kcal) as ratios of the recommended kcal. 74
Figure 35. Frequency per day for major food categories recorded by children in their food diaries. 75
Figure 36. Frequency distributions for children's food diary entries for vegetables/week and fruit/week for 419 children. 76
Figure 37. Meal Planner spreadsheet of table and chart outputs, illustrating results for a lunch of moussaka on Monday of week 2 using conventional vegetables. 86
Figure 38. Macronutrient quantities for lunches with moussaka (expressed as % recommended quantities) from normative recipes for 12 schools. 88
Figure 39. Vitamin quantities for lunches with moussaka (expressed as % recommended quantities) from normative recipes for 12 schools.. 89
Figure 40. Normative for lunch with moussaka showing ingredient and nutrient quantities for the original normative, a normative adjusted while keeping the quantity of courgette constant and a normative adjusted by replacing some courgette with potato. 89
Figure 41. Winter lunch menu for day 3 showing, in the table, each course, a detailed recipe, list of ingredients and quantities for one child and 20 children. 94
Figure 42. An example of tabular and graphical outputs for winter lunch menu for day 3. 96
Figure 43. Annual food quantities for winter week 1 lunch menus, with ingredients listed in decreasing rank order. 97

LIST OF ABBREVIATIONS AND ACRONYMS

BARILLA: Barilla Group (Italy)

BEL: University of Belgrade

CHO: carbohydrate

EFSA: European Food Safety Authority

EuroFIR: European Food Information Resource Network

HACCP: Hazard Analysis and Critical Control Point

IPH: Institute of Public Health

KAP: Knowledge, Attitude and Practice

LOC: Local model of procurement

LOW: Lowest price model of procurement

MPNTR: Ministry of Education, Science and Technological Development (Serbia)

PSFP: Public Sector Food Procurement

SFSC: Short Food Supply Chain

UNED: University of Edinburgh

USDA: United Stated Department of Agriculture

WHO: World Health Organization

WP: Work Package

ZAG: University of Zagreb

LIST OF APPENDICES

Appendix 1:

Questionnaire: Basic data on schools and meals

Appendix 2:

Ministry of Education, Science and Technological Develop letter to schools

Appendix 3:

Children's monitoring instrument food images and score sheet

Appendix 4:

Parents' monitoring instrument of statements

Appendix 5:

Monitoring instrument instructions

Appendix 6:

Internal and external variables used for multi-level analyses, and multi-level methodology

Appendix 7:

Food diary instructions and template for one week of meals

Appendix 8:

Questionnaire to assess children's nutritional knowledge

Appendix 9:

Instruction sheet to accompany questionnaire to assess children's nutritional knowledge

Appendix 10:

Children’s knowledge on the healthiness of individual food items according to gender, age, and school location

Appendix 11:

Winter and summer standardised menus

1. INTRODUCTION

The pilot school meals initiatives in Serbia to stimulate Short Food Supply Chains (SFSCs) were planned in response to accumulating evidence of increasing problems of inadequate nutrition of children in Serbia, leading to both childhood obesity and malnutrition. During the period 1990-2010, obesity has increased by around 60% (FoNet, 2017). According to Serbia's Institute of Public Health (Nikolic 2011), about 18% of young people, aged 7 to 18, are moderately obese and obese. In 2015, a survey of over 5000 children in 42 Serbian schools (Djordjić et al., 2016) showed around 35% of them, especially boys, to be either overweight or obese. This problem is just as concerning in rural as in urban communities (Janković, 2016). Part of the increase in childhood obesity is associated with an increasingly sedentary existence (e.g. time spent on a computer, Ješić, 2017), but also with differences in the diet of children associated with poverty, with around 15% of people not able to afford an adequate diet (Anon, 2020). Even in the capital city, Belgrade, about 10% of children are malnourished (Janević et al., 2010).

In addition, anecdotal information indicated that the quality of existing school meals in primary schools was poor, with an overreliance on processed and starchy foods. However, at the start of Strength2Food, no central database of information was available within MPNTR (Partner 25) on meal provision in primary schools, the type of meals, their nutritional quality, and where existing school food suppliers were located. The Ministry had details of kitchen facilities, but no information on whether they were still in use or not.

The strategy for the school meals pilot scheme was a sequence of activities to identify the existing baselines, provide opportunities for improvement, and build on expertise and findings from other projects WPs to improve food procurement procedures and to stimulate short food supply chains, through action research as follows:

- to establish how school meal provision took place with an information-gathering exercise;
- to identify existing food procurement practices in primary schools;
- to identify a number of suitable schools with which Strength2Food could work;
- to monitor children's and parents' knowledge of food and practices;
- to provide resources for those schools to facilitate improved meal nutrition and food procurement;
- to identify any changes and improvements in meal provision, procurement and supply during the project to improve nutrition and support SFSCs.

Strategies to modify the eating habits of schoolchildren, developed by BARILLA, BEL and ZAG (Partner 24, 7 and 10) were compared to identify those having the greatest impact in terms of children's uptake of, and persistence with, more nutritious school meals. Drawing upon its experience of evaluating school meals' initiatives in the UK, UNED (Partner 3) assisted in research design and data analysis.

To achieve these steps, our action research required frequent interactions with all the relevant stakeholders: school directors, administrative, teaching and kitchen staff, parents, food suppliers and growers, policy makers at local, provincial and national levels, nutritionists, primary health care professionals, as well as procurement experts. Action research with the supply side (producers, growers and policy makers) is described in D9.5.1.

2. COLLECTING INFORMATION ON ALL SERBIAN PRIMARY SCHOOLS

2.1 Methodology

To provide the Serbian partners, and especially the Ministry of Education, with information on school meal provision, a questionnaire was designed for all Serbia's primary schools to complete. Following an Introductory statement in the questionnaire explaining its purpose, and basic information requested on the school, questions were grouped into five sections:

A) General technical questions on numbers of pupils, types of meals provided, their cost to parents and numbers of children taking each meal;
B) Meal provision details, any standards used, the time given for each meal, estimates of food wasted and foods that generated either a little or a lot of waste;
C) Aspects of child nutrition policy and their priority within the school;
D) Overall approach and attitude towards school food provision and nutrition, initiatives to improve nutritional awareness, including those that failed, and willingness to support local agriculture;
E) The interest of the school in taking part in the Strength2Food school meals pilot scheme.

The full questionnaire is reported in Appendix 1, both in English and in Serbian. A further section on food procurement was considered, but not included in the final questionnaire because of the complexity and diversity of options, and requirements for food procurement, which were thought to be too onerous to add to the already extensive list of questions (74 in sections A to E). See section 3 for information collected from schools on food procurement.

The questionnaire was prepared to be completed online through a MPNTR weblink. Schools were informed about the questionnaire and requested to complete it through the Ministry's network of regional school management offices, which distributed requests to all of Serbia's approximately 1135 primary schools.

2.2 Findings from the questionnaire

The questionnaire went online in December 2016 and completed questionnaires from schools were received until February 2017, by which time 751 primary schools had completed the questionnaire (66%). Note, a further 186 primary schools completed a simplified version of this questionnaire before the project began. In addition, school websites, the MPNTR schools' database and the public sector procurement portal showed an additional 94 schools which had either food procurements or provision of all-day schooling, which requires schools to provide at least one meal a day. So, some information on meal provision was obtained on 1031 schools, amounting to 91% of all primary schools.

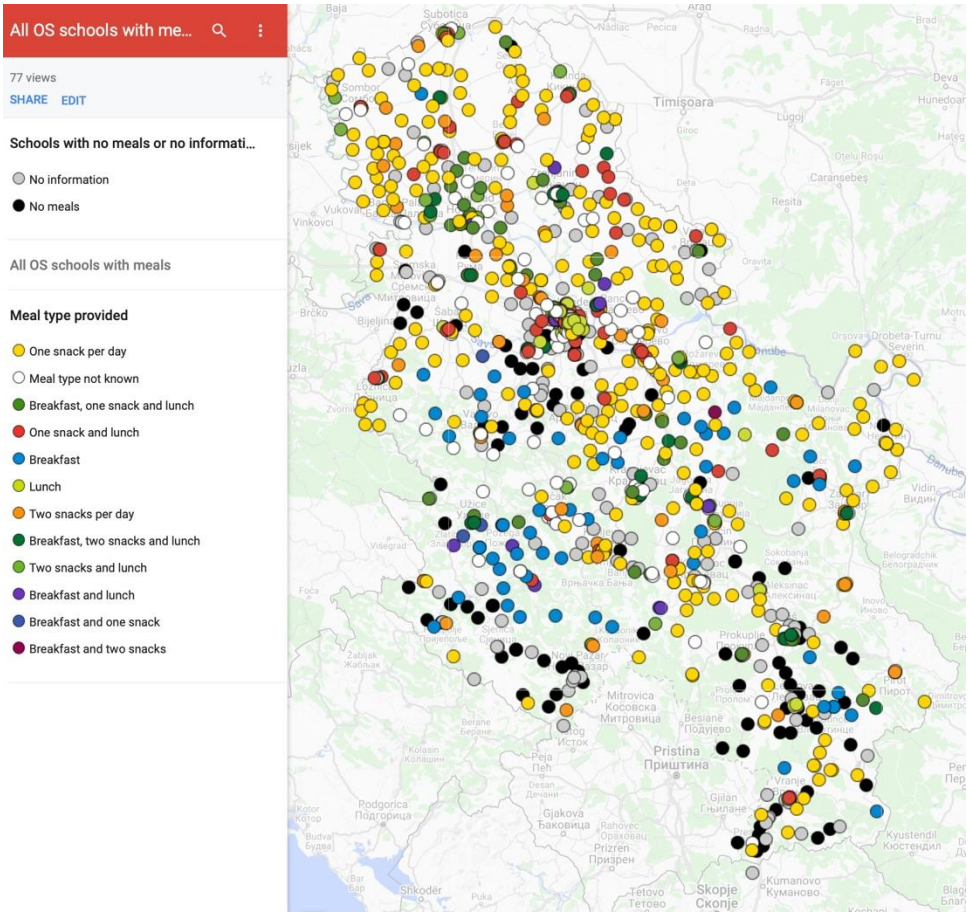


Figure 1. Map of Serbia showing the distribution of primary schools and the type of meal provision by each school. (Interactive version available **here**)

Considerable diversity in meal provision was evident, as shown in Figure 1. At least 200 schools (20%) provided no meals of any sort. These were distributed mainly just south of Belgrade, southwest Serbia and the far south of Serbia, the latter two regions comprising municipalities with the greatest poverty in Serbia (Anon, 2016). Around a third of schools (329, 32%) provided only a snack (yellow and orange circles), and at least 384 schools (37%) gave lunch, with or without other meals. At least 192 schools (18%) gave breakfast, and many of those (particularly blue circles in Figure 1) were rural schools where many children have to walk some distance to get to school. For those schools, breakfast is a substantial meal.

Information on the type of meal provision came from section A) of the main questionnaire. The majority of schools (59%) providing a meal used an external caterer (red and orange circles in Figure 2). Nevertheless, a third of schools (274, 33%) used their own kitchens and staff to prepare meals (green circles in Figure 2), of which 136 (13%) prepared lunches, and another 50 (5%) prepared only breakfasts.

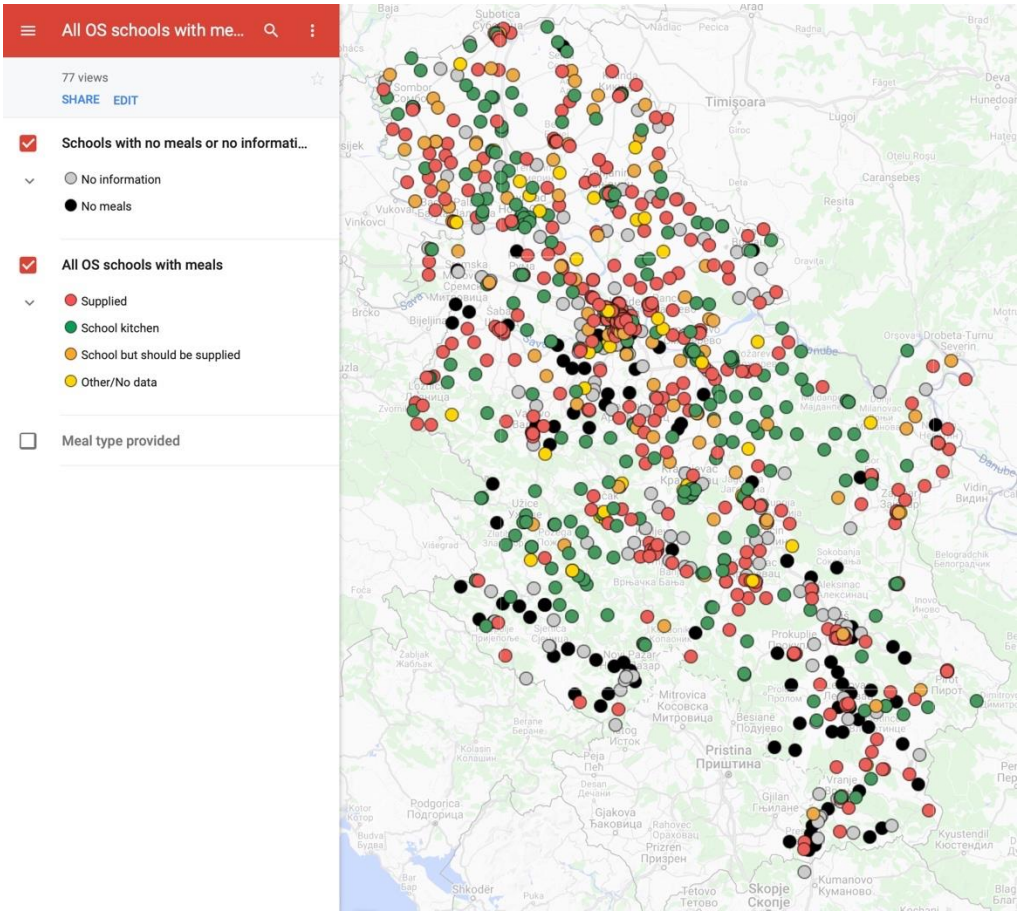


Figure 2.Map of Serbia showing the type of meal provision - externally supplied or prepared in the school's kitchen with its own staff. (Interactive version available here)

Having found several hundred primary schools, distributed throughout Serbia, still using their own kitchens and staff to prepare school meals, although the majority of schools used caterers, the decision was taken early on to focus on schools making their own meals. Individual schools were thought to have greater flexibility in making changes to both the nutritional quality of their meals and their procurement practices to accommodate improved criteria for food provision and greater use of SFSCs. Working with schools making their own meals also allowed us to focus our resources more effectively, as food procurement and food consumption would be in the same places, reducing the number of organisations involved in our action research.

Other replies to questionnaire section A) gave information on school kitchens, meal numbers and their prices. We collected information on the availability and use of kitchens for 893 schools. Although official MPNTR data show 87% of primary schools have a kitchen, our findings showed that only 70% of schools (628) were known to have a kitchen, and only 174 were known to use their kitchens for preparing meals (15% of all primary schools). The remaining kitchens were out of use, though 143 schools wanted to renovate the kitchen and use it for meal preparation in the future.

The majority of schools offered meals to only children in years 1-4 (7-10-year-olds), though 77 primary schools also offered meals to children in years 5-8 (11-14-year-olds). The numbers of children having breakfasts and lunches were usually relatively low - only 1 to 40 per school (Figure 3), with 100 or more children per day being served breakfast in only 61 schools and lunch in 78 schools. However, numbers per school having a snack were frequently up to at least 100 children per day.

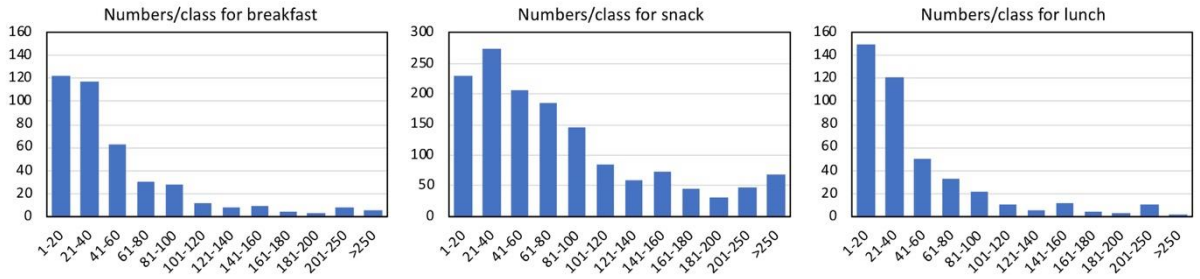


Figure 3.Frequency distributions for numbers of breakfasts, snacks and lunches per day in primary schools.

Meal prices charged to parents differed considerably both from school to school and according to meal type (Figure 4). Snacks were cheapest at 50.1 dinars (€0.42) on average, with a range from only 10 dinars (subsidised 10 dinars by the school) to 100 dinars. Breakfasts were slightly more expensive at 60.1 dinars (€0.51) on average and ranged from only 15 to 242 dinars. Average lunch price was 143.6 dinars (€1.21), ranging from 40 to 270 dinars. Very few meal prices were reported to be subsidised, so these prices represent the schools' estimates of the costs for meal ingredients.

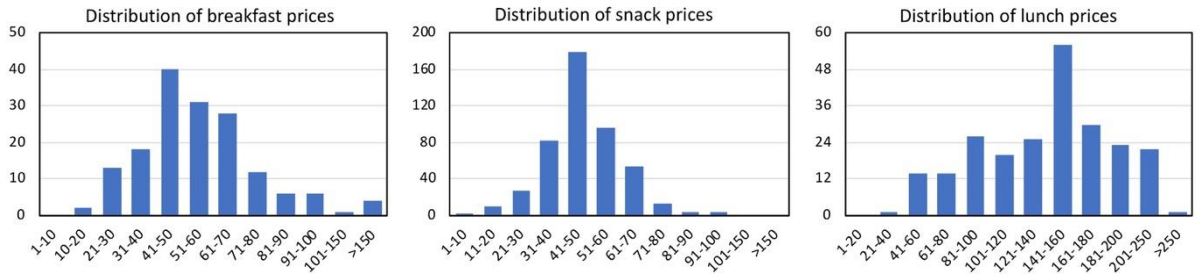


Figure 4.Distributions of prices charged for breakfast, snack and lunch in primary schools.

Meal prices in Novi Sad are regulated by the local authority at 2660 dinars *per month* for all meals per day (typically breakfast, 1 or 2 snacks and lunch), equivalent to only €1.12 per day for all meals; any deficit in food costs being made up by the schools. These prices had been held constant by the local authority for over 10 years and were a notable source of complaint from school directors in Novi Sad.

Some of the variations in prices, for all three meals, was associated with regional levels of poverty, with highly significant negative correlations between meal price and municipality % poverty. Thus, a typical lunch price in Belgrade schools of around 180 dinars, was around only 110 dinars for municipalities with the highest levels of poverty.

In addition to information on meal type and who prepared it, section B) had questions on the schools' regulations and procedures for meals, the time given for meals, aspects of food waste and foods that children liked and didn't like. Two thirds of schools (67%) used normatives for their meals, with 55% using standardised recipes and 79% using recommended portion sizes. For those schools using their own staff to prepare meals, those percentages increased to 71%, 63% and 82%, respectively, rising to 82%, 76% and 86%, respectively for schools preparing their own lunches. A small number of schools used nutritional advice from neighbouring kindergartens (which all employ nutritionists), and a few schools used their own biology teachers for nutritional advice or used local nutritionists on a part-time basis. Although many years ago primary schools also regularly employed nutritionists, budget cuts over the years led to these posts being lost.

The majority of kitchen staff (60%) had received no in-service training in any aspects of meal preparation or food hygiene. Only 17% of the kitchen staff had received training in HACCP safety procedures, and for the few schools we visited where HACCP procedures were in place, we either were not allowed to enter kitchens, or had to sign in and wear protective clothing. In discussion with schools, the cost of HACCP certification, and associated kitchen modifications were seen as obstacles to the more widespread introduction of HACCP regulations. Instead, many schools required HACCP certification of their food suppliers, which in most cases would be meal caterers.

The time given to children to eat breakfast was typically 20-30 min (mean 23.7 min). For the snack it was 15-20 min (mean 18.4 min), and the large majority of schools gave 30 min for lunch (mean 31.2 min). Although 18% of schools gave children less than 30 min for lunch (usually because of limited canteen space needing several sittings), there was no evidence that this was associated with increased plate waste, as estimated by kitchen staff.

Schools were also asked to identify four foods that the children enjoyed eating as well as four foods that generated a lot of plate waste. In total, 470 schools (60% of respondents) gave food preferences. However, to give a clear picture on preferences for each meal, these are presented according to schools giving only one meal type - breakfast, snack or lunch (45, 171 and 30 schools, respectively), shown in Figure 5, which shows only the 20 most frequently mentioned foods for each meal.

Pizza was clearly the most popular food for both breakfast and snack, with 13% and 15%, respectively, of all the foods that were liked. Beans (as seeds) were also well-liked for breakfast, followed by burgers, sandwiches and doughnuts, then savoury pies and potato stew. The majority of snacks consisted of pastries or bread with a savoury or sweet spread. Thus, frequently listed foods included sandwiches, chocolate spread, savoury pies, doughnuts and burgers. Beans (seeds) were by far the most popular foods listed for lunches (11% of the total), though as for breakfast and snack pizza was also popular. Children also liked pasta dishes (macaroni with cheese and spaghetti), peas, meatballs, and filled croissants, followed by moussaka, chicken and fish.

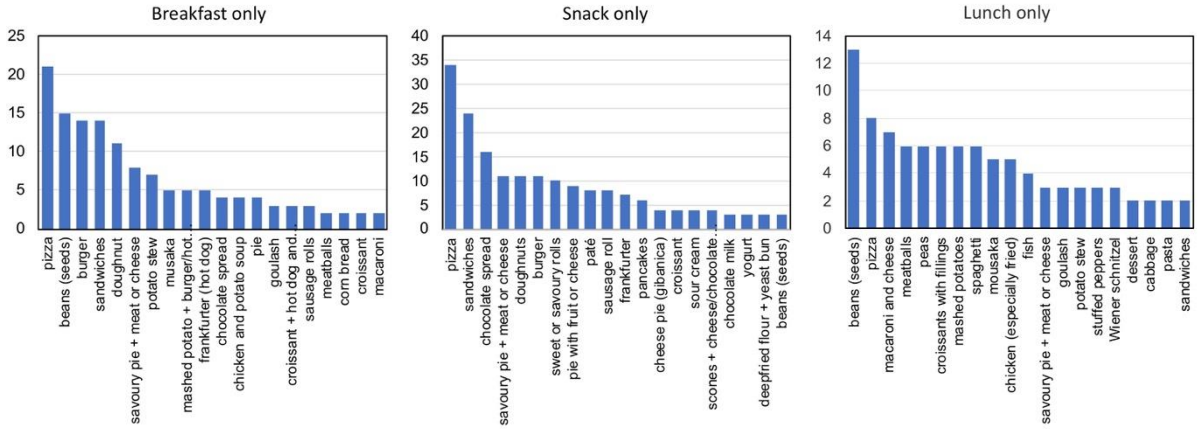


Figure 5. Frequency of foods that children like to eat for breakfast, snack and lunch.

For schools providing only breakfast or snacks or lunch, 32, 92 and 28, respectively, gave lists of four foods creating large amounts of waste (Figure 6, which shows only the 20 most frequently mentioned foods for each meal). The four foods creating the most breakfast waste were jams, sandwiches, pastries and spreads. For children given a hot breakfast, boiled cabbage was also frequently not popular. Rolls with sweet fillings were also disliked.

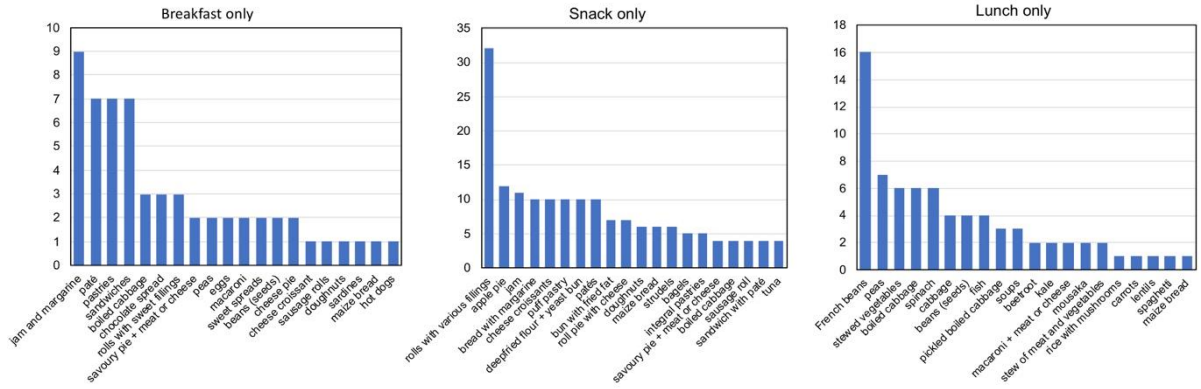


Figure 6.Frequency of foods that children do not like to eat for breakfast, snack and lunch.

A similar picture was found for snacks regarding foods disliked. By far the most frequent waste came from rolls with various fillings, both sweet and savoury. Apple pies were not popular, and the next most disliked foods reflected the picture for breakfast. Thus jams, bread, savoury croissants, snacks with puff pastry, patés and a Serbian speciality of deep-fried dough balls (*mekike*) gave more waste. Several schools claimed there was no waste of snacks because they gave children only foods that they liked to eat!

As regards lunch, it was clear that Serbian children do not like vegetables! For lunches, vegetables, either individually or mixed, comprised 77% of all foods listed. By far the least popular vegetable was French beans - 17% of all foods listed. Peas and beans (as seeds) were also disliked by many children, together with boiled mixed vegetables, boiled cabbage, spinach, and grated cabbage as a side salad. Fish, either battered fillets or as fish fingers, also created more than usual waste. Meat dishes were rarely mentioned as creating waste.

Section C) of the questionnaire focused on the school's attitude and policies towards food and nutrition. The large majority of schools strongly agreed with most statements or thought they were important (Table 1 and Figure 7), giving scores of 4 or 3 (86-93% of all scores). However, four statements were regarded by many schools (20% or more) to be of lesser importance or relevance. These were limiting the use of fried and deep-fried foods (80% scores of 4 and 3), limiting the use of salt in children's food (77% 4s and 3s), and perhaps surprisingly, schools did not always regard preventing malnutrition in children as being particularly important (68% 4s and 3s). Improving school attendance of children scored only 80% 4s and 3s. Nevertheless, nearly all schools acknowledged they had an important role to play in preventing obesity in children and generally improving their health. Schools were generally aware of the important role they have to play in improving child nutrition. Particularly, schools thought the most important food policy goals are improving the health of children and improving the educational achievements of children. The least important goal for school food policy was preventing malnutrition in children. Evidently, schools did not believe they had such a major role to play in this.

In regions with high poverty, limiting the use of both foods high in sugar and savoury snacks was less important (significant at $P<0.001$), limiting the use of fried and deep-fried foods as well as the use of salt in foods were less important (significant at $P<0.05$), though preventing malnutrition in children was significantly more important ($P<0.05$) in municipalities with high poverty. In addition, schools in municipalities with higher salaries were more interested in improving children's school attendance (significant at $P<0.05$).

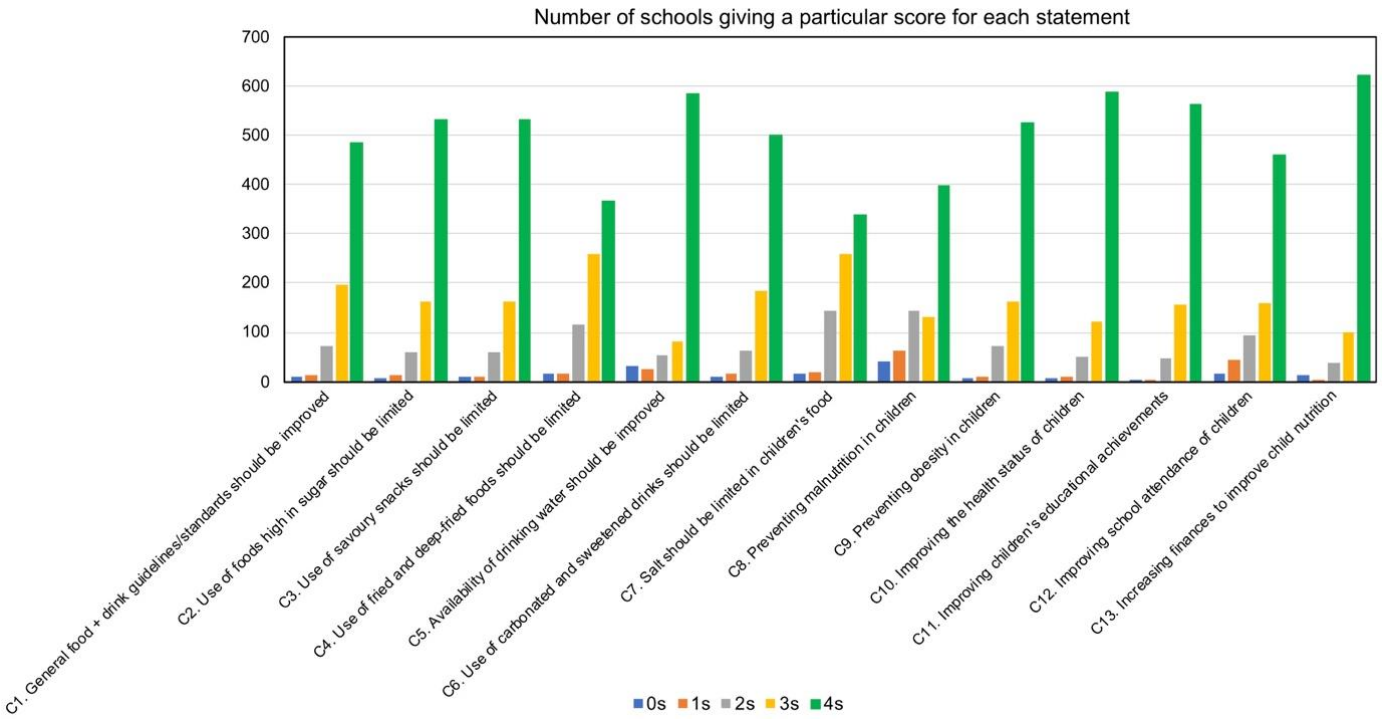


Figure 7. Number of schools giving a score from 0 (little agreement/importance) to 4 (strong agreement/importance) for 13 statements.

Moreover, section C) contained a free-form option for schools to add something else they considered to be a priority goal for their school regarding nutrition. This was completed by 102 schools, and their results are summarised in Figure 8.

The most popular comment was providing conditions for meal preparation, indicating that many schools wanted to provide meals for their children, but currently could not. A third of schools (254/776) said that improving nutrition in their school was either one of the priority development areas or was included in their school's development plan. That includes 18 schools that currently serve no meals.

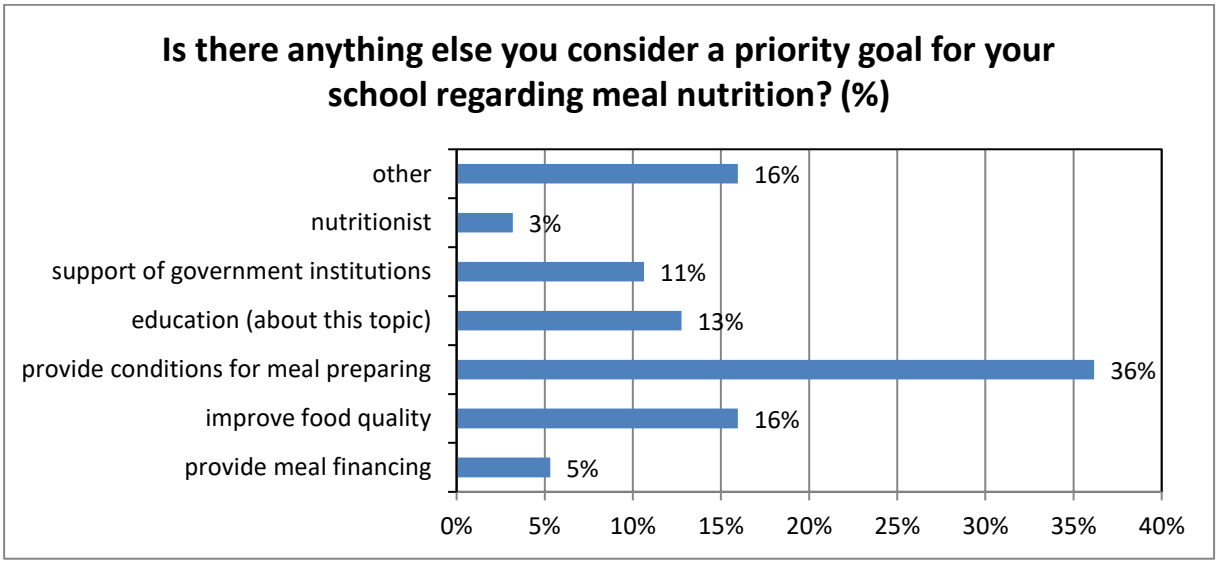


Figure 8.Respondents' free-form answers to the question on other priority goals for their school regarding meal nutrition

Statements in section D) focused on the schools' overall approach and attitude towards food provision and nutrition, and requested examples of initiatives to improve nutritional awareness and willingness to support local agriculture. Only 15% of schools allow organised sales of food and beverages to pupils, such as a bakery renting space on the school premises, and around 1 in 30 schools have some sort of food or drink vending machine on the school premises. Around 32% of schools restricted advertising of food or drink on the school premises.

Although many schools had some sort of activity representing an example of good practice in improving the nutritional quality of school meals (see DEV10.7 Table 8 for examples), the majority of schools (57%) had no specific activity or initiative on food or nutritional quality beyond the normal teaching curriculum, though many of these schools provided no meals.

The most frequently mentioned activities were for Healthy Food day on October 16th (27%), then additional lectures (23%) and workshop activities (17%) to promote good nutrition and healthy eating. Thirty-four schools (11%) specifically mentioned activities where the children make their own foods or prepare posters (e.g. the food pyramid), and 21 schools managed to change what their children ate (7%). A similar number specifically targeted parents with information on healthy eating. Eight schools reduced the availability of unhealthy foods in school, only six schools said they used a nutritionist and three schools grew vegetables or fruit on the school grounds. Many other non-specific or non classifiable activities were also given, such as "a healthier approach to nutrition in pupils".

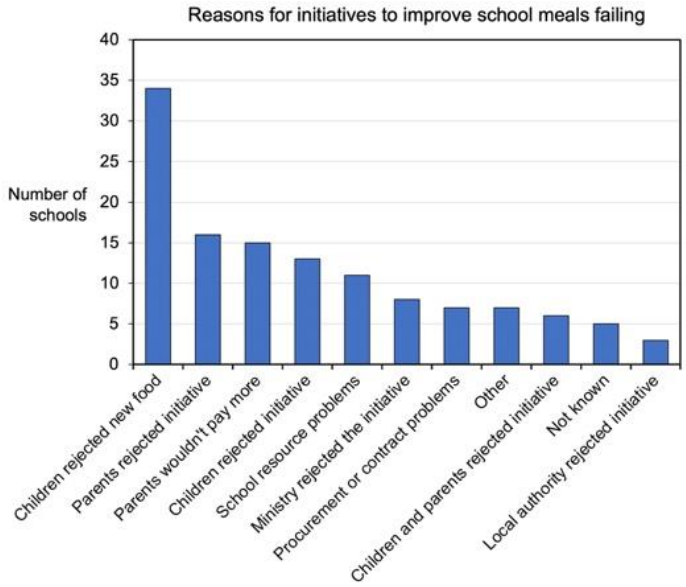


Figure 9. Frequency of reasons for initiatives to improve school meals failing

Section D) question on initiatives to improve food quality that were not successful was completed by 126 schools (Figure 9). The most frequent reason for initiatives failing was children rejected new foods. Parents were also obstacles, either rejecting the initiative outright or refusing to pay more for better quality food. Other initiatives failed because children rejected them, or because the school hadn't the resources to implement them effectively or because the Ministry rejected the extra costs involved.

The final question in section D) asked about the level of support schools were willing to give to local agriculture for food procurement (relevant for the development of SFSCs in WP9.5.1). Nearly two thirds would support this, with scores of either 3 (25%) or 4 (39%). Support for local agriculture was slightly higher outside the main cities. Only a small number of schools were unwilling to support local agriculture for food procurement (10% for 0 and 8% for 1).

For the willingness to take part in the Strength2Food project (section E), only 12% of schools answered NO, so these schools were essentially not contacted any further during the project. 30% of schools answered YES, and 58% of schools required more information before making a decision.

This questionnaire provided MPNTR with very useful information on the state of meal provision in primary schools, which had not previously been available to the Ministry. Results from the questionnaire provided information for many criteria that were subsequently used to select schools with which to carry out action research during the rest of the project.

3. COLLECTING INFORMATION ON PRIMARY SCHOOLS' FOOD PROCUREMENT

3.1 Methodology

Unlike the majority of countries in Europe, Serbian primary schools are responsible for their own food procurements. Therefore, to understand the procurement processes used by primary schools, identify particular procurement challenges and how Strength2Food could help to improve food nutritional quality as well as the uptake of more local food suppliers, it was necessary to collect procurement information from individual schools.

As explained in section 2, no questions on procurement were included in the school questionnaire, partly because food procurement documentation is, according to regulations, available both on school websites and on the government's public sector food procurement portal (available at https://jnportal.ujn.gov.rs). During 2016 and 2017, school websites and the procurement portal were searched for food procurement documents for three years - usually 2014, 2015 and 2016, and some into 2017. Typically, four types of document are uploaded for each procurement: the invitation to bid, the tender documentation, contract awarding decision and notice of concluded contract, plus occasionally other documents such as notification of changes to the tender documentation, reasons for cancelling a procurement (usually because nobody bid) and complaints.

Downloaded tender documentation for around 340 schools was searched for the following information:
- type of tender procedure (small value, open procedure, framework procedure);
- type of meals for which food was required (where given, usually for schools using caterers);
- the list of foods required (either ingredients or ready-made meals);
- the number of lots;
- criteria to be met by bidders (both for food items and bidding organisations);
- any selection criteria in addition to the lowest price offered;
- length of time for contracts;
- date of starting the procurement process and its duration.

Contract awarding decisions were used to collect information on:
- number of bidders for each lot
- names of bidders for each lot
- location relative to the school of bidders for each lot
- prices bid for each lot

Successful bidders for each lot, the contract price for each lot and contract start dates were obtained from notices of concluded contracts.

3.2 Findings from food procurement searches

In total, well over 4000 documents were downloaded on primary school food procurements for 2014 to 2017. The large majority of these came from the official procurement portal. Many schools seemed to remove their procurement documents after only a few months. Of 866 schools known or expected to serve meals, procurement documents were sought for 542 schools. The remaining 324 schools were either known to serve only snacks, known to use a caterer, or likely to serve too few meals to need a public procurement procedure or were in regions of Serbia too distant for regular access during the project. Of 542 schools, no procurement documents could be found for 156 of them, even though they were known to serve meals. Thus, procurement documents were downloaded for 386 schools.

Although food procurement documents were found for 188 schools using caterers and a further 89 schools having only snacks, detailed analysis of procurement documentation concentrated on the 203 schools known or expected to be making their own meals for breakfasts and/or lunches (individual vegetables and fresh meats included in procurement food lists). Thus, further procurement results are presented for only those schools either making their own cooked breakfasts or known to be making their own lunches.

The large majority of schools (83%) used the procurement procedure of small value - not more than 5,000,000 dinars (around €42,000), with the remainder using the open procedure. Nearly half the food procurements (45%) were also framework agreements made by schools with their suppliers, allowing schools to use more than one supplier for particular foods, for example, in case of problems with the first supplier during the year.

Only schools tendering for an external caterer identified in tender documents the particular meals for which food was required. Otherwise, a single food procurement list was provided for all meal types. For schools providing more than one type of meal, this made it a challenge to identify the foods and their quantities that were destined for a particular meal, such as lunch. Nevertheless, procurement food lists were available for several schools supplying only a single meal per day - either breakfast or snack or lunch. From these schools it was possible to assess the relative proportions of different categories of food (vegetables, fruit, meat, etc).

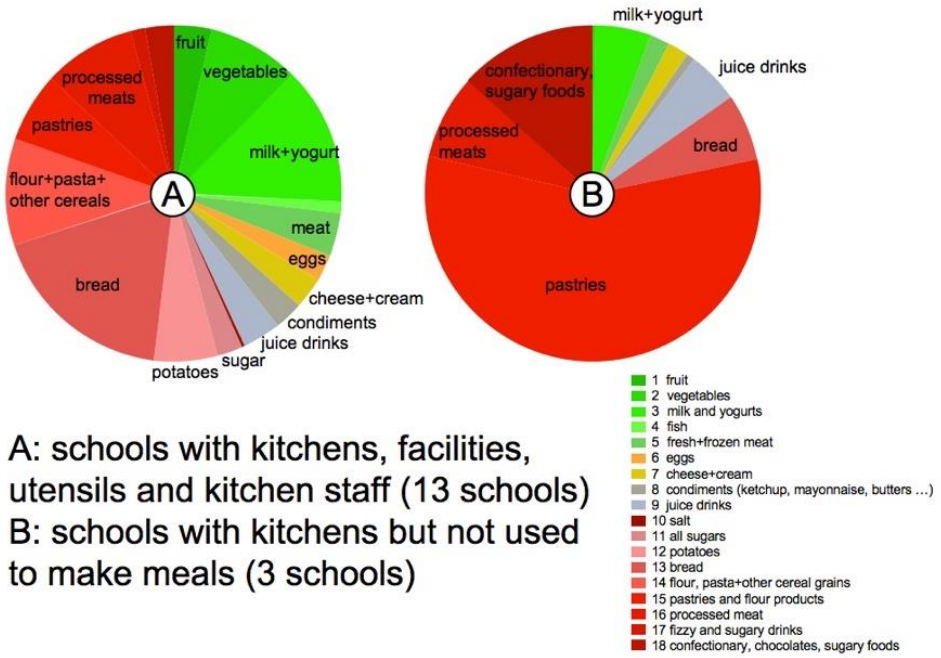


Figure 10. Relative food quantities procured in schools serving only breakfast, comparing schools using their own kitchens and staff (A) with schools using caterers (B).

Schools using caterers for breakfasts (Figure 10) had much higher proportions of pastries, and sugary foods (shown in shades of red) for breakfasts than schools making their own breakfasts. In contrast, these schools had much higher proportions of fruit, vegetables, milk and yogurt (shown in Figure 10 in shades of green and orange) than schools using caterers for breakfasts. The picture was similar for schools serving only snacks (Figure 11). The proportions of fruit, vegetables, milk and yogurt were higher in schools using their own kitchen and staff, and lowest in schools using caterers. The opposite was true for bread, pastries, and sugary foods for snacks, proportions being lower in schools using their own kitchen staff.

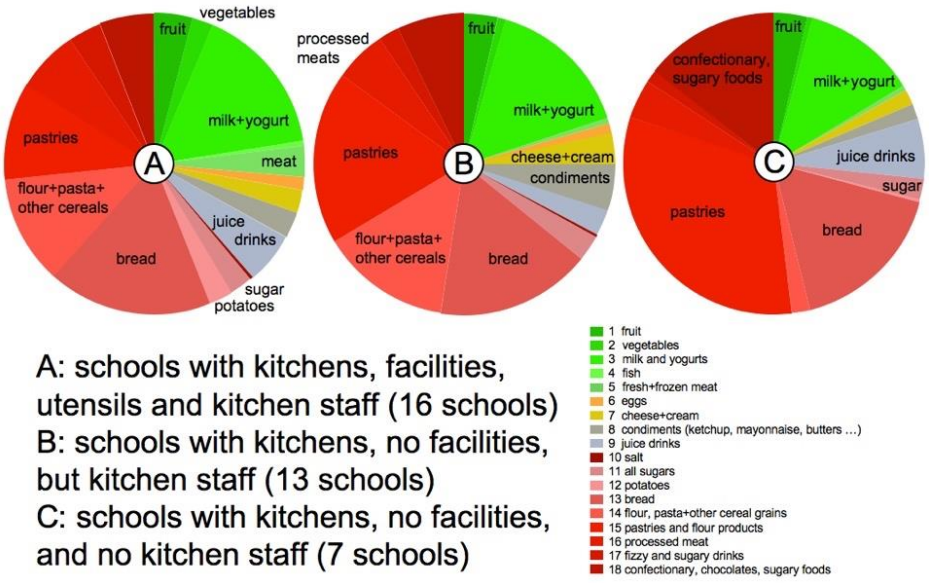


Figure 11. Relative food quantities procured in schools serving only snacks, comparing schools using their own kitchens, facilities and staff (A), schools with their own kitchens, no facilities but staff (B) and schools using caterers (C).

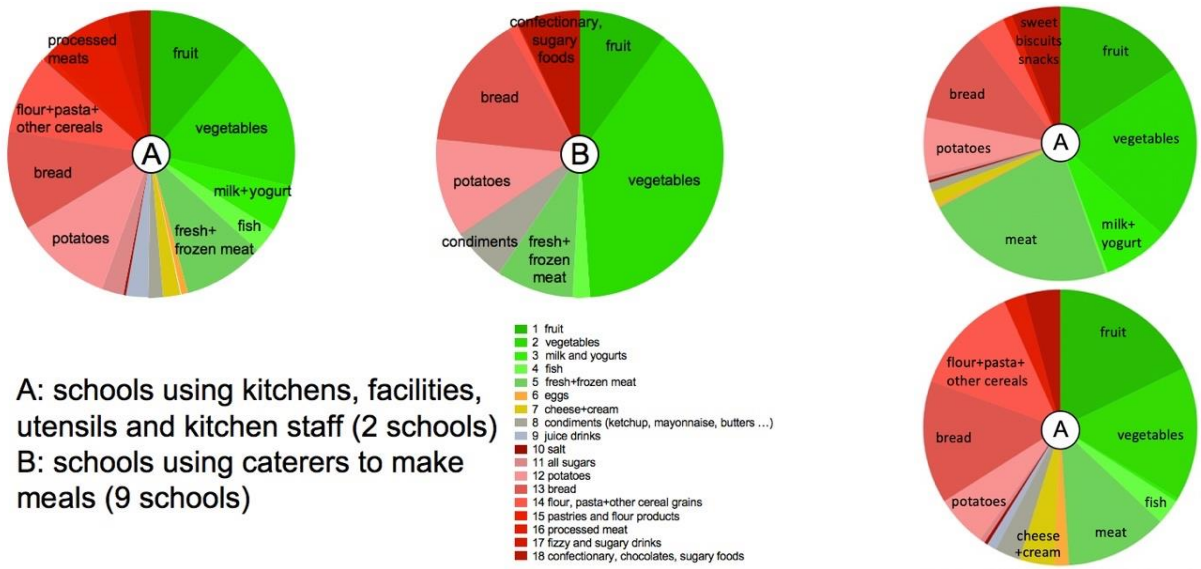


Figure 12. Relative food quantities procured in schools serving only lunches, comparing schools using their own kitchens, facilities and staff (A) and schools using caterers (B). Pie charts on the right hand side come from data collected for WP6.3.

Only two schools with available procurement documents served only lunches using their own kitchens and staff. These were compared with nine schools that were found to use caterers and to give detailed serving quantities for lunches (Figure 12). Food quantities from a further two schools making their own lunches, used for carbon footprint analysis in WP6.3, were calculated using menu normative quantities and weekly menus to estimate procurement percentages used only for lunch. Pie charts for these are shown in Figure 12 on right hand side. The only consistent differences between food proportions from schools making their own lunches and those from caterers were more fresh meat used in school-made lunches and more vegetables from caterer lunches. Most of the increased caterer vegetable proportions came from salads, which typically had larger quantities (100 g) compared with school-made salads (40-60 g). The much larger quantities of salads (around 2-fold) with caterer-supplied lunches may have led to more plate waste, though this was not measured.

Schools making their own lunches varied considerably in the total number of foods procured as well as the number of types of fruit, vegetables and fresh meat. A selection of 24 schools (most subsequently included in the school meals pilot scheme) gave a range of procured foods from only 40 to 297, types of vegetables from only 4 to 47, fruits from only 2 to 29 and types of fresh meat from only 1 to 20.

Quantities of foods procured by 33 schools in different food categories showed highly significant negative associations between both fresh meat and fish quantities and % municipality poverty (more poverty - less meat and fish procured). More poverty was also significantly associated with more processed meats and savoury pastries and fewer fruit and vegetables.

The most frequent number of lots for food procurements was one (Figure 13), though only 24% of schools used a single lot. In contrast, one school made every food a separate lot. Having all foods in a single lot makes the procurement process administratively easier for schools, and also reduces the risk of no bidders for the tender (see below) because the total value of the procurement would then normally be sufficient to make bidding economically worthwhile for bidders. For large food suppliers, primary school contracts comprised only 0.3% to 3% of

annual public sector contracts for the large distributors (information accessible at https://www.ekapija.com/company).

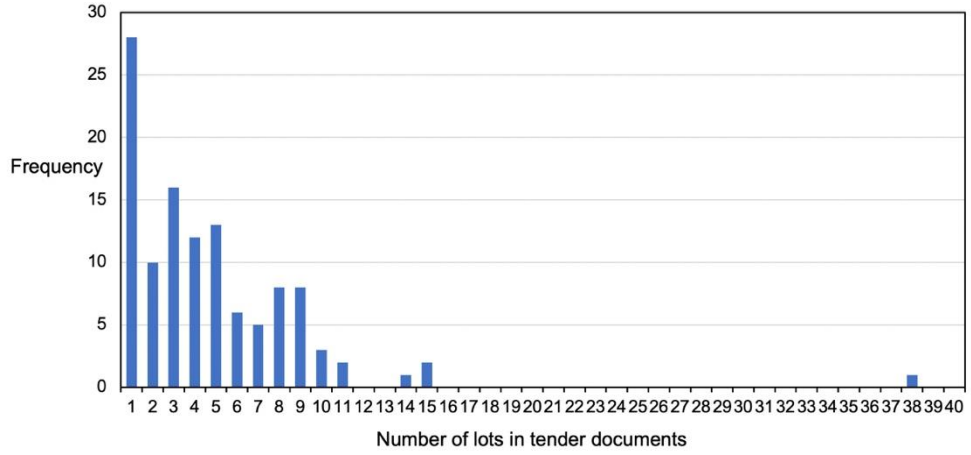


Figure 13. Lot number frequency for 115 primary schools buying food to make their own meals.

In addition to Procurement Law criteria (Article 75), schools often also give a list of regulations governing health and quality aspects of various food categories that bidders should satisfy, requiring validated certificates as evidence of compliance. These regulations included:

- The Law on Food Safety ("Official Gazette of RS", No. 41/09);
- Regulations on the quantities of pesticides, metals and metalloids and other toxic substances, chemotherapeutics, anabolics and other substances that may be present in groceries ("Official Gazette of the FRY", No. 5/92, 11/92, 32/02, 28/11 and 25/12);
- Regulations on the quality and conditions of use of additives in food and other requirements for additives and their mixtures ("Official Gazette of Serbia and Montenegro", No. 56/03, 4/04, 5/04 and 16/05);
- Rulebook on food additives ("Official Gazette of RS", No. 63/13);
- Regulations on declaring and labelling of packaged foodstuffs ("Official Gazette of Serbia and Montenegro", no. 4/04, 12/04 and 48/04) and the Regulations on declaring, labelling and advertising of food ("Official Gazette RS Gazette ", No. 85/2013);
- Regulations on conditions regarding health safety of objects of general use which may be placed on the market ("Official Gazette of the SFRY", No. 26/83, 61/84, 56/86, 50/89 and 18/91);
- Regulations on general and special conditions of food hygiene at any stage of production, processing and trade ("Official Gazette", No. 72/10);
- Regulations on the quality of grain, mill and bakery products, pasta and fast frozen tests ("Official Gazette of the FRY", No. 52/95, "Official Gazette of Serbia and Montenegro", No. 56/2003 and 4/2004);
- Regulations on the quality of fruits, vegetables and mushrooms ("Official Gazette of the SFRY", No. 29/79, 53/87 and "Official Gazette of Serbia and Montenegro", no. 31/2003, 56/2003 and 4/2004);
- Regulations on microbiological safety of foodstuffs in circulation ("Official Gazette of the FRY", no. 26/93, 53/95 and 46/02);
- Regulations on the quality of eggs and egg products ("Official Gazette of SFRY", No. 55/89 and "Official Gazette SCG ", no. 56/2003 - other regulations and 4/2004 - other regulations);

- Regulations on quality and other requirements for edible mushrooms and edible mushroom products ("Official Gazette of Serbia and Montenegro", No. 31/2003, 56/2003 - other regulations and 4/2004 - other regulations);
- Regulations on general and special conditions of food hygiene at any stage of production, processing and trade ("Official Gazette", No. 72/10);
- Regulations on the maximum permitted quantities of residues of plant protection products in food and feed and about the food and feed for which maximum permitted quantities of residues of plant protection products are determined ("Official Gazette of RS", no. 25/2010 and 28/2011).

However, very few schools specified all these criteria and those that did were mainly in and around Belgrade. Nevertheless, it was usual for schools to specify other criteria to be met on the capacity of bidders, such as financial status for 1 to 3 previous years, size of food storage space, number of ordinary and refrigerated delivery vehicles, number of delivery drivers or total staff, implementation of HACCP regulations. Usually most, but not all, schools listed all these extra criteria.

Criteria specifying the quality of individual foods varied from none at all (e.g. "*potatoes 800 kg*"), to great detail - e.g. "*potatoes (fresh, red, I class, physiologically ripe and healthy, of specific taste, without signs of germination, without shrivelled or damaged skin, without residual rot and mechanical damage, without foreign smell and taste, without deformations, spots and internal cavities, without green coloration) from months I to VI and from VIII to XII (whole school year)*". Some vegetable criteria would have restricted bidders to those that had effective grading systems, such as carrots: "*fresh, firm, maximum length 20cm, diameter from 20mm to 50mm in the upper part, I class, characteristic of the variety, smooth roots, purple or green colour at the top) from months I to VI and from VIII to XII (whole school year)*". Many fruit and vegetables, including fresh salad vegetables, were specified to be supplied for the whole school year, which would inevitably result in imported fruit and vegetables at times during the year (confirmed to us by a major food supplier), and discouraging local growers from bidding.

Although bids were always selected on the basis of the lowest price (though see page 27), additional criteria were occasionally added, particularly for those schools using a caterer, such as the number of free meals offered. Other schools gave additional criteria to separate organisations submitting bids of the same value: the first bidder to submit, the bidder offering the shorter delivery time for goods, the most favourable payment conditions, or the lowest price for a specified part of the lot (such as bread).

Contracts were typically for only one year from the date of signing the contract. However, because of the problems and challenges inherent in completing the procurement process, such as no bidders for a lot, contracts were frequently either extended (the Law allowing extension equivalent to up to 5% of the total value of the contract), to ensure food was continuously available to the school or shortened, to maintain food procurements generally at particular times of the year.

Food procurements took place continuously during the year (Figure 14), depending on the school, though two peak periods for starting procurement procedures were March-April and September. Even during the summer holiday period of July and August, schools were frequently at one stage or another of food procurement. Thus, it was evident that the majority of schools did not carry out food procurements in time for contracts to coincide with the start of the school year in early September.

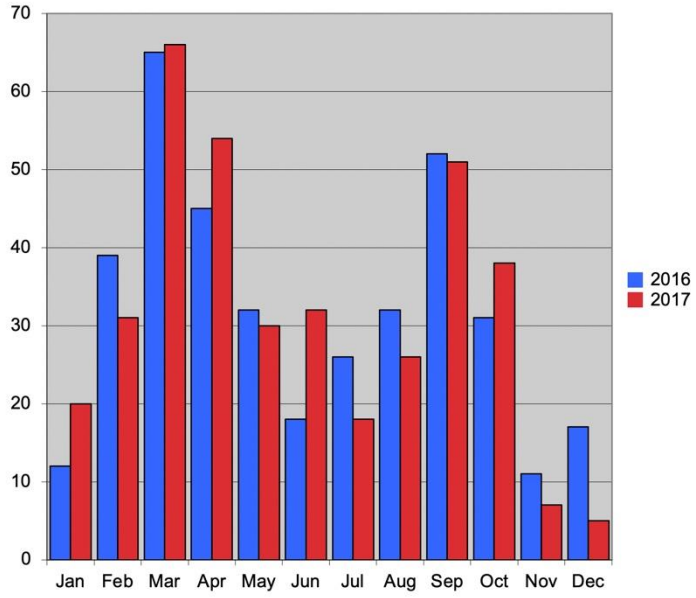


Figure 14. Monthly frequency for initiating food procurements in 380 schools during 2016 and 378 schools during 2017.

The duration of the whole process of food procurements was typically several weeks, starting with discussions between school administrators and cooks to agree on foods and quantities needed for the following year, followed by estimating realistic values for each lot - usually based on the previous year's unit prices and quantities. Once these phases were completed (2-3 weeks), the invitation to bid and tender documentation would be published on the school website and public procurement web portal. Subsequent timing to selecting winning bidders and signing contracts varied considerably, depending on how many bids were received per lot, and whether readvertising was required for any lots. For the eight schools studied in WP6.3 (4 LOC model and 4 LOW model), days from publishing the invitation to submit bids to announcing the signing of contracts varied from 23 to 76 (average of 6 weeks). One of those schools recently received no bids for one of its lots, despite tendering for the lot on three occasions, and was eventually told by the Ministry authorities to buy the foods from a local shop! That school has, unfortunately, now left the project because the cook retired and the director could not get a replacement cook for the salary offered (minimum wage), so the school now uses a caterer.

Information on the timing and duration of the food procurement process was valuable to plan the timing of subsequent action research with each school to ensure any proposed changes in procurement procedures and criteria were discussed in good time.

Downloaded contract awarding decisions and notices of concluded contracts were used for collecting numbers of bidders for each lot, their names and locations, together with the bid prices. Despite the Procurement Law requiring the receipt of 3 bids before making a selection, only 18% of lots attracted at least 3 bids (Figure 15). For 351 lots during 2014-2017, the most frequent number of bids per lot was 1 (approaching 50% of lots), and 15% of lots received no bids. Those lots would need to be readvertised, delaying the eventual selection of winning bidders and contract signing.

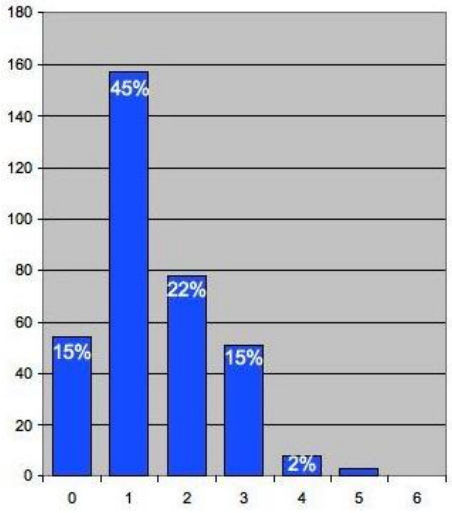


Figure 15. Frequency of number of bids for lots in primary school food procurements.

The majority of bidders were within around 10 km of the school (see Figure 16). However, these were companies supplying a range of foods (distributors, wholesalers, supermarkets). Inevitably these companies would receive goods from a wide range of sources (see section 4.2 on findings from school visits). Occasionally, bidders were prepared to drive long distances to deliver to schools, and these tended to be companies specialising in specific foods, such as dairy products, meats and bakeries. For example, a company in Nova Varoš was willing to deliver fruit and vegetables to a school in Belgrade, at least 250 km distant. A bakery near Belgrade delivered bread and pastries to a school in Loznica, 180 km away, and a dairy in Sombor delivered dairy products to a school in Novi Sad, almost 100 km away.

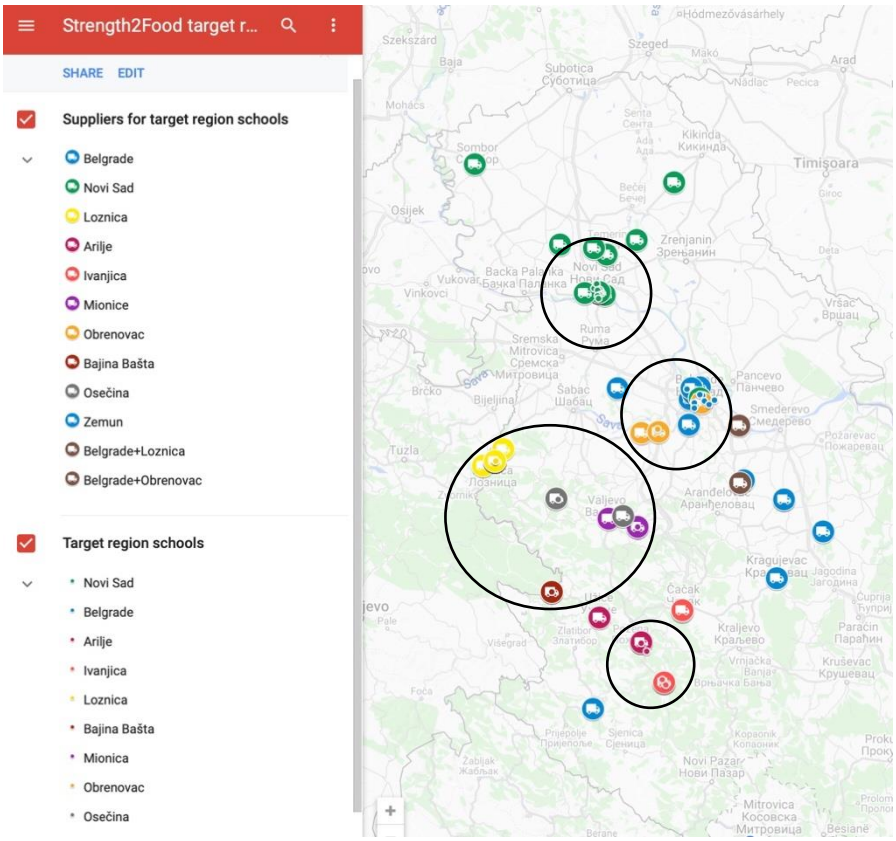


Figure 16. The location of suppliers (lorry symbols) bidding for food procurement lots in 27 primary schools (coloured dots). Schools and their lot bidders are located with the same coloured symbols. (Interactive version available here)

Although the Procurement Law requires schools to accept the lowest bid, this was not always the case. Occasionally the lowest bid was rejected for a variety of reasons:

- all bids, including the lowest, were above the predicted lot value;
- the bid was unrealistically low;
- the school had had problems with the bidder in previous years;
- the bid documentation lacked all the required certifications.

In those cases, schools either had to re-tender (wasting time and effort), or they selected another bidder.

Most schools were willing to accept changing from year to year the winning bidder for each lot, though it was clear that occasionally schools had a good working relationship with a particular supplier, and for those schools, there was usually only one bidder for the relevant lot year after year. This was particularly the case in more rural areas, where the local supplier was the only one reasonably close.

Analysis of procurement documents gave a valuable insight into the way school food procurements were carried out and the type of problems that were experienced. Lack of bidders for a particular lot was the most disruptive problem regularly experienced by schools.

4. COLLECTING INFORMATION ON PRIMARY SCHOOLS FROM VISITS

At the beginning of the project, a strategic decision was taken to focus on schools making their own meals, particularly lunches as these would provide the greatest consumption of fresh foods (meat, dairy, vegetables and fruit) that were the main targets of the project in WP3, WP5 and WP7. The questionnaire of section 2 gave locations of schools making their own meals and the numbers per day having school lunches, and the procurement information of section 3 gave the number of lots in each procurement and the value of each lot. At that time, project personnel in Serbia could readily access schools in Belgrade, around Valjevo (a large town located south of Belgrade - see Figure 16) and our project partner in Arilje gave access to parts of southern Serbia. However, it was clear from the schools' questionnaire that very few primary schools in Belgrade (including the adjacent city of Zemun) were making their own meals: only 7 of 80 schools. In contrast, almost every school in Novi Sad (located north-west of Belgrade - see Figure 16) was making its own meals (20 of 21 schools).

Although initially it was decided to focus on schools making at least 100 lunches, as this was calculated to give a value for fruit and vegetables of around €1000 per year (a realistic figure to attract new bidders arising from WP9.5.1 activities), few schools in Belgrade and Novi Sad were making and serving at least 100 lunches per day. Therefore, the 100 lunch threshold was lowered to include schools making fewer lunches that were in regions of Serbia accessible to Strength2Food personnel.

To improve diversity and to study less urban parts of Serbia, several schools making their own lunches accessible to Strength2Food personnel around both Valjevo and Arilje were considered. This would also allow work with several relatively small rural schools where improvements in the nutritional composition of meals might be needed and possible to implement. Thus, four broad regions were selected for a more detailed study: Novi Sad, around Belgrade, around Valjevo and around Arilje (circled in Figure 16). An initial list of around 50 schools was selected, from which the final choice of schools to work with during the project would be identified following site visits to schools.

4.1 Methodology for school visits

A standardised approach was used for each school visit, initially arranged by telephone. The activities for the first visit to each school were to explain to the school director the purpose of the Strength2Food project and how it could help improve the school's meal provision, and to collect the following information:

- to confirm (or collect) details of numbers of children taking each meal;
- to confirm (or collect) the cost per meal;
- to confirm (or collect) details of the timing of each meal;
- to confirm procurement arrangements;
- to identify any major concerns or constraints for food procurement;
- to identify any problems of food delivery and quality;
- to identify any major concerns or constraints for food provision;
- to get assessments from cooks of food wastes and disposal routes.

If it seemed appropriate to ask during the first meeting, then

- to request recipe normatives for each meal;
- to request unit prices for foods from contracts with suppliers;
- to request weekly menus for each meal;
- to request food labels to identify how much food was already produced locally.

Many of these points often had to be followed up during subsequent visits because of failure to collect the information during the first visit or conflicting information being given by different school personnel. Visits included a meeting with the cook, if timing allowed, and viewing the canteen, kitchen storage facilities and meal preparation resources. School visits were not audio-recorded, though photographs were often taken, with permission, of the school canteen and kitchen facilities.

4.2 Findings from school visits

School visits started in March 2016, and by October 2017, 66 school visits had taken place, representing at least one visit to 35 schools, including 5 schools that used a local caterer (to establish why these schools did not provide their own meals). Reports on the school visits showed a generally welcoming attitude towards giving the project information. Directors, administrators and especially cooks were willing to cooperate and give information.

When confirming information from the initial questionnaire, it frequently happened that different people gave different answers. This was particularly true for numbers of children having each meal type. Nearly all schools told us that kitchens were understaffed because of current Ministry regulations, which require at least 180 children taking meals per full-time cook and meal server. This meant considerable pressure of work for limited kitchen staff, for example with at least one Novi Sad cook arriving soon after 5 am every school day, and labour-saving procedures were implemented where possible, such as frozen and chopped vegetables being bought instead of fresh vegetables which might need cleaning and peeling. This led to schools

usually providing "unofficial" support for cooks from elsewhere amongst their staff to ensure enough pairs of hands to serve all the meals required.

Visits to canteens and kitchens gave information on canteen capacity, attractiveness of the eating surroundings, number of sittings required to cater for all children, and in the kitchens we assessed the capacities of storage facilities for foods kept refrigerated, frozen and at room temperature. Food storage conditions for some schools were very limited, meaning frequent deliveries during the week for perishable foods. Thus, from the cooks we also collected details of delivery dates and frequencies, particularly for perishable foods. Only 2 schools visited had HACCP certificates for handling food, and one of those was a rural school in one of Serbia's most poor municipalities.

For their considerable health and nutritional responsibilities, cooks were poorly paid and were usually doing the job because they either loved cooking or were motivated to look after children by feeding them well. Not all schools were able to provide recipe normatives for each meal, with cooks often preparing meals according to their previous experience, and serving quantities that were determined by the capacity of food ladles, bowls, cups, etc. Those schools with recipe normatives had not updated them for several years, and although menus were collected from schools when possible, meals on the weekly menu were very frequently not amongst the recipe normatives! This made subsequent attempts to assess the nutritive status of meals given to children a challenge! Cooks needed to cater for children with diverse food allergies as well as any medical needs of children, such as diabetes. We were told several times by directors and cooks that, by using their own kitchens and staff, children were getting more nutritious and safer meals than they would do using a caterer.

We asked cooks and servers of several schools to collect food labels which were collected for analysis during subsequent visits. These labels allowed us to identify producers and where foods originated. Most fresh fruit and vegetables unfortunately came without any labels or identified only the wholesaler and not the grower. However, occasionally we could build up a picture for a school of where some types of food originated. Thus, for one of the schools in Novi Sad, of 88 foods with food labels, 27 foods were imported from at least 14 countries around the world (Figure 17, interactive version available here): Bulgaria, China, Columbia, Croatia, Estonia, France, Germany, India, Italy, Northern Macedonia, Russia, Spain, Turkey and Vietnam. Although nearly all fresh vegetables were from Serbia, sweet peppers were imported from Turkey, as were citrus fruits. Carrots were grown only 32 km from the school, lettuce 79 km, and some potatoes 50 km but other potatoes were transported at least 240 km. The nearest fresh vegetables for another school near Valjevo were over 80 km distant. Only schools in Novi Sad had vegetables regularly supplied from growers less than 30 km from the school, though these were all through the school's wholesale supplier. Compared with other schools in the project, Novi Sad is in a very fertile region of Serbia, popular for vegetable (as well as cereal) production.

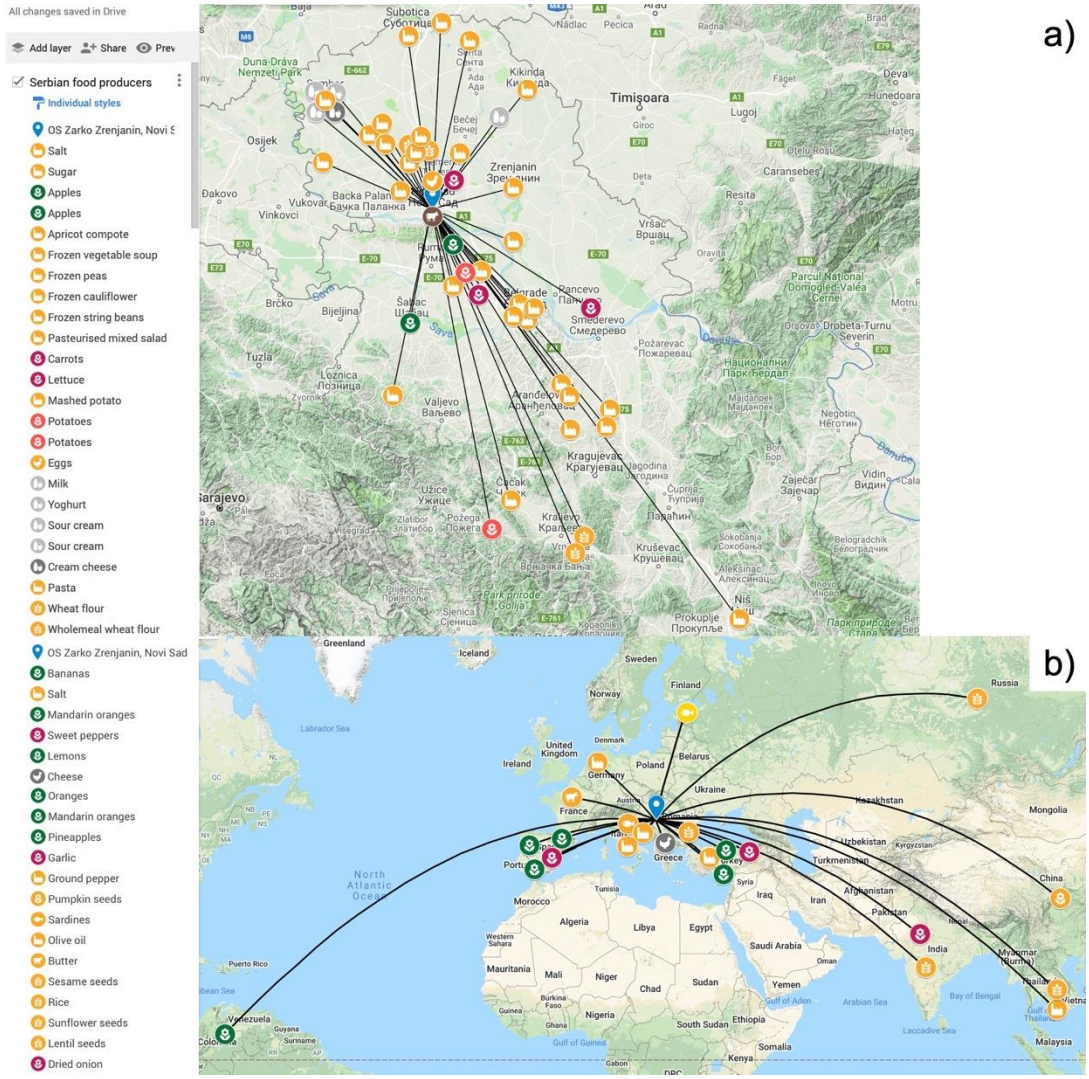


Figure 17. Origin of foods procured by a Novi Sad school (a) national and (b) international. Processed foods are shown with an orange factory symbol, and fresh foods with either an animal, fish or plant symbol.

One of the greatest challenges for school directors and administrative staff was food procurement (only procurement of school excursions caused more problems). Some schools were found to interpret the Procurement Law 'flexibly'. "*We don't feed enough children to need to use the public procurement procedures*" - from a school clearly spending more than 500,000 dinars per year on food (equivalent to around 60 snacks or 30 lunches per day). "*We don't bother with food procurement procedures and the school inspectors have never commented on this.*" "*If we run out of any foods, we go to the local supermarket to buy them.*" Another school included no fresh fruit and vegetables in its food procurements. It transpired that these were bought at the local market.

Schools fear making any changes to tender documents, copy-pasting documentation from one year to the next. So, the suggestion of any change to procurement procedures, however small or beneficial, was usually met with extreme skepticism and reservation. Also, using multiple lots created mountains of paperwork for administrative staff to keep on top of. School cooks also frequently complained about problems of unreliable or late deliveries from suppliers (usually because schools were given a lower priority than bigger customers), and meat deliveries were sometimes rejected because the food didn't look in good condition.

While some schools did not wish to give us their food contract prices, it was clear from food contract prices which we collected that unit prices for food items vary considerably from school to school, as illustrated for four schools in Figure 18. Here, procurement competitions for three Belgrade schools were in January, and for a rural school in August. Wholesale prices shown are for Belgrade wholesale market, which was the nearest to vegetable and fruit suppliers for the four schools. Thus, for some school food procurements, bidder prices appeared to be based on wholesale prices at the time of the bid, and not when foods were in full season. Food contract prices also varied considerably from bidder to bidder for a particular school. Some of this price variation, especially for fresh vegetables, was associated with the time of year for the school's procurement process. This could lead to several-fold variations in price amongst schools for the same fresh vegetable. For example, cucumber and sweet pepper prices were much higher in the winter than in the summer (Figure 18), and this price differential was passed on to two of the Belgrade schools. Similar large price differentials between foods for winter and summer procurements were also present for cabbage, and lemon. *Thus, the time of year for food procurements could be an important factor in determining the cost of food for schools making their own meals.*

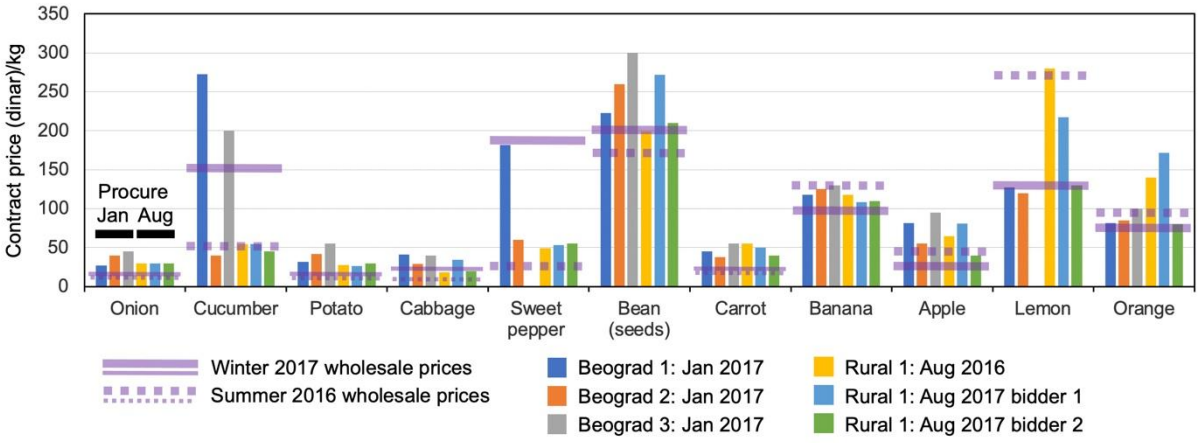


Figure 18. Variation in contract unit prices for vegetables and fruit for four schools (three in Belgrade and one in a rural town).

School visits proved to be an excellent way to gain the trust of directors and staff, as well as to get a feel for how food procurement and meal provision worked in practice and lay the groundwork for schools later on accepting to carry out activities for the project.

5. SELECTING SCHOOLS TO TAKE PART IN THE PROJECT

Sufficient information from the questionnaire, from procurement documents and from school visits was collected and tabulated by autumn 2017 to identify those schools with which Strength2Food would work for the remainder of the project. Criteria used for selecting schools were as follows:

- schools using their own kitchen and cooks to prepare meals;
-schools distributed amongst urban and rural parts of Serbia representing a range of municipality poverty levels;
- schools sufficiently accessible to Strength2Food personnel for at least 2 visits per year and sufficiently close to other schools to allow several schools to be visited per day;
- only schools that made lunches, or at least a cooked breakfast every day;

- schools having at least 100 lunches (or cooked breakfasts) per day, where possible; nonetheless, because Belgrade had so few schools making their own meals (only 7), they were all included however many lunches were prepared. Unfortunately one of those schools declined to take part in the project;
- as far as possible schools using public procurement procedures,
- schools that were positive towards taking part in the project after discussing the project during school visits.

Using those criteria, the initial list of around 50 schools was reduced to 30 schools which we considered we had the resources to work with effectively for the remainder of the project. Thus, 7 schools were selected in Belgrade and its peri-urban surroundings, including Zemun (ca. 1.8 million population in total), 10 schools in the provincial city Novi Sad (ca. 250,000 population, 80 km from Belgrade), 7 schools in rural cities (3,000-19,000 population, 80-190 km from Belgrade), and 6 schools in small rural communities (300-ca. 3,000 population, 80-190 km from Belgrade). These schools encompassed communities ranging in poverty levels from very low (5-6%) in Belgrade to amongst those experiencing the highest levels of poverty in Serbia (over 48%, most impoverished octile). These 30 schools were formally requested to take part in Strength2Food by MPNTR in December 2017 (see Appendix 2). Schools were asked to name a coordinator with whom Strength2Food personnel could communicate to arrange future visits, and to request information from schools. Coordinators from all schools were identified by February 2018.

This list of schools included one school using a caterer for meal provision. This school was included as it appeared to be unique amongst Serbian primary schools in having a school vegetable garden that was tended by children during the school year. We wanted to establish the impact of the school garden on the children's food knowledge and preferences. One school from the list subsequently decided to leave the project, and another school changed from making its own meals to using a caterer because the cook retired (unfortunately a school in Belgrade), so we stopped working with this school in 2018. Thus from September 2018, we were working with 27 schools making their own lunches or cooked breakfasts, and the school with a vegetable garden.

6. SERBIAN STRENGTH2FOOD WEBSITE AND BARILLA VISITS

6.1 Strength2Food website in Serbian

Having identified and signed up target schools, and established a well-defined baseline for their current procurement and meal provision arrangements, to ensure maximised impacts from the school meals pilot scheme, it was essential to ensure schools were kept informed of opportunities and provided with a range of educational resources targeting the schools, the cooks, the children and their parents.

A major development to deliver these resources was a Strength2Food website with all materials provided for Serbian project stakeholders in Serbian. The website, accessible at https://www.strength2food.rs/, initially had the following structure:

Home page	Materials	Nutrition in schools	News	Contact
	For schools	Strength2Food findings		
	For teachers	Initiatives		
	For pupils	Results of other research		
	For cooks	Documents		
	For parents			

However, the changed circumstances caused by the Covid-19 pandemic (see section 12) made it challenging for Strength2Food personnel to disseminate project information, resources and recommendations via further face-to-face contact with schools. Therefore, the Serbian Strength2Food website has recently been restructured to provide information to schools in a more logical format, and to allow users quick access to the information they are looking for. This is particularly important now that the project is in its final stage, where we have now prepared a range of educational resources suitable for teachers, children and parents, as well as recommendations that have to be circulated to each of the website's key stakeholder categories. Thus, the News category is now expanded to include interviews on advice to be provided by external experts in Serbia, who have supported the project since its inception. We plan to add these video interviews during the remaining project months. Educational material and Recommendations menus are also added, with sub-menus for each key stakeholder group: schools, teachers, pupils, cooks, parents and policy-makers. The new menu structure, with the original in Serbian, is as follows:

Home page	Schools	Teachers	Children	Cooks	Parents	Policy-makers	News and interviews	Contact
	Project findings	*Project findings*	*Project findings*	*Project findings*	*Project findings*	*Project findings*		
	Educational material	*Educational material*	*Educational material*	*Educational material*	*Educational material*	*Other documents*		
	Other documents	*Other documents*	*Other documents*	*Other documents*	*Other documents*	*Recommendations*		
	Initiatives	*Initiatives*	*Recommendations*	*Initiatives*	*Initiatives*			
	Recommendations	*Recommendations*		*Recommendations*	*Recommendations*			

The Strength2Food logo on the home page is accompanied by the words "Welcome to the official presentation of the Strength2Food project in Serbia" in Serbian. The Home page has links to the official Strength2Food website, and to websites for the 5 Serbian partners.

Documents as .docx, .pdf, .pptx, .jpg or video formats have been uploaded to the website as they become available, and these can be divided broadly into those generated as a result of project activities in Serbia, and documents external to the project that have been collected as being relevant to help school's improve their meal provision in some way. In Serbia, relevant non-project documents were collected by MPNTR, BEL and EUTA, and included documents with advice on healthy eating and nutrition from the Institute of Public Health, Vojvodina, with which Strength2Food personnel in Serbia have been working. Information for the website has also been collected from other Strength2Food partners, particularly BARILLA and ZAG. Documents in English, particularly from BARILLA, first had to be translated into Serbian, though Croatian is sufficiently similar to Serbian for documents in Croatian to be uploaded directly. Educational resources and recommendations on the Serbian website, as well as examples of good practice are described in more detail in DEV10.7.

We expect that the impacts of our pilot scheme findings and recommendations will accrue in the future not only for the 28 schools we targeted for most of our activities, but also for the remaining primary schools that provide meals (particularly lunches) to their children. For this, MPNTR is ideally placed to disseminate the website information and broadcast its recommendations to Serbian schools to ensure the sustainability of Strength2Food's findings and recommendations beyond the end of the project.

6.2 BARILLA cookery demonstrations for schools

In order to create synergies with partners' expertise, the constituent organisations of BARILLA, Barilla Academia and Madegus, provided a range of educational resources and organised food demonstrations for school cooks in Serbia. The food demonstrations were carried out during two visits by BARILLA personnel to Serbia, in November 2017 and December 2018. The first visit (Figure 19) aimed at visiting as many of our target schools as possible over the course of three days. In total, nine schools were visited in Belgrade, Novi Sad and Mionica, a rural town south of Belgrade.

The aims of this visit were to see kitchen facilities and equipment, and discuss with school cooks menus and challenges faced with school meal provision. Every school complained about the complexities of the current public sector procurement law, and the difficulties this generated regarding the quality of food that schools could buy. Having to accept the lowest bid generally was leading to poor quality food, that is not fresh and which could lead to large quantities of waste. Schools were enthusiastic to discuss opportunities of improving menus with the BARILLA colleagues, and looked forward to having advice on making their meals more attractive to children, not only to help improve their nutritional qualities, but to reduce plate waste.

Figure 19. Discussion of BARILLA personnel with school directors and kitchen staff in two Strength2Food schools.

At one school, the BARILLA visitors saw mountains of bread being consumed (just the soft spongy white centre, leaving the crust behind) in preference to the main course, which would lead to poorly-balanced food consumption, as well as representing a waste of the parents' money spent on their children's school meals. The BARILLA team was shown examples of regular nutritional analyses carried out by the Vojvodina (provincial) Institute of Public Health for the schools in Novi Sad. These analyses include recommendations on how to improve the balance between protein, carbohydrates and fats. Such analyses were not being carried out for the schools we visited in Belgrade and Mionica, so nutritional advice from BARILLA would be particularly useful for schools outside Novi Sad.

The BARILLA team subsequently prepared suggestions for school meal menus that should be not only more attractive to the children, but more nutritious and, importantly for the kitchen staff, quicker to prepare, without being more expensive. Thus, an initial list of 45 main course recipes in English was subsequently reduced to 40 recipes by excluding foods that would be difficult to access or too expensive for schools to buy, and these were translated into Serbian,

distributed to schools and uploaded onto the Serbian Strength2Food website. BARILLA also prepared three video demonstrations, subsequently given Serbian sub-titles, on how to save time in the kitchen and how to prepare highly nutritious dishes without meat. The subjects of two of the video demonstrations, pasta double-cooking and vegetable lasagne, were also used for the live demonstrations in schools during the second visit.

The second visit by the BARILLA team lasted again three days. Two schools had been selected for demonstrations of cooking and advice on meal nutrition to cooks from schools taking part in the Strength2Food project. The two primary schools selected for the demonstrations, one in Novi Sad and the other in Belgrade, were chosen because of the availability of suitable facilities for giving demonstrations and the timing of lunches in those schools. Accompanied by the EUTA team, the first day was useful to assess the facilities and discuss the practicalities of the demonstrations. The Barilla representative in Serbia accompanied the teams to both schools to help with translations and to contribute ingredients for the demonstrations. Several local growers of organic produce had agreed to provide vegetables for the demonstrations at each school. At each school, the BARILLA chef demonstrated pasta double-cooking and how to make a vegetable lasagne (Figure 20), while a member of the Madegus team gave information on meal nutrition and described how Madegus has been working in schools in Italy with educational activities to get children interested in nutritious food.

Figure 20. The BARILLA chef serving vegetable lasagne in the Novi Sad school.

Cooks from all our Strength2Food schools were invited to attend the 2h demonstration event, and over the two days we hosted representatives from 15 schools and 13 school chefs from many parts of Serbia. Three representatives travelled over 200 km from Ivanjica; others came from Loznica (150 km) and one enterprising cook took a day off to come from a village school near our project partner in Arilje (190 km). A television crew from Serbia's state television channel RTS2 was present at both events, filming for an educational programme which was broadcast in 2019 (https://www.youtube.com/watch?v=jKt0Qd34uNY&t=27s).

Although the demonstrations were the same in both schools, schools differed in the type of participants. At the Novi Sad demonstration we had several organic growers present keen to see their vegetables used by the Barilla chef and to discuss their products with school and parent representatives. In contrast, children were a major component of the audience at the Belgrade school, sitting and watching attentively while the dishes were prepared, and then clustering around the chef's table as he served up the vegetable lasagne. On both days, we had around 35 adults present for the demonstrations, but another ca. 35 young children were present for the demonstrations in the Belgrade school. The cooks were delighted with the demonstrations,

parents also writing down the recipes and cooking procedures, and children were also fascinated to have foreigners visit their school, with whom they could practice their English skills!

The BARILLA cookery demonstrations had a major impact on the schools and cooks that were visited, and with the video material and recipes provided by BARILLA it is likely that these visits will have longer-term impact on the project.

7. MONITORING INSTRUMENTS FOR CHILDREN AND PARENTS

To establish the impact on improving school meal quality and children's eating habits from Strength2Food educational activities and resources on the Serbian Strength2Food website, we needed to establish the current situation in our target schools regarding children's eating habits, and the extent to which these were influenced by the parental understanding of good nutrition and their attitudes towards food. As mentioned above, we could work with only 28 of the 30 schools invited by MPNTR, because one school dropped out and another changed to using a caterer. We also included 7 other primary schools using caterers for school meals that geographically were similarly located to the 28 target schools: two schools in Belgrade, one in Zemun, two in towns in the Valjevo region, and a village school close to a target village school near Valjevo, though a further school in Valjevo, providing no meals of any sort, wanted to complete just the parent's instrument. Apart from requests to complete the monitoring instruments, we planned no further interaction with these schools during the project so would not expect the project to have had any subsequent impact on either children's or their parents' food preferences or attitudes. Thus we could regard these as control schools. For monitoring, two instruments were designed - one to be used with children and the second with their parents, both in the form of questionnaires.

7.1 Methodology for developing and using monitoring instruments

We focused on children in years 1 and 2 of primary school (7-8-year-olds) as these would be the youngest children with sufficient cognitive development to be able to understand and answer reliably a simple instrument to test their preferences towards a wide range of foods. As we had selected schools making lunches (or cooked breakfasts), many, but not all, 7-8-year-olds would receive a school lunch (or breakfast), so we could simultaneously study the impact of school lunches on children's food preferences. Testing children at the beginning of their schooling would allow the evolution of their food preferences to be monitored as they passed through the subsequent years of their primary education.

7.1.1 Monitoring instrument for children

The children's questionnaire to assess their food preferences was designed to be as technically simple and interesting as possible for children to complete, so that it could be used by children without any detailed language knowledge. Therefore, the instrument scoresheet contained no words apart from the name of the food in the image, a number identifying each food, and a brief description of four 'smiley' options. Thus, children were presented with a series of colour

images of foods and on the scoresheet were asked to circle the relevant 'smiley': a sad smiley if they did not like the food, a neutral smiley if they neither liked nor disliked the food, a happy smiley if they liked the food, and a "?" smiley if they had never tasted the food. The instrument was planned to be done by children with the help of their class teachers, who would give the name of each food and describe it if children didn't recognise it from the image.

Ninety foods were selected (images and score sheets given in Appendix 3), with a bias towards those regarded as highly nutritious for young children. Details of food categories for the children's monitoring instrument, internal controls, the strategy used to select foods for the instrument, and methods of use by schools are described in Appendix 3.

A pilot version of the children's questionnaire was sent to four schools at the end of the 2017-2018 school year to assess the effectiveness of children's ability to use the smiley scoresheets, and to allow any technical issues encountered to be ironed out in time for the final version of the instrument to be sent to schools in October 2018. Thus, a few images that were almost universally given a happy smiley in the pilot instrument were replaced with other images for the final instrument. More detail was also added to instructions for teachers for the final version of the instrument.

7.1.2 Monitoring instrument for parents

The parents' questionnaire was divided into four groups of statements testing their knowledge, attitude and practice (KAP) towards food together with a group of statements specifically for those parents with children having school lunches. Each KAP group had 12 statements and the school lunch group had 10 statements, to be assessed by parents using a 5-point Likert scale: 1 (strongly disagree) to 5 (strongly agree). Several statements in each KAP group were worded in such a way that the preferred/beneficial response would be 1 instead of 5.

A few additional questions were provided at the end of the four groups of statements to collect information on the number of children parents had at school, whether they had school lunches, and if not why not (multiple choice options). Parents of children not having school lunches were asked what their children did for lunch, and for those buying food for lunch, how much they were given by parents. Statements and questions of the parents' questionnaire are given in Appendix 4.

Statements were prepared in English, translated into Cyrillic Serbian (the alphabet most frequently used in both urban and rural communities), and the translation checked for meaning independently by another Serb. Statements were also back translated into English to check for consistency of meaning in English. To minimise costs, the parents' questionnaire was designed to fit onto a single sheet of paper, double-sided, and the children's instrument score sheets were designed to fit onto two sheets of paper double-sided.

To be able to relate completed children's questionnaires to questionnaires completed by their parents, children were asked by their teachers to provide at the top of their questionnaires a code consisting of the child's initials (name and surname), a six-digit code for their date of birth (day, month, year), the child's gender, and to give the child's year and class number as well as whether he/she usually had lunch in school or not. Parents were asked to give the same code for their child and also to give the child's year and class number, and whether they usually had lunch in school or not. Thus, six criteria were available to match parent and children

questionnaires to the same child: child initials, date of birth, gender, school year, class number, having lunch in school or not.

7.1.3 Monitoring procedure and data processing

The finalised questionnaires were printed and distributed to each school by post. Schools were requested to ask teachers of classes in years 1 and 2 to get children to take the parent questionnaire to their parents to be completed at home. Both questionnaires were sent to schools early in the school year (early October, 2018), so year 1 children (7-year-olds) were only just starting their primary education and year 2 children (8-year-olds) had completed one full school year. After one-two weeks, completed questionnaires were collated, returned by post and transcribed into Excel™. Researchers had no direct contact with either class teachers, their children or parents, communicating only with school coordinators, who were acting as a liaison between researchers and children and their teachers. Therefore, schools were also sent detailed written instructions on how parents' and children's questionnaires should be completed (Appendix 5).

Other factors were also considered as part of the initial monitoring process. A panel of nutritionists (two from Serbia at Institute for Public Health Vojvodina, one from ZAG, Croatia and three from BARILLA, Italy) independently assessed the nutritional quality of the 90 foods, prepared as shown in the images, using a range of 1 (lowest nutritional quality) to 5 (highest nutritional quality). The mean nutritional value of each food was calculated from the six assessments. Cooks in the 27 schools preparing their own meals were asked to assess how frequently each of the 90 foods was served in school meals, using a score of 0 (never served), 1 (food served 1-2 times per year), 2 (food served 2-3 times per half-year), 3 (food served on average once per month), 4 (food served at least once per week).

A wide array of characteristics at the level of the municipality, settlement or school defining the schools and its children's environment were also recorded, detailed in Appendix 6. These were divided into internal factors (within the school, such as the number of pupils, food procurement information), and external factors (the school's external environment, such as demographics, municipality poverty level).

Completed score sheets from the two questionnaires were analysed both as individual monitoring questionnaires and jointly. Excel™ statistical package was used for simple statistics, t-tests, one-way ANOVA, Pearson correlations and bar charts and scatter plots.

Multilevel (three level) analysis:
For this more robust statistical analysis, information was used on children and parents collected from 25 schools for which there were sufficient matching data from both children and their parents. These schools clustered within 15 municipalities (4 within the city of Belgrade), leading to the hierarchical (clustering) structures of data. We applied multilevel (three-level) modelling with random intercepts following Matheson et al. (2008) and Chambers et al. (2016). The unit of analysis here was children and parents as the first level, schools as the second level and municipalities as the third level. A detailed description of the methodology is given in Appendix 6. For analysis, children's food preferences were entered for two sets of food items as scores of 0 = food disliked, 1 = not bothered either way, and 2 = food liked: each food item, and only the 30 vegetables and fruits. As these analyses are still in progress, only summary results for the main findings are referred to below, and a summary of preliminary findings is published in Tiwasing et al. (2020).

7.2 Monitoring instrument results

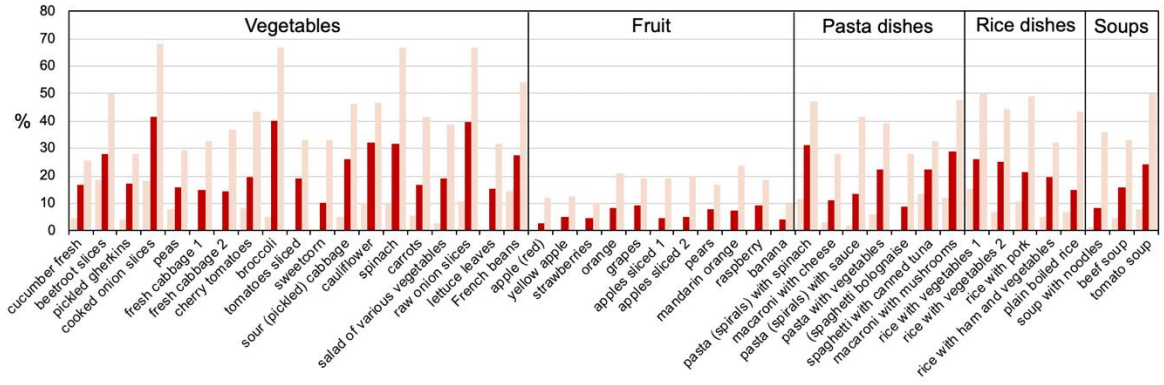
7.2.1 Children's instrument

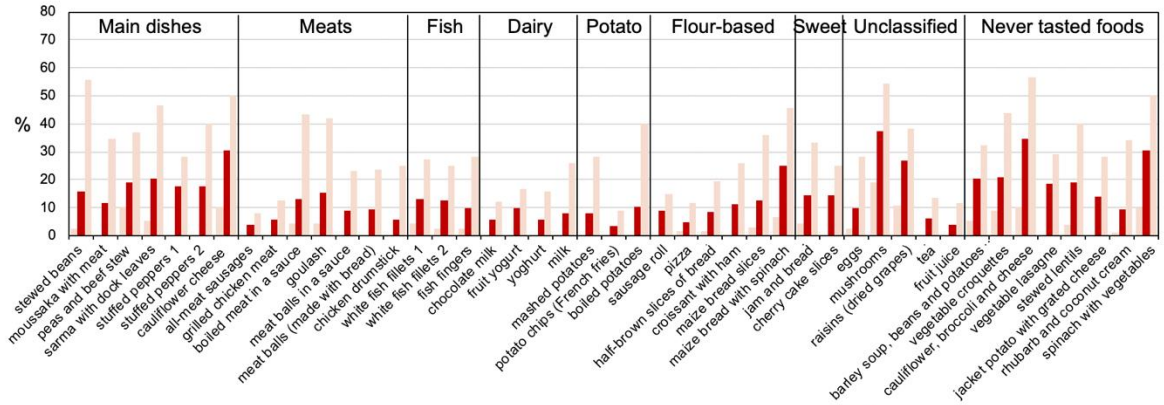
The children's instrument was completed by 33 schools: 25 target schools making their own lunches and 7 control schools, plus the one target school using a caterer. However, not all schools completed both instruments, and occasionally children completing the children's instrument and children of parents completing the parent's instrument were in different classes! Completed questionnaires from another school were lost in the post. Matching children to their parents using the codes was also often a challenge. Therefore, the number of schools with more than 5 children plus their parents completing the monitoring instruments was only 25, including 6 schools using caterers, equalling in total 2004 children/parents. There were also 2229 children questionnaires without parent questionnaires, and 1021 parent questionnaires without their children's questionnaires. In total, 5245 questionnaires (either children or their parents) were completed. Transcribing these completed questionnaires into Excel took around 6 months.

Overall picture:
For the following summary results, all % data refer to the proportion of the 4 smiley options selected by children for a particular food: for example, 100 x sad smiley/ (sad+neutral+happy+"?" smileys). Mean % scores across all schools for the 90 foods for sad, happy and "?" smileys for each school are illustrated in Figure 21, showing the minimum, mean and maximum % for each smiley category for each food. In total, the average number of children giving scores to each food was 3927, with individual food preferences as follows:
- total sad smileys across all foods: 618 (15.7% total scores per food)
- total neutral smileys across all foods: 452 (11.5% total scores per food)
- total happy smileys across all foods: 2250 (57.3% total scores per food)
- total "?" smileys across all foods: 607 (15.5% total scores per food)

Across the 14 food categories, sad smileys (children don't like the food) were much fewer (mean 15.5% across all food categories) than happy smileys (mean 60.8%). That excludes preferences for the "Never-tasted" food category, which gained 21.0% sad smileys and 20.9% happy smileys, even though most children were unlikely ever to have tasted the foods. Averaged across all schools, % of "?" smileys was 15.5, and this increased to 50.1% for the 8 foods in the "Never-tasted" food category – not the expected 100%! Neutral smileys made up the remaining 8.2%. "?" smileys for the "Never-tasted" food category varied widely amongst schools from only 40.5% to 70.6%. We asked school coordinators in two of the schools having high % of "?" smileys for the 8 "Never-tasted" foods why they thought their "?" smiley scores were much higher than those for other schools, and both replied that they were very careful to explain to children how to score foods they had never tasted. This probably led to fewer false scores of "like" or "dislike" for those foods in these schools.

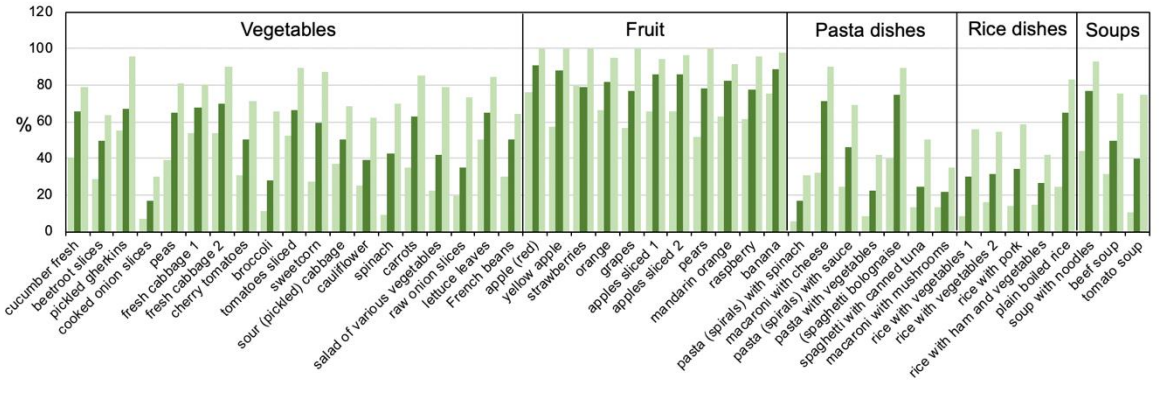
In general, % scores for happy smileys tended to be the inverse of % scores for sad smileys for all food categories.

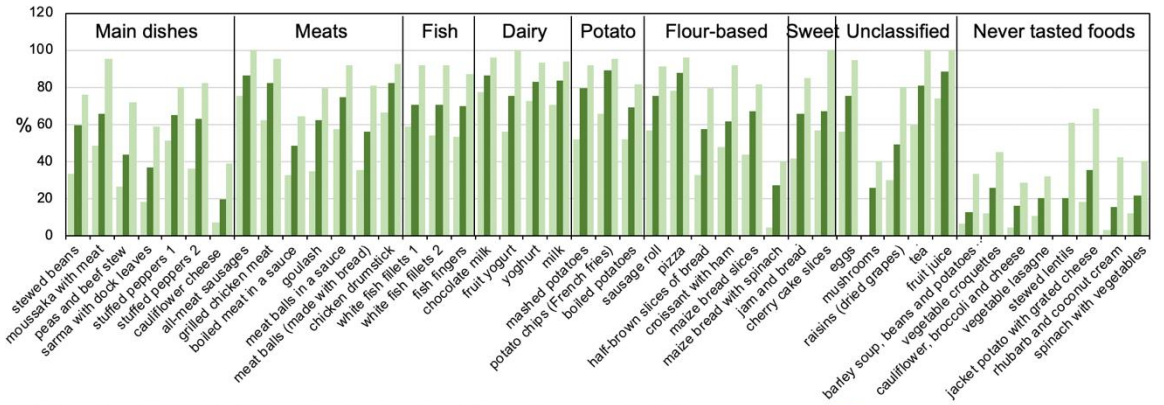




All 31 schools (4006 children) and schools with maximum and minimum:
% sad smileys (children don't like the food)

Average of all schools (31)
Maximum and minimum





All 31 schools (4006 children) and schools with maximum and minimum:
% happy smileys (children do like the food)

Average of all schools (31)
Maximum and minimum

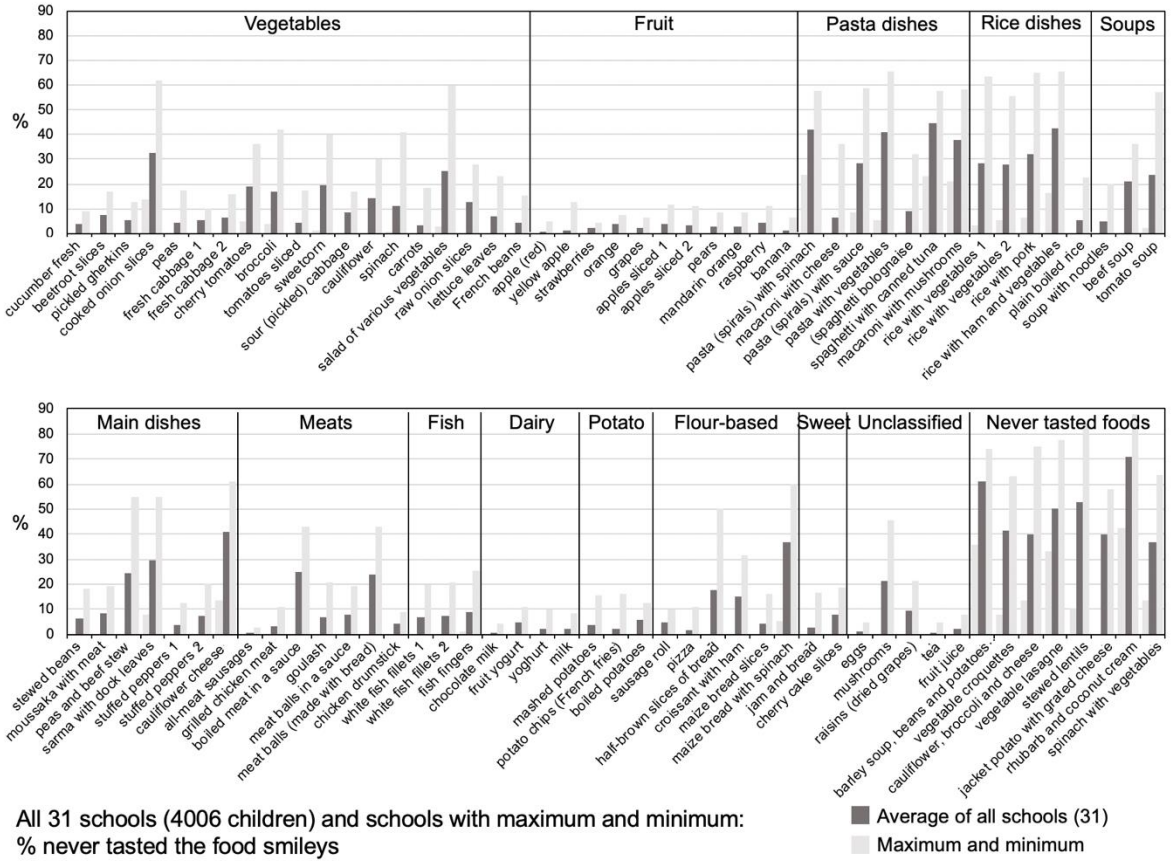


Figure 21. Minimum, mean and maximum % for (top) sad smileys (don't like the food), (middle) happy smileys (like the food), and (bottom) "?" smileys (never tasted the food) amongst all schools.

Vegetables were given the most sad smileys – nearly a quarter of food preference scores (23.5%). However, much of the high % of sad smileys was accounted for by only 2 foods: broccoli (40.0%) and onion (41.6% and 39.6% for cooked and raw onion, respectively). On average, 52.2% of children liked vegetables (happy smileys), though the range was large, from only 16.8% for cooked onion to 68.8% for cabbage salad. Only 27.9% of children liked broccoli, and around 50% of children liked pickled beetroot and French beans (49.4% and 50.5%, respectively). The majority of vegetables given to children for school meals, such as carrots, peas and salads, were liked by at least 60% of children. Only 11.1% of vegetables, on average, had never been tasted by children.

Fruits as a food category had the lowest number of sad smileys overall (only 6.1%), and of those, grapes and raspberries had the most sad smileys (both 9.2%). Fruits earned the most happy smileys (83.2%). Of the 4 images of apples, red apples had the most happy smileys (91.1%), though interestingly, yellow apples were not as popular; only 81.9% (a difference significant at $P<0.01$). Grapes had the lowest number of happy smileys, only 76.6%. Sliced apples (86.1%) were not as popular as whole apples. Children in Belgrade and Novi Sad schools liked raspberries less (by ca. 11%) than children in the smaller towns and rural areas: 71.6% (Belgrade+Novi Sad) and 82.8% (other schools).

Pasta and rice dishes were the least popular food categories after vegetables, and were given 19.7% and 21.4% sad smileys, respectively, and for happy smileys only 39.6% for pasta dishes and 37.4% for rice dishes, the food category with the lowest % happy smileys. However, boiled rice by itself was liked by the majority (64.9% happy smileys). Evidently children don't like other foods being mixed into rice. Pasta and rice dishes were the highest two food categories

for "?" smileys, reflecting the fact that these are not traditional Serbian dishes. Nevertheless, macaroni with cheese and spaghetti bolognaise were liked more than all of the main course dishes included in the instrument: 71.4% and 74.4%, respectively, compared with 66.0% for the most popular main course (moussaka).

Soups were given 16.0% sad smileys and 55.5% happy smileys. Despite being a regular component of the Serbian diet and frequently served in schools, 16.5% of children gave "?" smileys on average for the 3 soups. The least popular soup was tomato soup, with 21.6% sad smileys and only 45.4% happy smileys.

Main courses (where several foods are mixed together) were generally liked (sad smileys <20%, and happy smileys ca. 60%). However, cauliflower cheese was definitely not popular (30.6% sad smileys, and only 19.9% happy smileys), compared with macaroni cheese which got 71.4% happy smileys! That was probably associated with a lack of familiarity with cauliflower cheese, as over 40% of children (40.9%) gave it a "?" smiley.

Meats and fish were both very popular, with over 70% happy smileys on average (70.2% and 70.3%, respectively), and sad smileys generally <10%. Only cooked meat chunks in a sauce and goulash were given >10% sad smileys (13.2% and 15.4%, respectively) – perhaps because young teeth find pieces of red meat hard to cope with. Only 11.9% of children gave the 3 fish dishes sad smileys. However, good quality white fish, either filleted or as fish fingers, is hard for schools to find.

Milk products had few sad smileys (7.2%). Chocolate-flavoured milk and plain yogurt had fewer sad smileys (ca. 5.5%) than fruit yogurt (9.7%) and milk (7.8%). Differences between chocolate-flavoured milk and plain yogurt compared with fruit yogurt and milk were significant by ANOVA at $P<0.0001$. All milk products were given happy smiley scores over 75%. Although very few children gave any of the 4 milk products a "?" smiley (all <5% on average), "?" smileys reached at least 10% in 2 schools, and 8.5% of children had never tasted milk in one rural school, near Arilje.

Potato dishes were generally well-liked, with almost 80% happy smileys (79.4% overall), and less than 10% sad smileys (7.3% overall). Boiled potatoes were liked the least (10.4% sad smileys and 69.4% happy smileys) and, unsurprisingly, chips (French fries) were liked the most (only 3.5% sad smileys and 89.1% happy smileys). On average, 5.7% of children had never tasted boiled potatoes, though 1 in 8 children (12.5%) in a Belgrade school had never tasted boiled potatoes.

Flour-based foods (wheat and maize flour products) were very diverse as a food category, varying from the highly popular pizza (87.5% happy and only 4.8% sad smileys) to maize bread with spinach (only 26.8% happy smileys and 25.5% sad smileys). In reality, few children are likely to have tasted this food, so the "?" smiley of 36.9% is probably an underestimate. In contrast, maize bread itself was liked by two thirds of children (67.1% happy and 13.0% sad smileys) and only 4.1% had never tasted it.

Sweet foods were limited to only bread and jam and sour cherry pie, a typical school meal dessert. Both foods were liked by around two thirds of children (65.4% and 66.8% happy smiley for jam and bread and cherry pie, respectively), with only 14% sad smileys for both foods. Of unclassified foods, the image of sautéed mushrooms in a sauce was liked least (37.4% sad smileys, 25.6% happy smileys), eggs were liked by 75.6% of children and the two drinks (tea and fruit juice) by 81.1% and 88.7%, respectively.

"Never-tasted" foods: despite the high probability of never having tasted foods in the "Never-tasted" category, a fifth of children said they didn't like them (21.2% sad smileys), a fifth said

they did like them (20.9% happy smileys) and less than half (49.1% "?" smileys) said they had never tasted them. While it is possible that some children may have been given occasional foods from this category (for example, a small number of schools are known to buy lentils), foods in this category suggested by BARILLA (barley, bean and potato soup, vegetable croquettes and vegetable lasagne) and the dessert rhubarb (a rare plant in Serbia) and coconut cream ought never to have been given to these children. Even this dessert was liked by 15.2% and disliked by 9.5%, so it is likely that many children have mistakenly given sad or happy smiley scores instead of "?" scores for foods in this category. Maybe some children thought that some of these "Never-tasted" foods looked similar to foods they have tasted. Nevertheless, the average "?" smiley scores for these foods gave a measure of the ability of 7-8-year-old children to recognise reliably foods in the images, together with accompanying word(s) spoken by the teachers.

Urban and rural schools compared:

The 33 schools completing the children's instrument were grouped into schools in Belgrade (large urban), Novi Sad (small urban), large rural towns (large rural) and small rural towns/villages (small rural). Comparing the effect of school location on children's food preferences, children from the four urban and rural school groups often had significant differences in their food preferences. For the majority of these foods, urban children liked them (or had tasted them) more than rural children, urban children liking 44 foods more, compared with rural children who liked 30 foods more. This was particularly expressed with vegetables (see Figure 22 for examples of food preferences showing consistent urban-rural differences). Urban children also liked non-traditional foods, such as pasta and rice dishes, more than rural children. In contrast, rural children tended to like sweet foods, illustrated in Figure 22 by fruit yogurt and cherry cake slices, and traditional foods more than urban children.

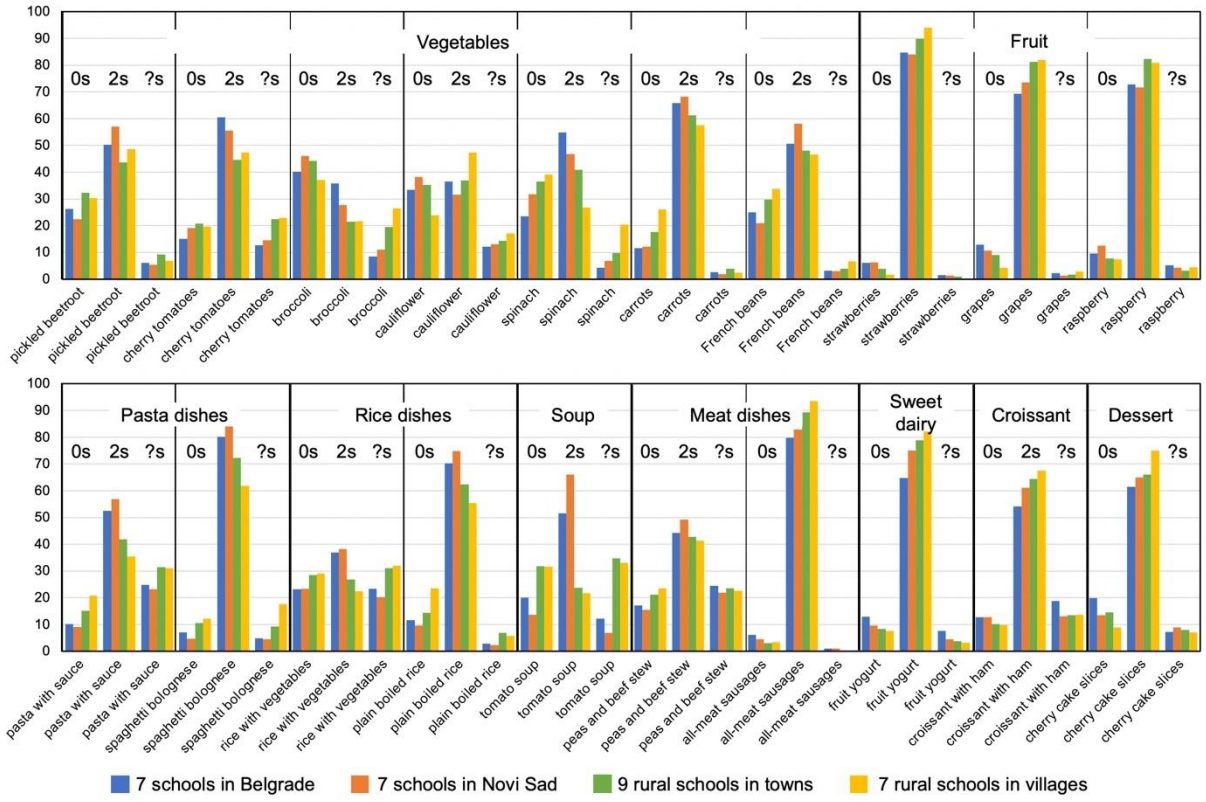


Figure 22. Comparison of food preferences for children in a range of urban and rural schools. Foods that children disliked, liked and hadn't tasted are labelled 0s, 2s and ?s, respectively.

Despite being more likely to have access to vegetables in rural environments, children in rural schools generally disliked more vegetables than children in urban schools. However, rural children frequently liked fruits more than urban children (Figure 22) - a difference of 5.4% more happy smileys from rural children meaned over all 11 fruits.

Children from rural schools consistently disliked more and liked less dishes with pasta or rice, and more rural children had never experienced those foods compared with urban children. Tomato soup had particularly large differences in popularity between urban and rural schools, with an overall difference between urban and rural schools for happy smileys of 37.7%. In contrast, however, 35.3% of rural children gave tomato soup a "?" smiley, compared with only 9.3% for urban children, so tomato soup is evidently not given frequently to children in rural environments.

Differences between children from urban and rural schools in preferences for meat dishes were relatively small, though peas with beef stew were liked more by urban children and all-meat sausages (ćevapi) were liked more by rural children.

Interestingly, the one food amongst the 90 that children will never ever have been given (rhubarb and coconut cream) was given fewer "?" smileys by rural children (77.7% urban, compared with 64.2% rural). The difference in % "?" scores was because of both more sad (5.2%) and more happy (5.3%) smiley scores from rural children. This may indicate that rural children in general were either less able to understand or follow instructions on how to score the foods, or that the quality of instructions given on how to complete the instrument was not as good in rural schools.

Effect of school lunches on food preferences.

We wanted to establish whether eating school lunches (or cooked breakfasts) had any influence on children's food preferences. This was tested in two ways. The first was to compare the food preferences of children who had school lunches with those who did not have a school lunch. Both the children's food preference questionnaire and their parents' food habits questionnaire contained questions on whether children ate lunch in school or not. The wording of the children's questionnaire was "Do you usually eat lunch (or breakfast if there isn't lunch) in school?"

	School	Place	Children with lunch	Children with no lunch	Children with lunch	Children with no lunch	Children with lunch	Children with no lunch	Children with lunch	Children with no lunch
			Number	Number	%0s	%0s	%2s	%2s	%?s	%?s
Target schools	Ljuba Nenadović	Belgrade	68	89	15.0	17.2	57.2	54.3	17.5	18.9
	Anta Bogičević	Loznica	95	37	14.2	14.2	56.5	57.4	14.7	14.4
	Miloš Crnjanski	Novi Sad	82	61	12.8	14.7	57.8	57.2	17.0	17.5
	Djordje Natošević	Novi Sad	150	47	15.0	15.3	56.7	49.7	17.3	20.6
Control schools	Filip Kljajić Fića	Belgrade	61	36	14.7	13.9	64.2	60.1	8.4	12.2
	Svetozar Marković	Belgrade	61	68	11.4	14.6	58.3	56.6	19.5	15.9
	Vuk Karadžić	Loznica	61	41	15.9	17.0	59.3	56.0	12.0	18.1
	Sonja Marinković	Zemun	108	47	11.6	9.4	63.0	57.8	13.9	21.2

Children with lunches had better scores	P<0.05	P<0.01	P<0.001	P<0.0001
Children with lunches had worse scores			P<0.001	

Table 1. Comparison of children's food preference scores according to whether children had a school lunch or not. Schools shown in red text use a caterer. Significance of differences tested using paired-sample *t*-test for each of the 90 foods.

Although 33 schools completed the children's questionnaire, relatively few reliable data (consistent information for all criteria determining whether a school lunch was eaten or not) were collected on numbers of children having lunches provided by the school. Thus,

comparisons within a school of the effect of school lunches on children's food preferences are subject to some uncertainty. Nevertheless, 8 schools (4 making their own lunches and 4 using caterers) were identified with a high likelihood of children either having or not having school lunches.

For those eight schools, children eating school lunches usually, but not consistently, had more favourable food preference scores (Table 1). Thus, children having lunches at Ljuba Nenadović, Miloš Crnjanski (Novi Sad) and Svetozar Marković had significantly fewer (1.9%-3.2%) sad smileys, though children having lunches at Sonja Marinković had significantly more sad smileys (2.2%).

Overall, children having school lunches gave significantly more happy smileys in 6 of the 8 schools, with eating school lunch having no significant effect on food preferences on either happy smileys or "?" smileys at Anta Bogičević and Miloš Crnjanski schools. For the other 6 schools, having a school lunch increased children's liking for foods by around 4% (1.7-7.0%). Proportions of "?" smileys were more consistently lower for children having school lunches (i.e. children having school lunches had tasted more foods), being around 3% lower for 6 of the 8 schools (1.4-6.1%).

A very similar picture was found when considering just the 19 vegetables in the instrument. Five of the 8 schools showed significantly more happy smileys from children eating school lunches and fewer "?" smileys (around 5-6% difference for each smiley).

So, the overall picture is that having school lunches may have a positive influence on children's food preferences, with a frequent tendency for children to dislike fewer foods, to like more foods, including vegetables, and also to have experienced a wider range of foods.

The second way in which we estimated the effect of school lunches on children's food preferences was to record the frequency of serving each of the 90 foods in school meals. Those foods that were rarely or never served in school should not differ in food preference scores between children eating a school lunch or not. Cooks from 18 schools scored the 90 foods according to the frequency each food was given to children in school (0 – never, 1 – 1-2 times per year, 2 – 2-3 times per semester, 3 – on average once per month, 4 – at least once a week). As expected, foods differed markedly in their serving frequencies with, for example, broccoli, cauliflower and spinach being served maybe once or twice a year, but cabbage served almost every week. Apples and bananas were the most frequently served fruits - several times per week. The most frequently served main course was bean stew, which was served more-or-less every week. Stewed meat with peas and moussaka were served nearly every week as well as chicken and pasta with cheese. Other pasta dishes and rice dishes were served 2-3 times per month. As expected, the foods suggested by BARILLA and other non-Serbian foods (inserted as negative controls) were either never or very rarely served for school meals.

Foods were grouped into scores of 0-1 and 3-4, to compare children's food preference differences between cooks' food frequency scores. The effects of cooks' food frequency scores were determined for the only 3 schools making their own meals with at least 20 children ***not*** having lunches: Ljuba Nenadović, Anta Bogičević and Djordje Natošević (Figure 23).

Children's food preferences clearly differed between foods that were rarely-served (0-1) and frequently-served (3-4) in school, though this was ***not*** particularly associated with whether children had school lunches or not. So, in each of the 3 schools, foods rarely-served in school generally had more sad smileys than frequently-served foods, and this was irrespective of whether children had school lunches or not. This trend was even more expressed for happy and "?" smileys. Overall, for rarely-served foods (scores 0-1), happy smileys were *ca.* 30% fewer

in Ljuba Nenadović, *ca*. 15% fewer in Anta Bogičević and *ca*. 20% fewer in Djordje Natošević (all differences significant at $P \leq 0.01$).

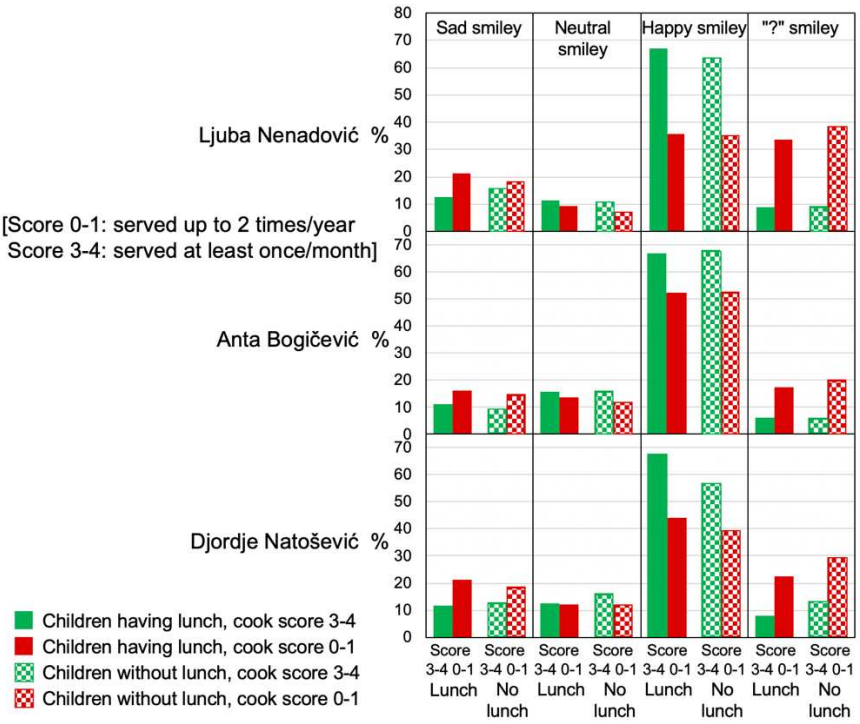


Figure 23. Effects of cooks' food serving frequency scores on food preferences for children having or not having school lunches (mean data for children food preference scores in three schools).

For % "?" smileys, the differences between rarely-served foods and frequently-served foods were also large: over all children, about 4-fold (from 9% to 35%) for Ljuba Nenadović, 3-fold (from 6% to 19%) for Anta Bogičević and around 2-3-fold (from 10% to 26%) for Djordje Natošević (all differences highly significant at $P \leq 0.001$). This was the only school showing a relatively large effect of children having school lunches on their % "?" smileys – *ca*. 7% fewer "?" smileys for children having school lunches.

Thus, cooks' serving frequencies were clearly associated with how much children liked the foods or had experienced the foods, though the preference differences were evidently not ***caused*** *by eating school meals.* It seems likely that, as large differences in food preference scores were present between rarely-served foods (scores 0-1) and frequently-served foods (scores 3-4) even for those children ***not*** having school lunches, *school cooks tend to serve more frequently foods that all children like, whether they have school lunches or not. Therefore, we found no evidence that children's food likings could be improved by encouraging them to have school lunches.* However, see page 50 (Figure 25) for the effect of a school vegetable garden on children's vegetable likings.

Children's food preferences according to nutritional value:
Using the nutritionist mean scores for each food (1 – very low nutritional value to 5 - very high nutritional value), the most nutritious food category was fruits (4.98), closely followed by vegetables (4.67). Other food category means above 4 were rice dishes (4.43), pasta dishes (4.14) and main course dishes (4.08). Low scores (below 3) were given to flour-based dishes (2.93), sweet dishes (2.67) and potatoes (2.50).

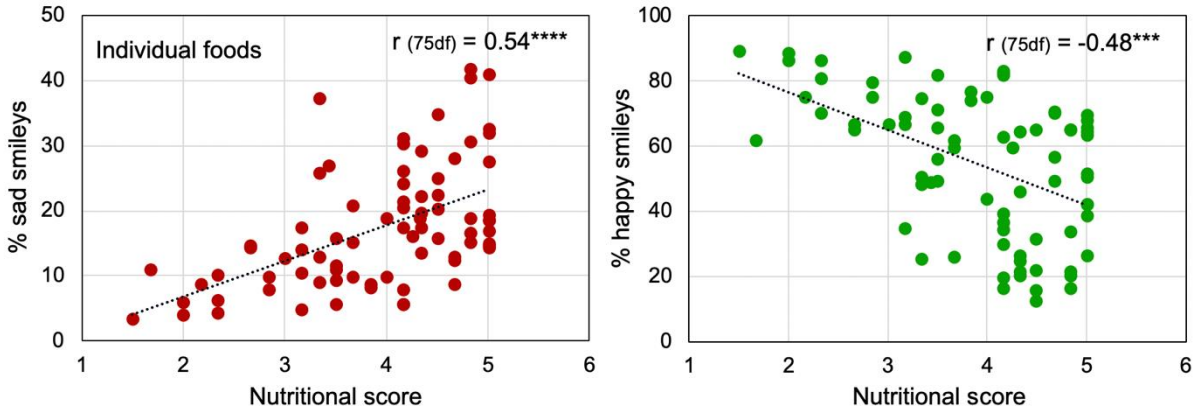


Figure 24. Association between nutritional score for food categories and individual foods and children's food preferences. Note - fitted lines exclude data for fruits.

Thus the most nutritious food category (fruits) coincided with the food category given the lowest % sad smileys (6.1%), and the highest % happy smileys (88.5%). Note - only foods that children have tasted are considered here, so "?" smileys are not discussed. However, for all other food categories the association with food preference smileys was the reverse: as the nutritional value of a food category increased, % sad smileys increased, and % happy smileys decreased (Figure 24). Apart from the fruit category, which was unique in being universally liked by children, the other 5 highly nutritious food categories with mean nutritional values above 4, listed above, were also the 5 food categories with the highest % sad smileys. Conversely, those 5 highly nutritious food categories, with mean nutritional values above 4, were also the 5 food categories with the lowest % happy smileys.

On an individual food basis, 8 foods were given mean nutritional scores of <2.5. These foods were given only 6.7% sad smileys. In contrast, the 54 foods given nutritional scores >4.0 were given over 3 times as many sad smileys: 21.4%. The picture was the mirror image for happy smileys: foods with low nutrition (scores <2.5) were given almost 80% happy smileys (79.9%), while foods with nutrition scores >4.0 got only 53.1% happy smileys. Note that these data include the 11 foods in the fruits category, the food category most liked by children. Excluding the 11 fruits from foods with nutrition scores >4.0 resulted in only 45.3% happy smileys for the remaining 43 foods. The only food with a nutritional score of at least 4.5 that got over 70% happy smileys was white fish (not battered or fried). Plain boiled rice (nutrition score 5.0) was also generally liked by children (64.9% happy smileys).

So, it is clear that, apart from fruit, and a couple of other exceptions, there is a generally negative association between food nutritional value and children's food preferences. This negative association would probably have been much stronger if the food preference instrument had not been biased, on purpose, towards more nutritious foods.

Association of children's food preferences with other school and external factors:
The likely influence of children's food preferences on other factors, internally within the school, and externally within the municipality or settlement was tested through correlations with mean data for various food categories for 32 of the schools (Table 2). Several food categories gave significant associations with external factors (settlement population, municipality % poverty and cars/1000 people). Thus, larger settlement sizes were associated with children liking pasta and rice dishes and soups more, and fruit, sweet dairy (chocolate flavoured milk and fruit yogurt) and sweet dishes (jam and cherry cake) less than children in smaller settlements. Similar associations were present for the number of cars per person, and the opposite trends were present with municipality % poverty.

Food category	Log total population 2011	Cars/1000 people	Municipality poverty %	C8. Preventing malnutrition of students	C9. Preventing obesity of students	Extent of work with children on food	Total no. of food items procured
Vegetables+fruit %2s	-0.118	-0.016	0.075	0.230	0.000	0.305	0.139
Pasta+rice %2s	0.464	0.644	-0.553	-0.070	-0.191	0.289	0.676
Main course+meats %2s	-0.237	-0.007	0.079	0.139	-0.014	0.248	0.345
Total % "?"s	-0.047	-0.315	0.292	-0.141	-0.030	-0.455	-0.565
Vegetables	0.172	0.200	-0.102	-0.100	-0.079	-0.113	0.003
Fruit	-0.493	-0.546	0.521	0.224	0.020	0.070	-0.327
Pasta dishes	0.250	0.381	-0.347	0.043	-0.151	0.244	0.326
Rice dishes	0.416	0.462	-0.372	-0.157	-0.249	0.041	0.551
Soups	0.470	0.382	-0.340	-0.168	-0.303	-0.046	0.450
Main courses	-0.200	0.076	0.026	0.066	0.047	0.169	0.242
Meats	-0.162	-0.117	0.178	0.183	-0.038	0.097	0.110
Sweet dairy	-0.530	-0.462	0.478	0.543	0.200	0.014	-0.211
Sweet dishes	-0.517	-0.222	0.254	0.401	0.092	0.311	0.003
Total "?"s	-0.051	-0.324	0.300	-0.147	-0.036	-0.451	-0.579

Significance	*P*<0.05	*P*<0.01	*P*<0.001
Positive			
Negative			

Table 2. Coefficients for correlations between various food categories either as % happy smileys (%2s), or overall mean scores (0=sad smiley, 1=neutral smiley, 2=happy smiley) and both external factors and internal factors.

For within-school factors (importance of school policy to prevent malnutrition, obesity and overall health of children, and the number of food items procured in 2016), the school's importance given to its policies towards child malnutrition and obesity (discussed in section 2.2) evidently had no positive impact on children's food preferences. The only foods to be significantly associated with school health policies were sweet dairy foods and sweet desserts being liked more in those schools giving more importance to school policy towards malnutrition. However, the extent of school activities specifically towards food (such as participation in Healthy Food day) had a slight, but significant, impact on the number of foods experienced by children. More food activities reduced the number of "?" smileys.

Interestingly, children in schools buying a wider variety of foods in total liked significantly more rice dishes, liked soups more and gave significantly fewer "?" smileys. Children in those schools evidently also had wider food experiences.

Schools using their own cooks compared with schools using caterers

Although 8 of the 33 schools completing the children's food preference instrument used caterers, 2 of those schools did not use a caterer to provide lunches. Therefore, the 6 schools using caterers to provide lunches were compared with 6 schools using their own cooks, matched geographically as closely as possible: 4 schools using caterers in Belgrade and Zemun, and 2 in Loznica and Ljubovija, close to Bajina Bašta.

Although means for the 90 foods differed overall between the 6 'caterers' schools and 6 'cooks' schools by less than 2% (1.5% sad smileys, 1.2% happy smileys, 1.9% "?" smileys), these overall differences were highly significant (P<0.0001, 0.01 and 0.0001, respectively). *In general, children having lunches in schools using caterers liked **more** foods. However, children having lunches in schools using caterers had tasted fewer foods.* Thus, children in schools with cooks had tasted more rice dishes: the 5 rice dishes had 4.7% fewer "?" smileys.

These significant differences overall, with children in schools using caterers generally liking more foods, are difficult to explain. They could indicate differences in the frequencies of individual foods being served in the 6 'caterers' and 6 'cooks' schools, or artifacts due to the small number of schools in each category with specific in-school differences.

Children scores in year 1 compared with year 2
Of the 4234 questionnaires completed, 1978 were from children known to be in year 1 and 2028 were from children known to be in year 2. The remaining questionnaires were either completed by children in other years, or without any year information.

Using scores for each smiley combined for all schools for each of the 90 foods, scores for each smiley differed highly significantly between children in year 1 and children in year 2 (paired sample *t*-test), though differences were typically small (only 0.7-2.7%). Children in year 1 gave slightly more sad smileys, always more happy smileys and always fewer "?" smileys than children in year 2:

% sad smileys - 15.7% and 15.0% for years 1 and 2, respectively (P<0.001),
% happy smileys - 62.0% and 59.4% for years 1 and 2, respectively (P<0.0001),
% "?" smileys - 14.3% and 17.0% for years 1 and 2, respectively (P<0.0001).

An extra category was also considered - the number of missing scores from each child. Children in year 1 had more missing scores than those in year 2: 4.4% and 1.9%, respectively (P<0.0001). For every one of the 90 foods, % missing scores were greater for year 1 children than year 2 children.

It is not clear whether the frequently higher % happy smileys for children in year 1 indicate a genuinely greater liking for foods in those children which they then lose by year 2, or whether this merely represents greater unreliability amongst seven-year-olds in their ability to understand and respond to instructions. Certainly, it is illogical that % "?" smileys (never tasted foods) should be 2.7% fewer for year 1 children than year 2 children. Therefore, it is probable that year 2 children gave more realistic assessments of whether they had ever tasted a food or not. Thus, more happy smileys and fewer "?" smileys from year 1 children could be artifacts of their lower cognitive maturity.

However, the consistently higher number of missing scores for year 1 children implies greater confusion amongst the younger children in knowing how to score the food images. Nevertheless, the almost identical % sad smiley scores overall for year 1 and year 2 children and significantly higher % sad smileys in year 1 children for fruits and meats food categories provide no evidence for greater food rejection by children as they get older, at least during their early school years.

Contrasting rural school
Two otherwise similar rural schools close to Valjevo differed in one particular feature. The school in Brankovina had a vegetable garden on the school grounds and the school in Popučke, less than 10 km away, did not. The director at that time of the Brankovina school was interested in promoting healthy eating, and children spent time during the year learning how to sow, cultivate, harvest and taste the vegetables. It is the only school on our project with a vegetable garden on the school grounds, which the children help to look after. Food preference scores for the two schools are compared, together with the average results for all schools for a selection of foods in Figure 25.

Children's food preference scores reflected the use of the vegetable garden in Brankovina, with children giving the lowest % sad smileys for 7 of the 19 vegetables in the instrument, and the lowest average % sad smileys for vegetables of all the schools (11.3%).

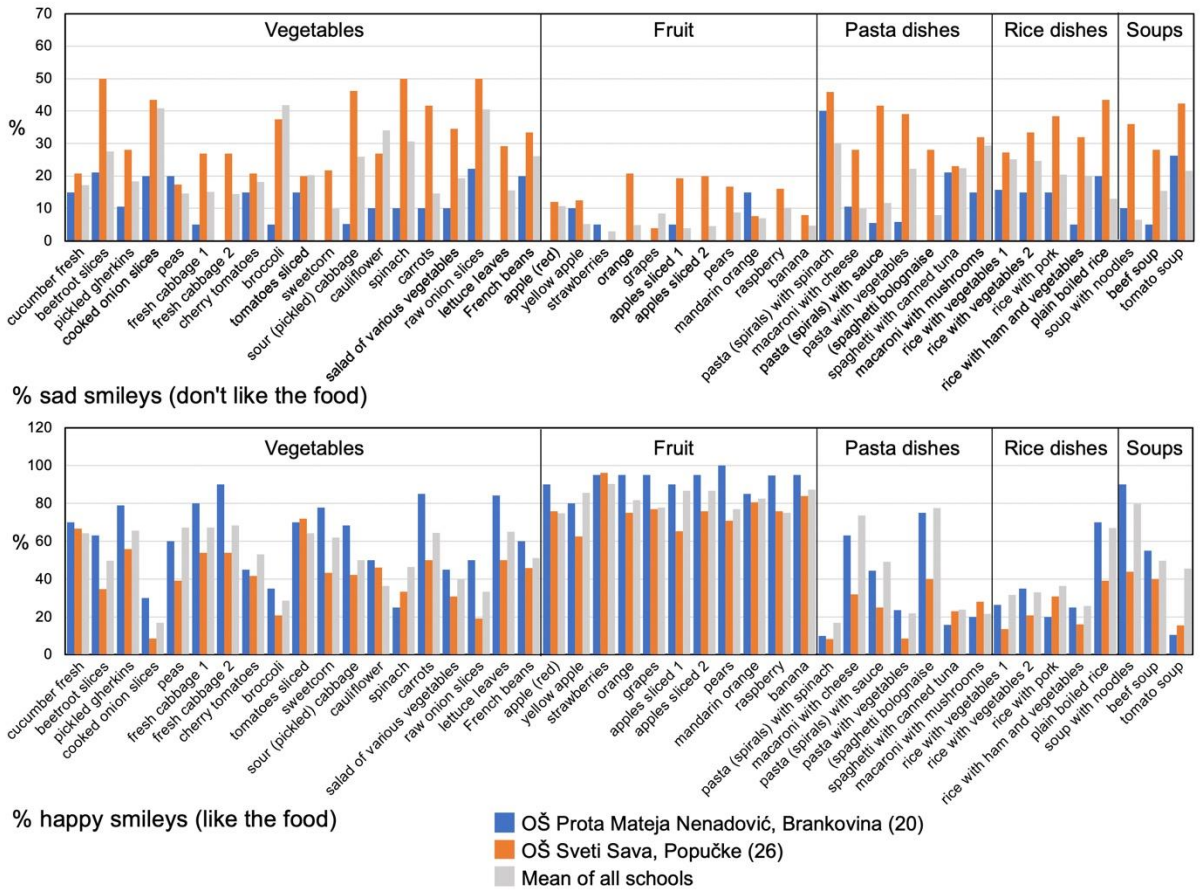


Figure 25. Food preference scores (sad smileys and happy smileys) compared for vegetables, fruit, pasta and rice dishes and soups for village schools in Brankovina (with a vegetable garden) and Popučke, together with mean results for all schools.

In addition, the school had the lowest (or joint lowest) % sad smileys for 7 of the 11 fruits (average 3.2%). In contrast, the neighbouring school in Popučke was notable for having the highest number of maximum % sad smileys: 38 foods, distributed across all food categories, and particularly for vegetables and fruit, children in Popučke liked them less than the average for all schools.

The low % sad smiley scores for the Brankovina school were reflected in maximum % happy smileys. This school had the highest proportion of happy smileys for vegetables – 61.5%, as well as a maximum % happy smileys for 9 of the 20 vegetables and fruits. This was the highest combined average % happy smiley score for vegetables and fruits of all the schools (72.4%, compared with 63.5% for the average for all schools). In total, the school had the lowest % sad smileys for 28 foods and maximum % happy smileys for 21 foods. This was more % sad smiley minima plus more % happy smiley maxima than for any other school. The school also had a minimum % "?" smileys for 16 foods.

Evidently, the school director's involvement of children at first hand with many foods, and her campaigning for awareness among children of the benefits of healthy eating habits had a noticeable effect on the children's food preference scores. *Thus, attitudes within a school towards food and healthy eating, coupled with giving children hands-on experience of growing and tasting food are evidently effective in influencing children's food preferences and eating habits. This benefit was not restricted to only the vegetables that children experienced in the*

school garden, but preferences for a wide range of other foods were influenced, such that more foods in general were liked.

Conclusions from the children's instrument:

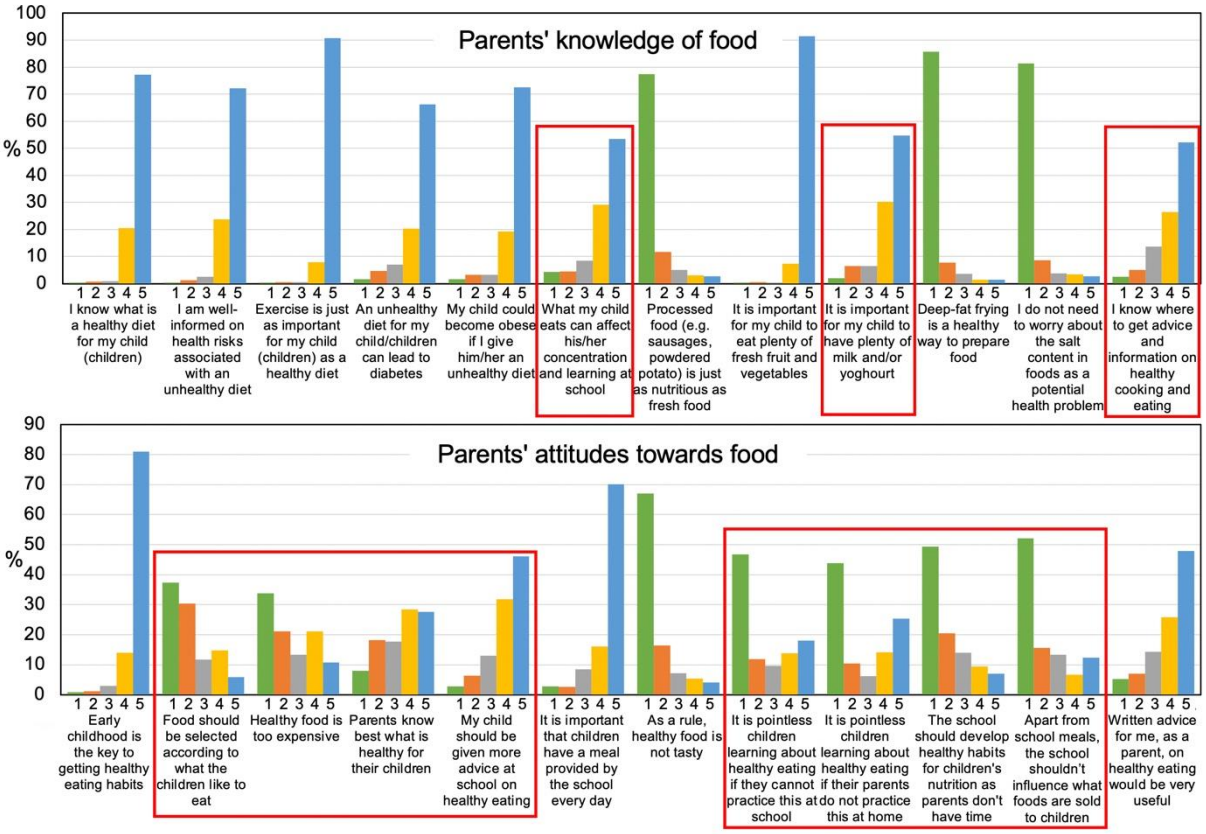
As expected for such a diverse array of foods, children's food preferences were very diverse.

- Vegetables were given the most sad smileys, and fruits the least sad smileys, which is in line with previous observations reported by schools and schools meal wastes measured in WP6.2.
- Fruits were the food category liked the most and, apart from macaroni with cheese and spaghetti bolognaise, pasta and rice dishes the least.
- Pasta and rice dishes were also given the most "?" smileys, indicating that children had limited experience of tasting these non-Serbian dishes.
- Traditional main lunch dishes of meat with (potato and) vegetables were liked more than pasta and rice dishes, though plain boiled rice was relatively popular.
- Not surprisingly for their age, children's food recognition and taste preferences were sometimes suspect as they scored many foods that they would never have tasted with either sad or happy smileys.
- The quality of description of the instrument by teachers to children and instruction on how they had to fill it in had a major impact on the reliability of food preference scores, as "?" scores were higher in schools where Strength2Food coordinators emphasised the care with which they explained to children what they had to do.
- Children having school lunches led to a small (but often significant) improvement in their liking for foods, with fewer "?" smileys than children who had no school lunches.
- The frequency with which cooks served particular foods in school meals was highly significantly associated with children's food preferences (more frequently-served foods were liked more), though eating meals in school was not the cause of this. Instead, cooks tended to give foods that children in general liked more frequently in school meals.
- Children's food preferences were usually inversely related to the food's nutritional value – more happy smileys for lower nutritional value, such as potato chips and sausage rolls.
- The exception to this was fruit – the only food category which had high nutritional value and which was highly liked by children.
- Children's food preferences varied according to urban and rural regions, with urban children tending to like more vegetables and non-traditional foods than rural children.
- Food preferences varied very little between children in year 1 and in year 2 in terms of % scores for each smiley, though children in year 1 found the questionnaire more challenging to complete, as year 1 children failed to score many more foods than year 2 children.
- A vegetable garden in the school grounds used to give children hands-on experience of foods had a very positive impact on children's food preferences and eating habits. This is consistent with the finding of WP9.1.2 that children in schools with their own gardens liked more vegetables.
- Individual schools differed markedly in the relative proportions of foods given sad, happy and "?" smileys. Some of this variation was associated with the quality of the instructions given to children on how to carry out the food preference instrument. However, much of the school-to-school variation was not due to technical reasons, and this needs further investigation directly with those schools.

7.2.2 Parent's instrument

Overall picture

The parent's instrument was designed to test their knowledge of food, attitude towards food, practices towards food, and views towards their children's school meals. Only 29 schools got children's parents to complete questionnaires, divided between 21 target schools and 8 control schools either using a caterer or serving no food. The parent's instrument was completed by 3025 parents in those schools.



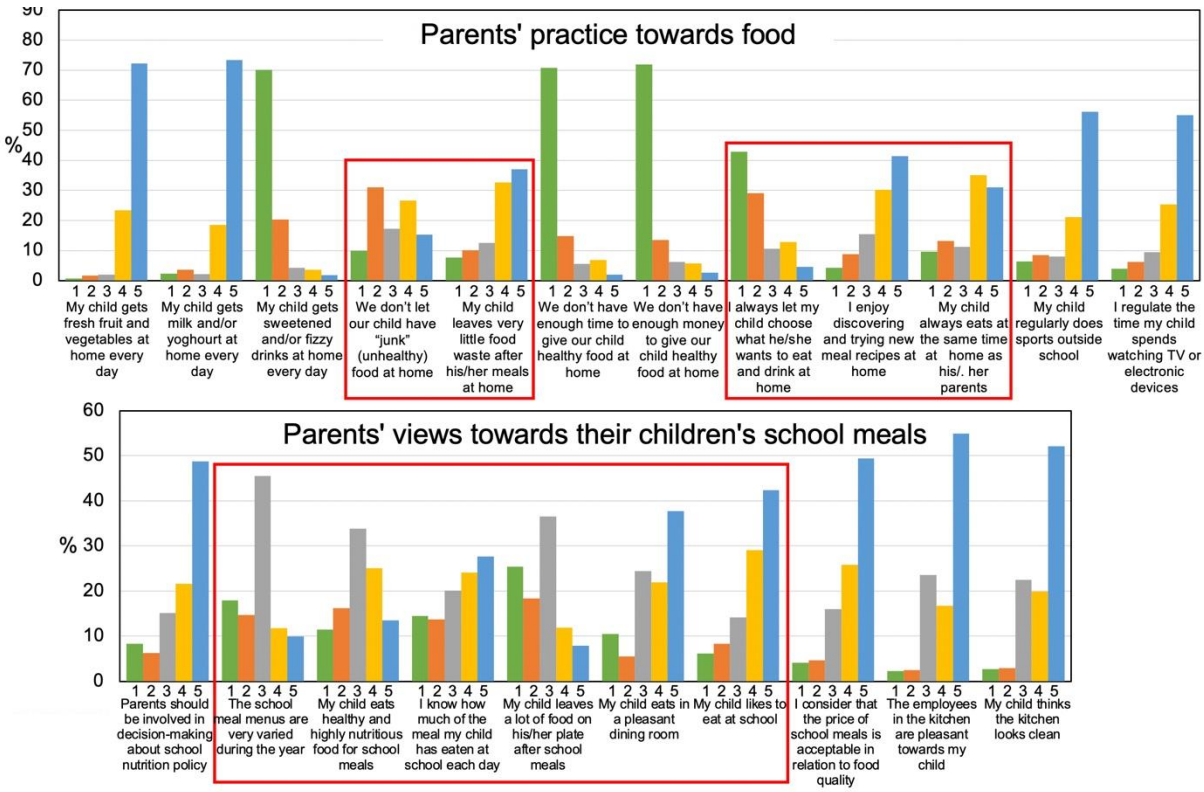


Figure 26. Mean parent assessment scores for their knowledge of food (top), their attitudes towards food (second), their practices towards food (third) and their views towards their children's school meals (bottom).

Of those, around 2015 parents completed the section of the instrument for parents with children have school lunches. Mean scores for each statement are in Figure 26, showing statements with particularly diverse scores in red boxes.

Several statements gave low discrimination, with over 80% of parents selecting the highest score for 5 statements. A further 10 statements gave between 70 and 80% selecting the highest score. However, 22 statements gave diverse responses, with the highest assessment score being selected by less than 60% of parents.

Specific findings for parents' food knowledge

The large majority of parents knew what a healthy diet for their children is (97.9% 'agree'); they were informed on health risks from an unhealthy diet (95.9% 'agree') and agreed that exercise is just as important as a healthy diet (98.7% 'agree'). Not all parents were aware that an unhealthy diet could lead to diabetes (86.7% 'agree') or obesity (91.9% 'agree').

Parents were less certain that their child's diet could affect his/her concentration at school (only 82.7% 'agree'), and 10.9% of parents did not disagree with the statement '7. Processed food (e.g. sausages, powdered potato) is just as nutritious as fresh food'.

Essentially all parents agreed (98.8% 'agree') that fresh fruit and vegetables were important for their child's health, though they agreed less about the health benefits of milk and/or yogurt (only 85.1% 'agree'). The large majority of parents disagreed with the statements that deep-fat frying and high salt contents were healthy ways to prepare food (only 6.5% and 10.0% did not disagree with statements for deep-fat frying and high salt, respectively), though many parents did not know where to get information on healthy cooking and eating - 21.2% did not agree with statement 12 'I know where to get advice and information on healthy cooking and eating'.

Statements with the most 'disagrees' were:
6. What my child eats can affect his/her concentration and learning at school (8.8% disagree)
9. It is important for my child to have plenty of milk and/or yogurt (8.5% disagree)
12. I know where to get advice and information on healthy cooking and eating (7.5% disagree)

Specific findings for parents' food attitude:
Parents' attitudes towards food showed much greater diversity in their responses than their knowledge. Only two statements had strongly agree scores of at least 70%:
13. Early childhood is the key to getting healthy eating habits (81.0% strongly agree)
18. It is important that children have a meal provided by the school every day (70.1% strongly agree)

Two statements gave strongly bimodal responses, with significant numbers of parents both agreeing and others clearly disagreeing:
20. It is pointless for children to learn about healthy eating if they cannot practice this at school (58.6% disagree, 31.8% agree)
21. It is pointless for children to learn about healthy eating if their parents do not practice this at home (54.3% disagree, 39.5% agree)
Evidently, for these statements, the majority of parents do not see the need to link theory with practice, as far as their children's food appreciation is concerned.

Over 20% of parents thought food should be selected according to what their children like to eat. Nearly 32% of parents thought that healthy food is too expensive. Perhaps these parents were thinking in terms of organic food, which is indeed much more expensive than conventional food in Serbia. Fewer than 10% of parents thought that healthy food is not tasty, and over 26% of parents admitted to not knowing best what is healthy for their children to eat.

It is encouraging to find that nearly 78% of parents thought their children should be given more advice at school on healthy eating, though over 9% thought this was unnecessary. A similar number of parents (74%) agreed that written advice for themselves would be useful. Interestingly, a large proportion of parents (70%) disagreed that the school should develop their child's healthy eating habits, presumably preferring to do this themselves at home. Nevertheless, the majority of parents (68%) were happy for the school to influence the foods that are sold to children (3.4% of our schools, around 30, at the time of the questionnaire either sold food within the school or at the school entrance).

Specific findings for parents' food practices:
Parents almost universally agreed with two statements:
25. My child is given fresh fruit and vegetables at home every day (95.7% strongly agree)
26. My child is given milk and/or yogurt at home every day (91.1% strongly agree)
Although this sounds impressive, the food diary results (see section 8.2) showed a different picture. It is likely to be only vegetables that children are given to eat almost every day, and many children reported eating fruit only once or twice a week. At least the large majority of children were not given sweetened and/or fizzy drinks at home every day (90.5% disagreed with the statement), which is encouraging.

Parents clearly differed in their attitude towards children having "junk" (unhealthy) food at home as the percentages agreeing and disagreeing with the statement on "junk" food were very similar (41.9% agreed, and 40.9% disagreed). Parents' assessments of the amount of food their children waste were also diverse, with 18% disagreeing that their children waste little food. Lack of time and lack of money were not major factors preventing their children from getting healthy food. Only 9% (time) and 8% (money) agreed these were problems.

A significant proportion of parents (nearly 18%) let their children choose what they want to eat and drink. A large proportion of parents (72%) enjoyed discovering and trying new meal recipes, and two thirds (66%) of parents agreed that their children ate meals at home at the same time as their parents. The final two statements were not food-related, but instead sought information on how active the parents' children were. Despite the large majority of parents agreeing with the statement that their children regularly did sports outside school, a sizeable minority (15%) of children are evidently not very active outside school. Most parents regulated to a greater or lesser extent the time their children spent watching TV or electronic devices, with 80% agreeing with statement 36 "I regulate the time my child spends watching TV or electronic devices".

Specific findings on parents' views towards their children's school meals:
It was clear that many parents were not familiar with what their children were given for school meals and how much of the meals their children ate, as the most popular assessment for three statements was 'can't decide' (a score of 3 in Figure 26):
38. The school meal menus are very varied during the year (45.6% 'can't decide')
39. My child eats healthy and highly nutritious food for school meals (33.9% 'can't decide')
41. My child leaves a lot of food on his/her plate after school meals (36.5% 'can't decide')
Almost a quarter of parents (24.4%) were not certain what the dining room was like at school - scores of 1, 2 or 3 for 'My child eats in a pleasant dining room'. Overall, parents were strongly in favour of being involved in decision-making about school nutrition policy (70.3% agree), but around half the parents did not know how much of the school meal their child had eaten each day - only 51.7% agreeing with statement 40 "I know how much of the meal my child has eaten at school each day".

It was evident that the majority of children liked to eat at school, as 71.5% of parents agreed with the statement. Parents were generally happy with the price charge for the school meals (75.3% agree) and only 8.7% disagreed with statement 4 "I consider that the price of school meals is acceptable in relation to food quality". Only 4.8% of parents disagreed with the statement "The employees in the kitchen are pleasant towards my child", though nearly a quarter was uncertain (23.6% 'can't decide'). Considering the lack of financial incentives to work in school kitchens, it would not be surprising for kitchen staff to work there because they like working with children, which would result in the high proportion of 'agree' assessments. Apart from 22.5% of parents who selected 'can't decide', the large majority of their children thought the kitchen looked clean (71.9% agree). Those disagreeing with the statement 'My child thinks the kitchen looks clean' amounted to only 5.6%, coming from 27 schools, 7 of which served either no food (!) or ready-made food from a caterer. Nevertheless, that still gave 83 parents who disagreed with the statement, implying that the kitchens in those 20 schools were not as clean as they could/should have been. No parents from the two schools implementing HACCP regulations gave any 'disagree' assessments.

Association of parents' views towards food with urban and rural schools:
Schools were grouped into large urban (7 schools), small urban (6 schools), large rural (8 schools) and small rural (5 schools) categories, amounting to 920, 678, 837 and 163 parents per category, respectively.

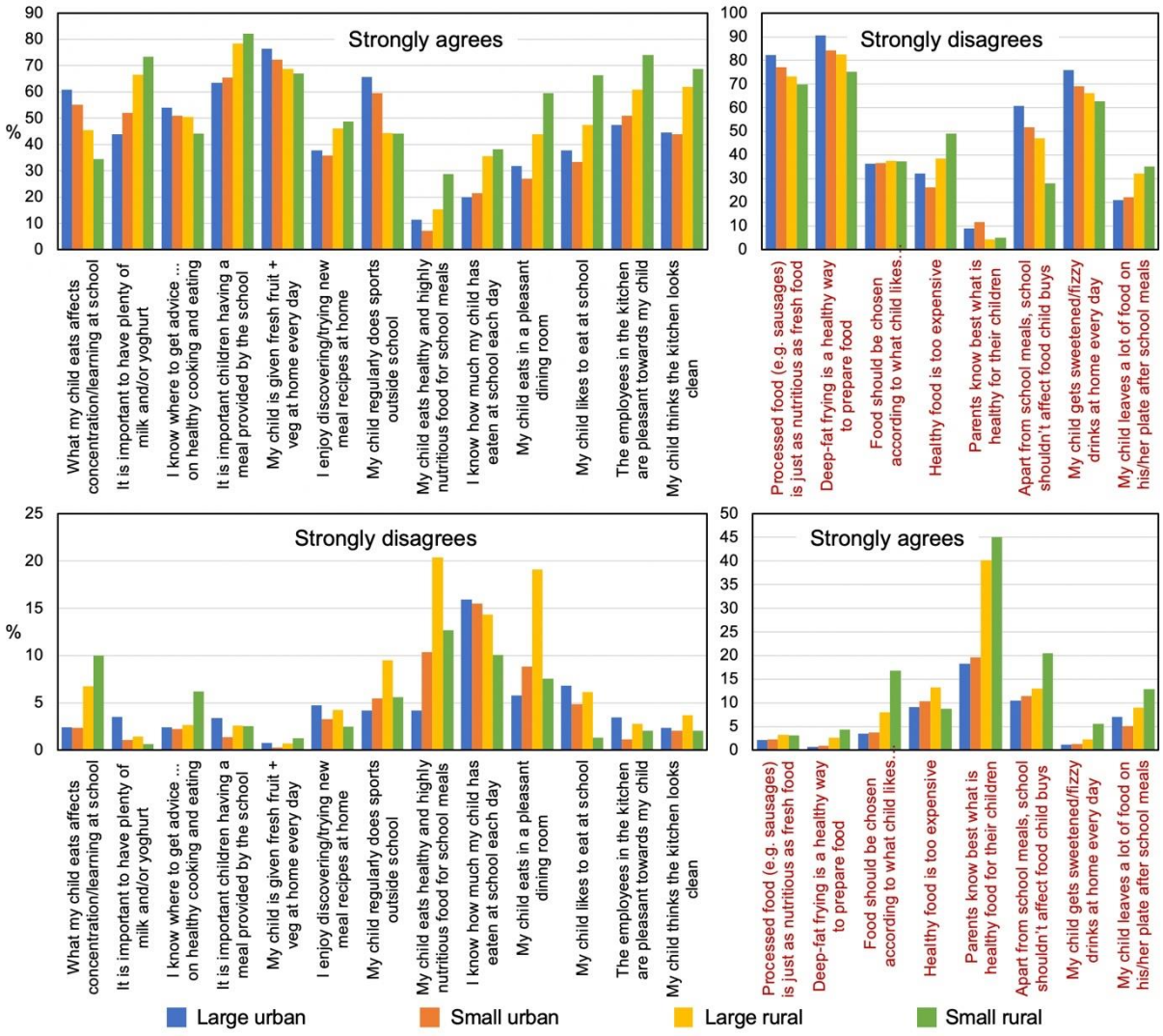


Figure 27. Statements showing clear differences in maximum and minimum assessments by parents according to urban-rural groups.

For the majority of parent questionnaire statements, assessment scores for the four groups of schools were very similar. However, several statements showed clear differences between urban and rural categories and frequently trends amongst the four groups (large urban to small rural) for the maximum assessment category - a score of either 5, strongly agree, or 1, strongly disagree, where the wording of the question favoured a low score to be preferred). For those statements, differences amongst parent assessments for the 4 categories of schools are shown in Figure 27, showing strongly agree and strongly disagree scores for 13 statements where 5 is the preferred/best score (statements in black), and 8 statements where 1 is the preferred/best score (statements in red).

Figure 27 shows that for many of these statements, scores for 'strongly disagree' are the inverse of scores for 'strongly agree' (compare upper and lower bar charts). Thus, a smaller proportion of parents from rural schools believed that what their child eats could affect his/her concentration/learning at school (lower 'strongly agree' and higher 'strongly disagree').

This trend of proportionally fewer 'strongly agree' scores and proportionally more 'strongly disagree' scores for rural schools was present for the following statements:

6. What my child eats affects concentration/learning at school

12. I know where to get advice and information on healthy cooking and eating
25. My child is given fresh fruit and vegetables at home every day
35. My child regularly does sports outside school
Evidently, parents of children in rural schools were less well informed on healthy cooking and eating. Perhaps surprisingly, rural parents gave their children less fruit and vegetables than urban parents, and their children don't exercise as much outside school as children of urban parents.

For statements where 'strongly disagree' was the preferred option, parents of rural schools strongly disagreed less than parents of urban schools for the following statements:
7. Processed food (e.g. sausages) is just as nutritious as fresh food
10. Deep-fat frying is a healthy way to prepare food
23. Apart from school meals, the school shouldn't influence what foods are sold to children (either at or around the school)
27. My child gets sweetened and/or fizzy drinks at home every day
Thus, compared with urban parents, rural parents did not regard processed food and deep-fat frying as unhealthy. Rural parents were not so concerned about children buying their own food in or at the entrance to schools, and more rural children were given sweetened and/or carbonated drinks by their parents.

Two statements in the category where 'strongly disagree' is preferred showed many more rural parents ***agreeing*** with the statements. These were:
14. Food should be selected according to what the children like to eat
16. Parents know best what is healthy for their children
Thus, many more rural than urban parents agreed that they should give children what they like to eat and, especially, that twice as many rural parents than urban parents know best what is healthy food for their children.

In contrast, rural parents gave higher assessment scores than urban parents for 11 statements:
9. It is important for my child to have plenty of milk and/or yogurt
18. It is important that children have a meal provided by the school every day
33. I enjoy discovering and trying new meal recipes at home
39. My child eats healthy and highly nutritious food for school meals
40. I know how much of the meal my child has eaten at school each day
42. My child eats in a pleasant dining room
43. My child likes to eat at school
45. The employees in the kitchen are pleasant towards my child
46. My child thinks the kitchen looks clean,
together with two statements in the category where 'strongly disagree' is preferred:
15. Healthy food is too expensive
41. My child leaves a lot of food on his/her plate after school meals
So, compared with urban parents, more rural parents wanted their children to have milk or yogurt each day, and more of them wanted the school to give their children a meal each day. More rural parents enjoyed trying new meal recipes, and rural parents generally knew more than urban parents about the meals their children ate in school. Thus, more rural parents thought school meals were healthy, more of them knew how much of the school meals their children had eaten, their children ate in more pleasant dining rooms and more rural parents had children who enjoyed eating in school, perhaps because rural kitchen staff were more pleasant towards their children. In consequence, rural children tended to leave less plate waste after school meals than urban children. In addition, more rural parents said their children thought the school

kitchen looked clean. However, more rural than urban parents thought that healthy food was too expensive.

Other questions on the parents' questionnaire
Questions at the end of the parents' questionnaire provided an insight into children's eating habits at home and at school. Just over half of children (53%) either had no breakfast or breakfast only sometimes before going to school. While many of those children would be having breakfast at school, it is quite likely that many would not. Some 7-8-year-olds may buy breakfast on the way to school. For those schools providing only breakfast (around 9 am), 10% of children ate breakfast at home every day before coming to school.

Of children whose parents completed the questionnaire, around 56% had school lunch. The remainder either brought a lunch from home (18%), or bought it outside school (12%) or waited until getting home to have it after school (14%). Those that bought their lunches outside school were given around 118 dinars on average by their parents (a range from 50 to 500 dinars). As might be expected, parents from urban communities gave their children more than those in rural communities: urban large (Belgrade) - 150 din/day, urban small (Novi Sad) - 109 din/day, rural large - 111 din/day, rural small - 95 din/day. The most popular lunches bought by children (from visual evidence) would be slices of pizza, hamburgers or various meat or cheese pies from fast food outlets, sometimes located at school entrances!

The cost of meals was rarely given as a reason for children not having school lunches (only 2.3% of answers), though over a quarter of children (27.1%) did not have school lunches because they didn't like them. A further 15.4% did not have school lunches because they preferred to play with their friends, and 23.4% of children were given lunch to take to school by their parents. An additional 22.6% of children preferred to go home for lunch after school.

7.2.3 Association of parents' views with their children's food preferences

A major objective for the two monitoring instruments was to examine the relationship between children's food preferences and their parents' practices regarding food and views on their children's school meals. This would allow us to answer the research question "to what extent could children's food preferences be explained by their parents' food practices?" Amongst the 33 schools completing the monitoring questionnaires, 26 schools had answers that could be matched for the same child from both children's and parents' questionnaires, giving 1970 children/parents in total, though only 25 of these had sufficient answers to be statistically useful (at least 5 per school). Of those 1970 children/parents, on average 1946 of those parents completed each of the 12 statements on food practices, and 1441 of the parents completed each of the 10 statements on views on their children's school meals.

These combined datasets were analysed in two ways. The first was to use parent scores of 1-5 (strongly disagree - strongly agree) and children scores of 0-2 (dislike food - like food) to look at simple correlations between parent statement scores and children's preference scores for various food categories and individual foods. In particular, we wanted to identify those practices of parents and schools that were associated with children liking more foods.

As well as considering the full dataset of 1995 children also having their parents' assessments, these data were also divided into two types of sub-categories. One sub-category was children separated according to those in year 1 (1029 children/parents) and those in year 2 (947 children/parents), to test whether the parents' influence on their children depended on the child's age. The second sub-category was based on the school's municipality % poverty, with 13

schools being classed as low poverty areas (5%-15% poverty municipalities, corresponding to schools in Belgrade and Zemun, large urban, and Novi Sad, small urban), and 11 schools being classed as high poverty areas (25-48% poverty, corresponding to schools in the Valjevo, Arilje and Ivanijica regions, large rural and small rural). One school was excluded from this sub-category, being peri-urban to Belgrade and having a 20% poverty rate.

The second type of analyses was to associate results from both questionnaires with a wide array of internal school factors and external factors. For these analyses, we used three-level regression modelling with random intercepts. Principal Component Analysis was used to reduce related internal and external variables to the best individual variable (factor). In the final model, the internal school factors included were the total number of pupils in the school and the proportion of in-service training points/teacher. A third internal factor, number of children taking domestic science, included in an earlier model, was excluded from the final model.

External factors included in the final model were log settlement population, percentage of people receiving social welfare (a measure of poverty), and percentage of people with secondary education and above. Additional factors from the monitoring instruments that were included in the multilevel regression models were gender (male, female), school year (1 or 2) and having a school lunch or not. Dependent variables for the models were the number of 'like' scores for all foods, and number of 'like' scores for the 30 vegetables and fruit combined.

Association of parents' practices towards food with their children's food preferences:
Associations (as correlation coefficients) for parent scores for individual statements were tested against their children's mean scores for 68 individual foods, and % 'like' scores for a range of food categories and total number and % of "?" smileys, totalling 96 measures of food preference, as shown in Table 3. Most individual foods are given low nutritional scores (typically potatoes and flour-based foods) and foods that children should not have tasted were excluded from these analyses.

Results are summarised according to the number (expressed as percentage) of significant (P<0.05) correlations amongst the 96 individual food and food category combinations for all parents/children and also for the four year and poverty subcategories (Figure 28). Although, with so many comparisons, Type 1 errors cannot be excluded, the overall picture shows parents' scores for several food practices to be clearly associated with their children's food preferences.

Food category mean scores	Food category scores as % total
All 90 foods	Vegetables %2s
Vegetables	Fruit %2s
Fruit	Vegetables+fruit %2s
Vegetables+fruit	Vegetables+fruit %"?"s
Sweetcorn+pickled vegetables	Pasta+rice %2s
Pasta dishes	Main courses+meats %2s
Rice dishes	All milks+yogurts %2s
Pasta+rice	Total % "?"s and total number of "?"s
Main courses	
Meats	
Main courses+meats	
White fish	
Soups	

Milk+yogurt	
Sweet dairy	
Potatoes	
Flour-based foods	
Sweet dishes	
Never-tasted foods	

Table 3. Food categories and scores for testing association of parents' practices towards food with their children's food preferences.

The frequency of significant correlations also showed internal consistency. Thus, statement 29 "My child leaves very little food waste after his/her meals at home" was highly significantly correlated with statements 41 "My child leaves a lot of food on his/her plate after school meals" (negative, $P<0.001$) and 43 "My child likes to eat at school" (positive, $P<0.001$). Further, the two parent statements 25 "My child is given fresh fruit and vegetables at home every day" and 26 "My child is given milk and/or yogurt at home every day" had many significant correlations between parents' scores and their children's scores for those foods: 60% and 86% of correlations for the 38 vegetable+fruit foods and the 7 milks+yogurts foods, respectively (see Figure 28).

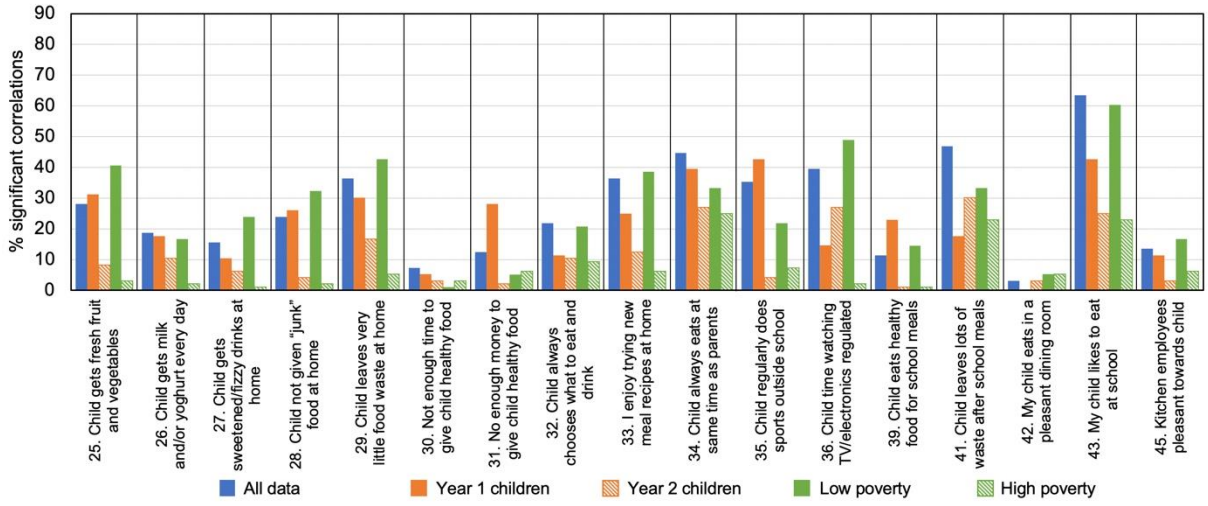


Figure 28. Percentage of correlations significant at $P<0.05$ between parent statement scores for their food practices and views on their child's school meals and child preference scores for a collection of 96 individual foods (68) and food categories (28).

As might be expected, the parent statement giving the highest number of significant correlations with children's food preferences was 43 "My child likes to eat at school", completed by only those parents whose child had a school lunch (or breakfast if no lunch). Children who enjoyed eating at school the most also liked the most foods (64% correlations significant for 96 foods). Also, children who left a lot of food waste after school meals (statement 41) were significantly *negatively* correlated with their food preference scores for nearly half the foods (47%).

The parent practice statement to be most strongly associated with children's food preference scores was 34 "My child always eats at the same time at home as his/her parents" (45% correlations significant). Other parent statements having many significant correlations with food preference scores were 36 "I regulate the time my child spends watching TV or electronic devices" (40% correlations significant), 33 "I enjoy discovering and trying new meal recipes at home" (37% correlations significant) and 35 "My child regularly does sports outside school" (35% correlations significant). Giving children fresh fruit and vegetables every day at home (statement 25) also influenced children's food preference scores for total foods (28% correlations significant), though almost all of these foods were only fruit and/or vegetables.

Variation in parent scores for some parent statements clearly had no influence on their children's food preferences, such as 30 "We don't have enough time to give our child healthy food at home", and 42 "My child eats in a pleasant dining room" (only 7% and 3% correlations significant, respectively). So, the school canteen eating environment had no effect on whether children liked foods or not. The attitude of kitchen staff towards children also seemed to have little effect on whether children liked foods or not (14% correlations significant).

Regarding the school year subcategories, for most parent statements, the parents' influence on their children was much greater for the younger children (year 1) than year 2 children (Figures 28, 29). This was particularly evident for statement 35, where the amount of sport/physical activity of year 2 children outside school had essentially no effect on their food preferences. Regulating children's time watching TV and/or electronic devices had more effect on year 2 children, maybe because the older children would otherwise have wanted to spend more time watching TV or playing computer games. Parents also reported that their year 2 children created more school meal plate waste than their year 1 children (statement 41), especially for vegetables and fruit (Figure 29). This could reflect children's evolving food preferences, which would also explain the lower percentage of year 2 compared with year 1 correlations for statement 43 with the 96 food/category combinations (Figure 28).

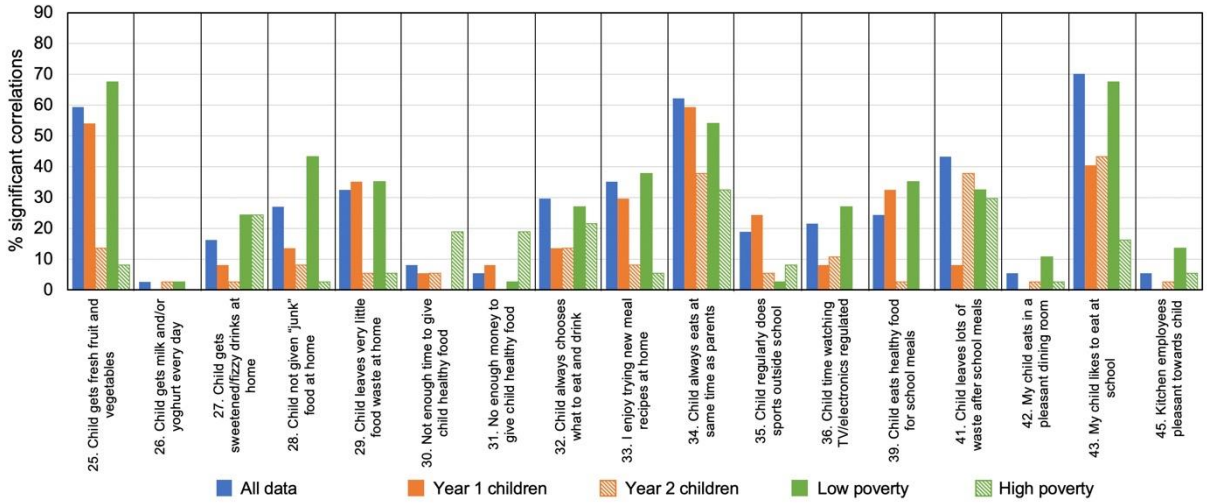


Figure 29. Percentage of correlations significant at $P<0.05$ amongst parent statement scores for their food practices and views on their child's school meals and child preference scores for a range of vegetables and fruit food categories (38 items). Other details as for Figure 28.

Parents and children in low poverty (urban) areas also differed markedly from parents and their children in high poverty (rural) areas in the extent to which parents could influence their child's food preferences. Variation in parental statement scores consistently had much less effect on children's food preferences in higher poverty, rural areas. Conversely, parents in low poverty areas (urban) could have considerable influence on their children's food preferences. These differences between low and high poverty areas were particularly large for statements 25-29 and 33, 35 and 36. Only statement 34 ("My child always eats at the same time at home as his/her parents") gave similar numbers of significant correlations for both low and high poverty subcategories. *Thus, our findings show that the only way parents of children in high poverty areas are likely to have success in increasing the number of foods liked by their children is to encourage them to eat meals at home with their parents.*

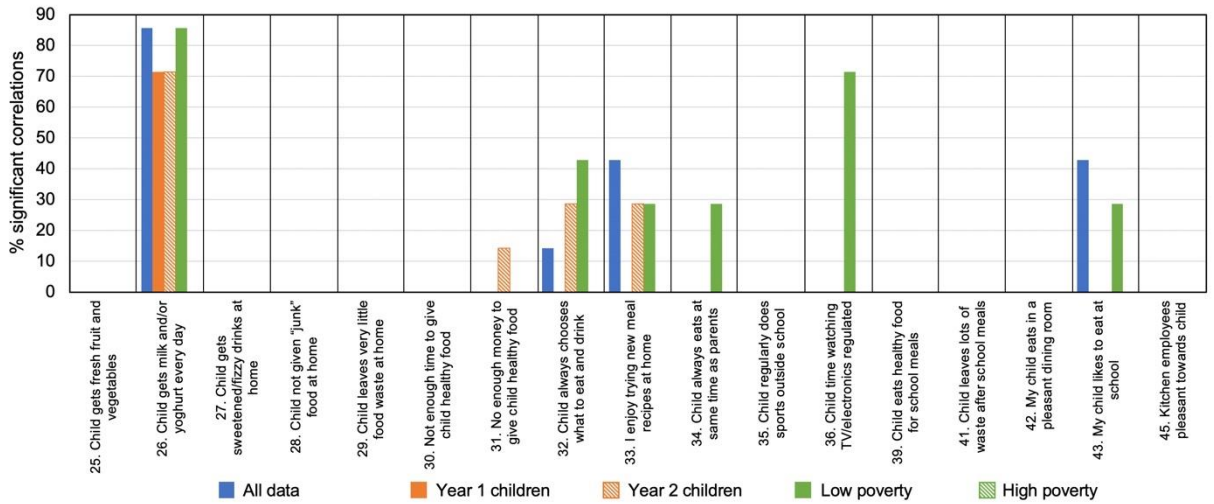


Figure 30. Percentage of correlations significant at $P<0.05$ amongst parent statement scores for their food practices and views on their child's school meals and child preference scores for a range of milk and yogurts (7 items). Other details as for Figure 28.

In addition to total foods (96 items), parents' attitudes towards foods were also studied in relation to children preferences for each of the following groups of foods: fruit and vegetables (37 foods/categories, results shown in Figure 29), milk and yogurts (7 foods/categories, results shown in Figure 30), main courses and meats (18 foods/categories, results shown in Figure 31) and pasta and rice dishes (16 foods/categories, results shown in Figure 32). Children's likings for fruits and vegetables were strongly influenced by two parent statements: 25 "My child is given fresh fruit and vegetables at home every day" and 34 "My child always eats at the same time at home as his/her parents" (60% and 62% correlations significant, respectively). These effects were much stronger for children in year 1 and those in low poverty areas. Thus, giving children plenty of fruit and vegetables was clearly associated with children in general liking more fruits and vegetables. Getting children to eat meals at the same time as their parents may have allowed parents to encourage children to eat more of their fruits and vegetables. Children who liked to eat school lunches (statement 43) also had many more significant correlations for fruit and vegetable items (70% correlations significant), especially for children in low poverty areas. Giving fruit and vegetables to children each day (statement 25) also reduced the number of "?" smiley scores by children in low poverty areas and in year 2, so they had evidently also experienced more types of fruit and vegetable.

Statement 26 asked parents to assess how frequently they gave milk and/or yogurt to their children. Those that strongly agreed with the statement evidently influenced their children to like milk and yogurt more (Figure 30). However, this effect was completely absent from parents and children living in high poverty municipalities. This was probably a combination of fewer parents in high poverty areas disagreeing with statement 26 (3.6%) compared with parents in low poverty areas (6.5%), and around 5% more children in high poverty areas giving 'like' smileys. Few other parent statements were associated with children's preferences for milk and yogurt. Statements 32 ("I always let my child choose what he/she wants to eat and drink at home"), 33 ("I enjoy discovering and trying new meal recipes at home") and 36 ("I regulate the time my child spends watching TV or electronic devices") were associated with children's preferences for milk and yogurt for some subcategories. For statement 32, parents who did *not* let their children eat what they wanted at home had children who liked more milk and yogurt. It is not obvious why parents in low poverty areas who regulated their child's time watching TV or playing on electronic devices should have influenced their children to like more milk and

yogurts, as parents who agreed with statement 36, generally only weakly agreed with statement 26!

A relatively large number of food items in the children's questionnaire were either main courses, meats used in main courses and main courses not containing meat. These could be broadly categorised as typically Serbian dishes, and typically non-Serbian dishes, such as pasta and rice dishes. Results for these Serbian and non-Serbian dishes are presented separately here. As with fruit and vegetables, children's likings for many typically Serbian dishes (Figure 31) were associated with their parents' food practices, with correlations significant for over 40% of the 18 foods.

For parents who agreed that their children liked to eat lunches in school (statement 42), their children liked most main courses and meats - 78% correlations significant. Conversely, children who left a lot of plate waste (statement 41) liked fewer main courses and meats (72% correlations significantly negative). A similar high percentage of significant positive correlations (67%) was present for statement 29 ("My child leaves very little food waste after his/her meals at home"). Statements 26, 34, 35 and 36 also had over 40% of correlations with main courses and meats significant. As with other food categories, sub-category associations with main courses and meats were very diverse, with parents of year one children and in low poverty areas generally having much more influence on their children's likings for main courses and meats than parents with year two children in high poverty areas.

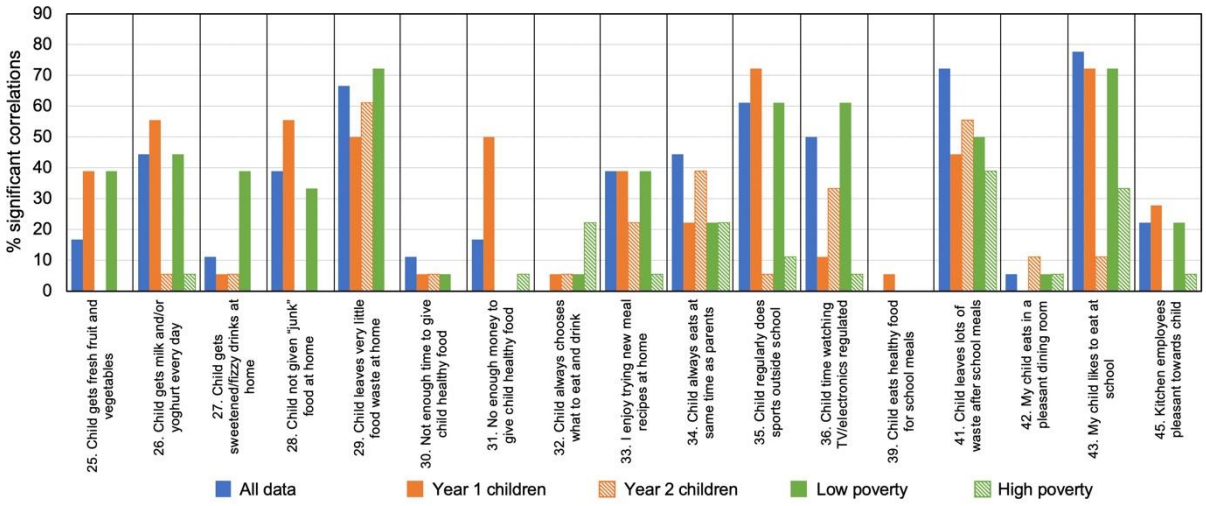


Figure 31. Percentage of correlations significant at $P<0.05$ amongst parent statement scores for their food practices and views on their child's school meals and child preference scores for a range of main courses (containing meat) and various meats alone (18 items). Other details as for Figure 28.

A generally similar picture was found for associations between parent statement scores and their children's food preference scores for typically non-Serbian pasta and rice dishes (Figure 32), except that numbers of significant food correlations tended to be lower for each statement. Again, the statement with the highest percentage of significant correlations was 43 "My child likes to eat at school", with 75% correlations significant. The converse statement (41 "My child leaves a lot of food on his/her plate after school meals" gave only 50% significant correlations, all negative. Across all parents/children, only two other statements had significant correlations exceeding 40%: 35 "My child regularly does sports outside school" and 36 "I regulate the time my child spends watching TV or electronic devices", which had 50% and 63% significant correlations, respectively.

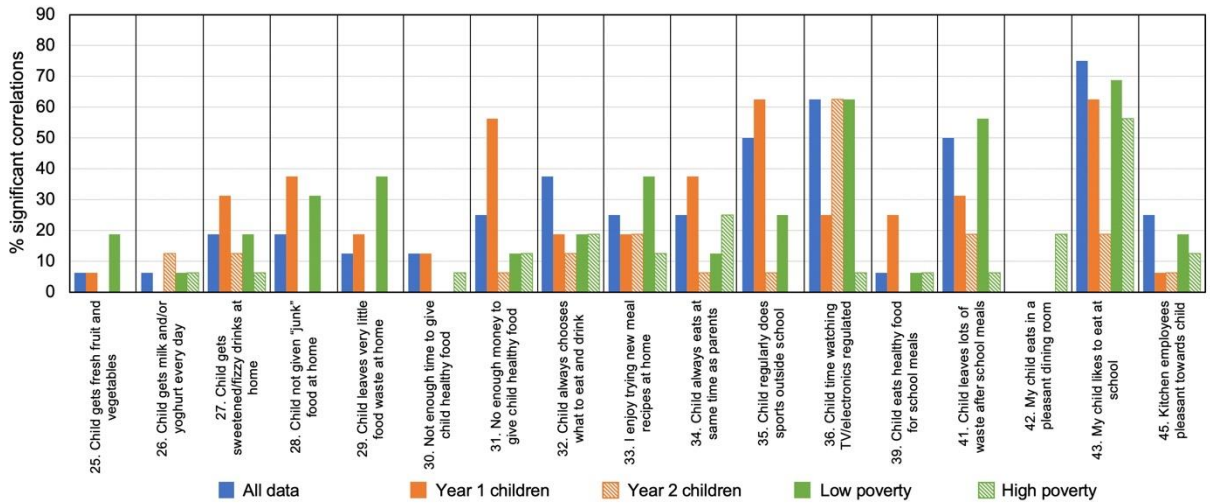


Figure 32. Percentage of correlations significant at $P<0.05$ amongst parent statement scores for their food practices and views on their child's school meals and child preference scores for a range of typically non-Serbian pasta and rice dishes (16 items). Other details as for Figure 28.

For these non-Serbian foods, parents with year 1 children sometimes had much more impact on their children's likings for pasta and rice dishes than parents with year 2 children, who struggled with nearly all food practice statements to have an impact on their children's liking for non-Serbian dishes. The only parent statement to have more impact on year 2 children than year 1 children was 36 "I regulate the time my child spends watching TV or electronic devices" (63% correlations significant). Year 1 children of parents who stated they had not enough money to give their children a healthy diet also liked many fewer pasta and rice dishes (56% correlations significantly negative) compared with parents with year 2 children, where an association was essentially absent.

Association of parents' practices towards food with children's food preferences and other factors

Further analyses using multi-level regression are still in progress, so only preliminary results are summarised here. Initial results showed that the variables settlement size (log population), % population receiving social welfare (a measure of municipality poverty), and % population completing secondary education from the municipality level, and school size from the school level were significantly associated with children's total food, and vegetable and fruit preferences.

At the school level, the number of pupils enrolled in the school was negatively associated with both total food, and vegetables and fruit preferences, so children in larger schools tended to like those foods less than children in smaller schools. However, this finding was not confirmed by a simple correlation of the school mean for all schools completing the children's questionnaire (32 schools) and all children (not just those with corresponding parent data). Using all children who completed the children's questionnaire, correlations of mean scores for all foods and just vegetables and fruits with school size were not significant. When all children scores were considered, school size was, however, significantly positively associated with children's food preferences for pasta and rice dishes. Children in large schools liked more pasta and rice dishes. Large schools would tend to be in the large towns and cities, where families and schools would probably give a more cosmopolitan diet, including more non-Serbian dishes.

At the children/parents level using the multi-level regression model, having a school lunch was positively associated with the range of foods, and vegetables and fruits liked (Tiwasing et al., 2020). *Thus, receiving school meals increases the number of foods liked by children, including*

vegetables and fruit, so having a school lunch would make a positive contribution to more balanced diets, not only within the school but also spilling over into wider food preferences generally. This is an important finding.

Considering parents' practices, only two of the 10 parent practice statements tested in the present version of the model gave significant associations with all foods and/or vegetables and fruit. Thus, statement 25, providing fresh fruit and vegetables at home every day, had a significant positive association with vegetable and fruit preferences, but not with total food preferences. The other statement significantly associated with children's food preferences was statement 33 (I enjoy discovering and trying new meal recipes at home). Thus, parents who enjoy discovering and trying new meal recipes at home pass on to their children a liking for a wider range of foods. These findings using the more rigorous statistical modelling approach confirmed some key associations between parents' food practices and their children's food preferences using simple correlation analysis, though the multi-level analyses are continuing.

7.3 Conclusions from the monitoring instruments

Children's food preferences were diverse, being determined not just by the individual child, but by the type of school, particularly its size, as well as its location, in large urban settings or in rural communities, as well as factors associated with the poverty level of the municipality. Furthermore, it was clear that the children's parents' food practices had a significant influence on the types and diversity of foods that children had tasted and liked. Nevertheless, the parent's level of impact on his/her child's eating habits was also governed by internal factors (the child's age) as well as external factors (poverty level, community size). In consequence, it is difficult to identify aspects of parents' food practices that would be universally applicable for children of all ages and socio-economic environments. Correlation analysis identified statement 34 to be the only aspect of parents' food practices likely to have a positive impact on their children's eating habits across a range of children's ages and socio-economic environments: "My child always eats at the same time at home as his/her parents".

The multilevel modelling demonstrated that eating school lunches had a significant positive effect not only on children's preferences for vegetables and fruit, but for all foods in general. Nevertheless, this benefit of eating school lunches was not associated with either the ambience of the school dining room or the attitude of kitchen staff towards children during school meals, though there was evidence that encouragement from the kitchen staff may have improved children's liking for a small number of individual foods, such as cucumber and fish.

The results from these extensive children's and parents' monitoring instruments provided an excellent foundation upon which to measure the impact of subsequent Strength2Food activities with those schools (target schools). However, although the two monitoring instruments were completed by schools at the beginning of the 2018-2019 school year, determining project impact since then has been made more complicated by the introduction at the beginning of the same school year of new Ministry of Education (MPNTR) regulations (MPNTR, 2018) requiring schools to adopt a range of practices to ensure the provision of nutritionally balanced and microbiologically safe meals for their children. *Importantly, Strength2Food personnel in Serbia provided input during 2017-2018 into the development of these regulations.* In consequence, many (though not all) of our target schools changed aspects of their meal provision in autumn 2018 following the introduction of these new regulations.

8. NORMATIVES AND FOOD DIARIES - ESTABLISHING WHAT CHILDREN ACTUALLY EAT

Although anecdotal information at the start of the project indicated that the quality of school meals in general was low, for the plate waste study of WP6.2 we needed to quantify ingredients for school lunches so that ZAG could assess the nutritional composition of what children were eating for school lunches. However, any improvements the project could make in the nutritional content of school lunches needed to be put within the context of what children were eating during the rest of the day, as school lunches would be contributing only around 30% of the daily calorie intact for children.

Therefore, two activities were carried out with schools to collect as much detailed information as possible on what children ate, firstly for school lunches (meal normatives), needed for WP6.2, and secondly to record what children ate throughout a typical day (food diaries).

8.1 Normatives (recipes) and menus for school meals

Each of our target schools was asked to provide their meal normatives (recipes). For most schools this was relatively straightforward to obtain (19 of 29 schools). However, for some schools this proved an impossible request, particularly for village schools where the school chef kept the meal recipes in his/her mind, didn't use email and didn't have time to write the information down for us. So, for a few schools, the only information we could obtain on what children ate for their school meals was the menu given to parents each week, which usually gave little useful information on ingredients and quantities (for example, "meatballs, salad, fruit" for lunch).

Meal normatives showed no consistency from one school to the next. Some schools had meal normatives in a one-week cycle, so the menus for the five days were repeated week after week. Some schools had only one weekly set of menus which were shuffled around from one week to the next. Some schools had a two-week cycle of menus which repeated every two weeks. Some schools had a three-week cycle of menus, and other schools a four-week cycle of menus. Some schools had separate sets of menus for the winter and summer seasons, and other schools had menu cycles that changed three times a year. Most meal normatives were based on the quantities of ingredients that went into each dish, but some schools used normatives for the quantities that were *served to children*, making quantities of ingredients difficult to identify for some dishes, liked mashed potato. Thus, there was extensive diversity in the frequency, as well as the composition of particular meal recipes being served to children.

Even for those schools that gave us their normatives, it soon became clear by looking at weekly menus that meals were frequently being served to children for which there was no normative, and many dishes for which we had normatives were never served to children. It seemed that most schools used meal normatives only as a reference document to be passed down from one generation of cooks to the next, to be available for school inspectors if anyone wanted to know what went into the school meals! The reality was that the large majority of school cooks were familiar with the quantities of each ingredient needed, and were happy to swap ingredients around every so often for a bit of variety. This did not make it easy to assess the nutritional intake of children from school meals.

Nevertheless, the plate waste study of WP6.2 provided some quantitative data on ingredients for two weeks of lunches in four of our Belgrade schools. For other schools, nutritional contents

of lunches were assessed from school normatives. These showed considerable variation in energy content (kcal) both amongst schools and also from day to day (Figure 33). Some schools achieved weekly energy contents for lunch very close to the recommended quantity (Dositej Obradović, Belgrade; Stevan Čolović, Arilje; Sveti Sava, Bajina Bašta, and Miloš Crnjanski, Novi Sad), though other schools gave both daily and weekly energy contents below the recommended quantity (Drinka Pavlovič, Belgrade and Jovan Cvijić, Loznica), which would have meant even lower energy intakes by the children allowing for plate waste (typically around 25% per lunch, WP6.2). In contrast, several schools gave weekly lunch kcal contents consistently greater than the recommended quantity, such as Pavle Savić and Kralj Petar I in Belgrade and Kosta Trifković and Petefi Šandor in Novi Sad. As plate waste results of WP6.2 for Pavle Savić showed about 25% plate waste, the actual energy intake from lunches by children should have been close to the recommended amount.

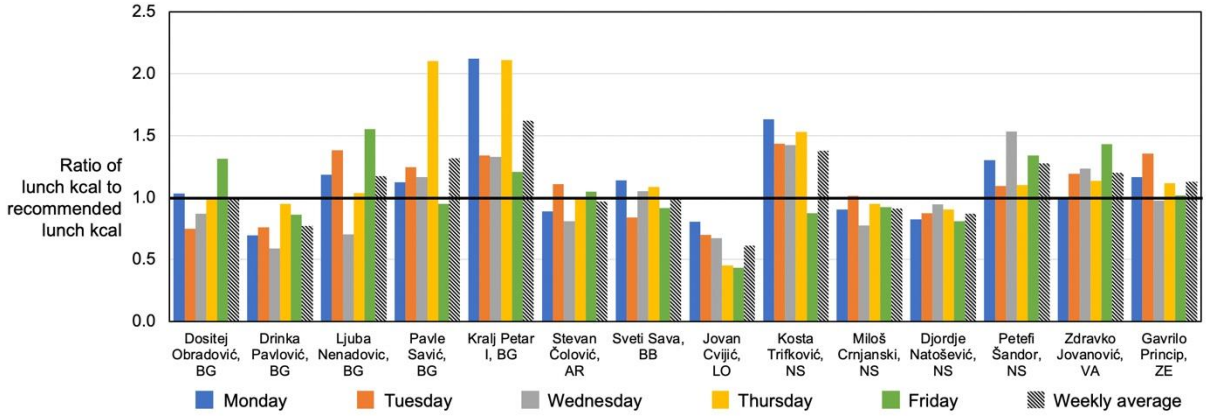


Figure 33. Lunch kcal for 14 target schools, expressed as ratio of kcal for lunch recommended by IPH, Vojvodina.

Another source of information on the nutritional content of children's school meals came from several schools in Novi Sad which had nutritional analyses carried out around three times per year by the Institute of Public Health (IPH), Vojvodina. For several of these analyses it was possible to compare the school's normative quantities for a meal with the quantities recorded by IPH (Figure 34).

These analyses of ingredient quantities by IPH, Vojvodina showed three main features:
- many meals given to children did not have a corresponding normative (no orange bars in Figure 34);
- actual meal kcal served and normative kcal were often very different (compare blue and orange bars for a particular meal number);
- many meals did not have the kcal recommended for the meal by IPH, Vojvodina (indicated by the heavy black line at 1.0 in Figure 34).

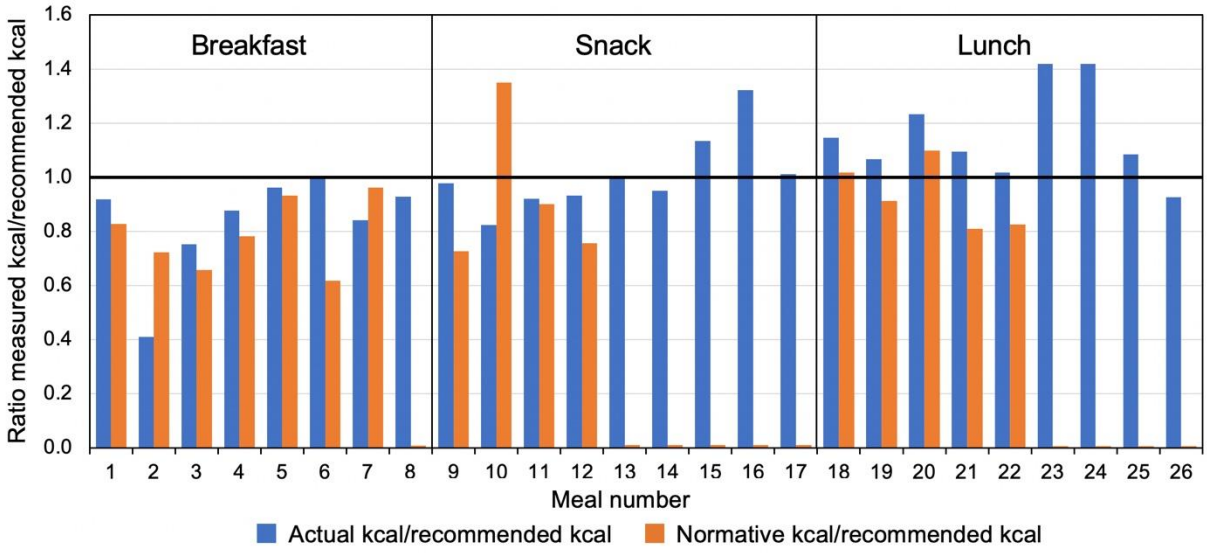


Figure 34. Actual (IPH) and normative meal total energy (kcal) as ratios of the recommended kcal. Data for four primary schools in Novi Sad.

These analyses would not take account of any plate waste for the meal. So, for those breakfasts in particular, many children would not be taking in the energy needed to get them through the school day. Normatives for some schools also showed deficiency in kcal intake for some meals, compared with recommended kcal intakes.

8.2 Food diaries for a week

A key target of the school meals scheme was to improve meals mainly through improving the uptake of vegetables and fruit, which were served sometimes for breakfasts but mainly for lunches, and WP6 focused only on school lunches. Therefore, despite the information from schools on meal normatives and menus, we had little information on what children ate outside school, which would be the majority food intake for the majority of children.

So, schools were requested to ask up to 50 children in year 2 (8-year-olds) to complete a simple food diary for one week, if necessary with the help of their parents. The diary template was designed to fit onto a single sheet of paper, with children asked to start the diary on Monday morning writing down every separate food item and drink that they had during a seven-day period from Monday morning until Monday morning the following week. For foods that could easily be quantified, children were asked to write down the number they were given to eat, such as 1 sausage, 3 fish fingers, 2 slices of toast, etc.

The instructions asked children to start recording each meal/snack by writing the approximate time, followed by the meal (breakfast, snack, lunch, supper, etc.), then the food item(s), giving as much detail as possible of each food item. Teachers were asked to emphasise to children how important it was that they should include every food or meal that they ate during the day. After each food item had been written down, children were asked to draw two circles to fit on the line immediately next to the food they had written. In one of them they were asked to make a “smiley”, either happy or sad, depending on whether they enjoyed eating the food or not. In the other circle, children were asked to colour in part of the second circle to indicate how much of

the food they ate: only a little, half of it, most or all of it. Two schools were asked to complete food diaries as a pilot to use their results to adjust instructions before the remaining schools were contacted. Full instructions for completing the food diary are given in Appendix 7.

In total, 419 children completed food diaries in 14 schools, representing the diversity of schools in the project - urban, rural, large, small, using cooks, using caterers. It was clear that many children found the exercise a struggle, returning completed diaries without times for foods, details of meal ingredients, or "smileys" or quantities of food eaten. In contrast, some children mastered everything required of them, even adding occasional extra comments. Much of the variation in frequency with which children recorded foods in each food category was due to the thoroughness with which children listed all foods in their weekly diary. For example, 33 children listed up to no more than 4 foods per day, and 24 children listed at least 12 foods per day. However, the proportions of children being thorough in recording every food were similar amongst the schools, so items per food category at the level of the school were not adjusted to take account of the total number of food items recorded per child.

Foods were categorised according to food categories similar to those used for procurement documents, and results for the major food categories are shown for each day of the week in Figure 35. Thus, flour-based processed foods, such as bread, pastries and pancakes, were typically recorded by a child once or twice each day. This was the most numerous category of foods recorded each day. The next most frequent category was meats, mentioned on average just over once per day. Vegetables (apart from potatoes) were mentioned only 6 days per week, and fruit only every second day on average. On the basis of numbers of entries normalised to the percentage of all foods recorded by the child for the week, averaged across the 14 schools, 11.4% of entries per child were vegetables, and only 1 in 16 entries per day (6.3%) were fruit. Potatoes were being eaten on around two days per week.

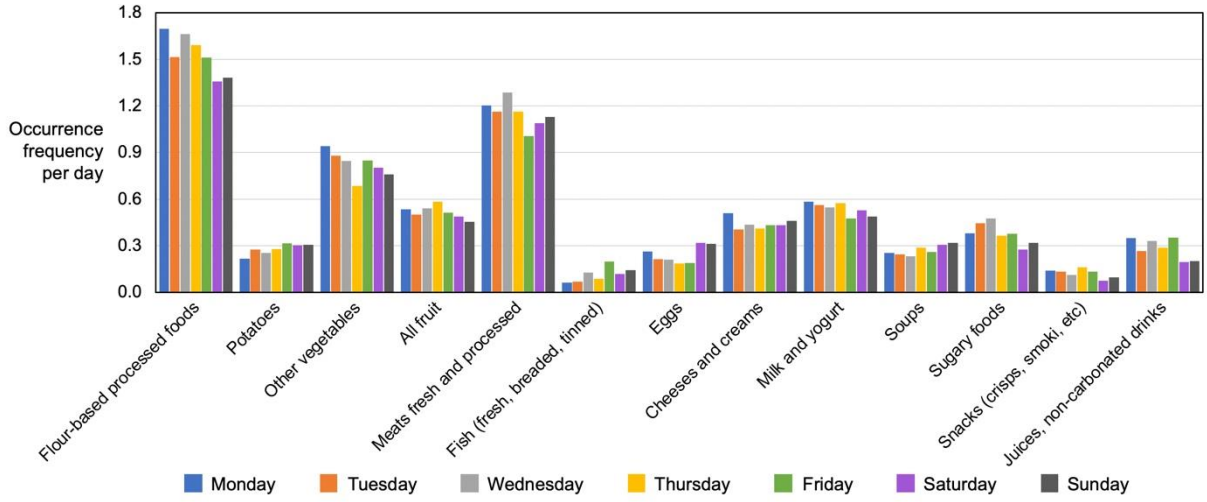


Figure 35. Frequency per day for major food categories recorded by children in their food diaries.

It was obvious that not all drinks were recorded by the majority of children, as the total of all drinks recorded (including water) was just under one entry per day. Milk and yogurt were the most frequently recorded drinks, being mentioned every second day on average, and even water was recorded only just over once a week. Interestingly, juices and other non-carbonated drinks were recorded more frequently during the week than at weekends. The opposite was true for eggs, which were more frequently recorded at weekends.

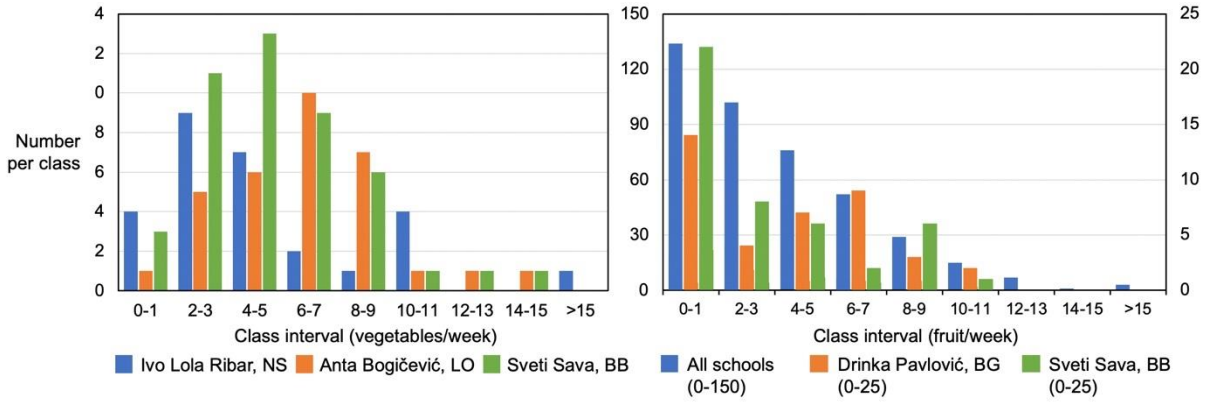


Figure 36. Frequency distributions for children's food diary entries for vegetables/week (left) and fruit/week (right) for 419 children.

Frequency distributions for vegetables per week for each child showed a widespread amongst children, with a range from 0 vegetables at all during the week (6 children) to at least 2 vegetables per ***day*** (12 children), with a mode of just over 6 vegetables per week. Three schools with children illustrating the range of vegetables recorded per week are shown in Figure 36 (left chart). The frequency distribution of entries for fruit was very different. The mode was 0 fruit entries, with 22% of children getting ***no*** fruit per week, though a similar proportion (18%) got at least one piece of fruit ***per day***. Contrasting school frequency distributions, together with the overall frequency distribution for fruit per week are shown in Figure 36 (right chart). Even many children in rural areas, where fruit growing is common, recorded no fruit during the week. For example, almost half (22/45) of the children at Sveti Sava school in Bajina Bašta (a raspberry growing area) recorded no fruit in their food diaries, illustrated in Figure 36 (right chart). Many schools showed a bimodal distribution for fruit, with a second peak around one piece of fruit per day, as illustrated by Drinka Pavlović in Belgrade.

We tested the association between frequency of individual foods and food categories with a number of factors associated with each of the 14 schools, such as settlement size (Table 4).

Settlement	Settlement population	Sandwiches	Pastas	Cereals	Potatoes	Vegetables	Beans	Fruit	Cheese + creams	Juices	Processed foods	Sweet foods	Unhealthy foods
Large urban	1344844	0.96	1.27	0.67	1.38	7.03	0.36	4.21	4.24	1.27	10.37	2.54	3.288
Small urban	231798	1.71	1.25	1.32	1.89	5.00	0.61	4.57	3.39	1.57	13.86	4.00	5.786
Large provincial	42181	0.31	0.57	0.30	1.74	5.26	0.71	3.38	2.79	1.61	10.82	2.32	3.179
Large rural towns	11709	0.45	0.82	0.19	2.32	5.32	0.77	3.15	2.61	2.64	11.04	2.65	4.280
Small rural towns	1098	0.04	0.85	0.02	2.39	5.80	1.48	3.72	2.46	2.30	10.39	2.61	3.391

Number of food diaries: Large urban 104, small urban 28, large provincial 84, large rural towns 157, small rural towns 46.

Table 4. Selection of food categories showing significant differences amongst settlement size. Numbers are diary entries per week. Significant differences determined using one-way ANOVA. The greater the colour range amongst means, the greater the significance of differences. Shades of red are used for less nutritious foods.

Children at schools in larger, urban settlements (Belgrade and Novi Sad) were given sandwiches, pasta dishes, cheese, cream and spinach more frequently compared with smaller and more rural schools. They were also given more breakfast cereals and foods made with maize flour. Children in Belgrade schools were given vegetables on significantly more occasions during the week than children in any other settlement category. In contrast, children in rural communities ate potatoes more frequently; they had many more dishes using beans (a traditional pulse) and also more fruit juices and other non-carbonated drinks. Several categories of foods with lower nutritional content varied significantly amongst the settlement classes, with children in the Novi Sad school (small urban) eating many more processed foods, sweet foods

(chocolates, boiled sweets, etc) and generally less healthy foods (deep-fried potatoes, sweets, snacks such as crisps and carbonated drinks). The Novi Sad school, Ivo Lola Ribar, was known to be in one of the more deprived areas of the city. We also found increased % municipality poverty to be associated with children being given soups and processed meats more frequently.

Although children were asked to give the child code to be able to link food diary results with the children's and parents' instrument results, this work has not yet been carried out. Once we have these results available we shall be able to assess the extent to which school meals contribute to children's weekly intake of vegetables and especially fruit. *The lack of fruit in the diet of nearly a quarter of these children is of particular concern, particularly in relation to the intake of fibre and vitamins.*

9. CHILDREN'S NUTRITIONAL KNOWLEDGE

As part of the process of establishing baseline information on children's knowledge and food habits in our target schools, we tested children's nutritional knowledge in several of these schools, so that we could monitor the impact of Strength2Food activities on these aspects.

9.1 Methodology to assess children's nutritional knowledge

The research was conducted during three weeks period in October 2020. Eight schools, from seven locations across the country have been included in the sample. An overview of the number of participants, according to their grade and location is provided in Table 5. Overall, 573 respondents participated in the survey.

School name	Location	I grade	II grade	III grade	IV grade
Stevan Čolović	Arilje			18	61
Sveti Sava	Bajina Bašta	17	22	20	22
Danilo Kiš	Belgrade				86
Drinka Pavlović	Belgrade		23	23	47
Kirilo Savić	Ivanjica		37	30	30
Jezdimir Tripković	Latvice	12	12	22	10
Jefimija	Obrenovac	49	2	2	5
Braća Nedić	Osečina				23
Total		78	96	115	284

Table 5. Participants in the research.

Note: I grade – 6-7 years old; II grade – 7-8 years old; III grade – 8-9 years old; IV grade – 9-10 years old.

For the purpose of this assessment, a questionnaire was developed (available in Appendix 8). All questions are based on existing relevant literature and their phrasing and scales are adopted from previous studies conducted in the subject field (Table 6) and validated in the pilot study. The statistical analysis (section 9.2) also follows the analysis techniques applied in the Table 6 references.

Question number	Source
1	Edwards, J. S. A., & Hartwell, H. H. (2002). Fruit and vegetables–attitudes and knowledge of primary school children. *Journal of Human Nutrition and Dietetics*, 15(5), 365-374.
2	Nguyen, S. P. (2007). An apple a day keeps the doctor away: Children's evaluative categories of food. *Appetite*, 48(1), 114-118.
3-4	Slaughter, V., & Ting, C. (2010). Development of ideas about food and nutrition from preschool to university. *Appetite*, 55(3), 556-564.
5	Wellman, H. M., & Johnson, C. N. (1982). Children's understanding of food and its functions: A preliminary study of the development of concepts of nutrition. *Journal of applied developmental psychology*, 3(2), 135-148.
6	Zarnowiecki, D., Dollman, J., & Sinn, N. (2011). A tool for assessing healthy food knowledge in 5–6-year-old Australian children. *Public health nutrition*, 14(7), 1177-1183.
7-10	Lin, W., Yang, H. C., Hang, C. M., & Pan, W. H. (2007). Nutrition knowledge, attitude, and behavior of Taiwanese elementary school children. *Asia Pacific journal of clinical nutrition*, 16(S2), 534-546.
11	Reisch, L. A., Gwozdz, W., Barba, G., De Henauw, S., Lascorz, N., & Pigeot, I. (2013). Experimental evidence on the impact of food advertising on children's knowledge about and preferences for healthful food. *Journal of obesity*, 2013.

Table 6. Sources of the questions in the questionnaire.

The questionnaire was provided in the Cyrillic alphabet, given that Serbian children of younger age read Cyrillic more easily than Latin script. Moreover, the survey form was decorated, to be more appealing to children, as suggested by other studies in this field. All scales used in the questionnaire were graphically presented (either with emoticons or with other suggestive symbols).

Pilot testing was conducted in March 2020, with children aged 7-9 (three girls and six boys). It was organized as one-to-one interviewing, in the presence of the child's parent. The average time needed to fill in the questionnaire was 30 minutes. Useful information was collected during the pilot testing, which served as the baseline for the development of the Instruction sheet, as well as for improving the final questionnaire. For instance, the wording of some questions was adjusted to be more specific and some items were better explained (e.g. children do not know what their date of birth or initials are; we clarified whether a specific food item or food group should be cited; the questionnaire also stated that their answers would not be graded).

The procedure for the investigation was precisely defined and all teachers included in the survey were supplied with an instruction sheet (Appendix 9). The instructions were given on a question-to-question basis, citing exactly what teachers should say before each question and providing answers to any assumed children's questions. They were advised to read aloud each question and to wait while every child completed it. Therefore, children were allowed to take as much time as they needed to answer each question. Teachers were present in the classrooms throughout the process of completing the questionnaire. The forms stipulated that children's privacy will be protected, as well as guaranteeing their anonymity and the confidentiality of their data.

Moreover, teachers were asked to complete a survey, specifically prepared for them, to assess the whole process of carrying out the children's survey. The survey asked the following questions:

- How long does it take for children to complete the survey?
- Did children ask for some additional information? Which ones?
- Did they comment aloud if they didn't know something?
- What is your general impression about the children's interest in the survey? (Likert scale 1-"totally uninteresting" to 5 – "totally interesting")
- What is your general impression of the survey questionnaire – what can we improve in our further studies?
- Do you find that the instructions that accompanied the survey have been useful? (Likert scale 1 – "totally useless" to 5 – "very useful")
- Please provide additional comments if you consider them to be useful.

Overall, 31 teachers filled in the questionnaire. The average time needed for children to complete the questionnaire was 45 min (duration of one school class), ranging from 20 to 60 minutes, depending on the children's age. They assessed both the questionnaire to be interesting for children and the instructions to be useful for them (the great majority in both cases selected point 4 on the Likert scale). In many cases, children asked teachers for an explanation of the word "fibre". In one case they wanted to know if "bread" in question no. 6 pertains to white or to whole wheat bread. In another case, children asked in question no. 5 if they should cite specific food items or food categories (e.g. fruits, vegetables, etc.). There were no other doubts or queries from the children.

Although all schools in the sample were instructed to perform the survey and were provided with the same number of copies of the questionnaire for children of all four grades, they failed to do it, which caused some unevenness of the sample. This was because the research was conducted during the second wave of Covid-19 in Serbia, which led to classes being reduced to only 30 minutes instead of 45 minutes, while certain schools adopted distant learning. Therefore, this limited possibilities for some of the schools to conduct the research across all four age groups, while one school in the sample (located in Valjevo and participating in other surveys of the Strength2Food project) could not take part in this research in any capacity. Nevertheless, the relatively large sample of 573 participants gave a range of useful information presented in the following section.

9.2 Analysis of children's nutritional knowledge

The first question in the survey assessed children's perception of a healthy diet. It was an open-ended question asking them to cite what a healthy diet is. Younger children cited fruits, vegetables and dairy to be relevant aspects of healthy eating significantly more frequently than older children, while age had no effect on children's understanding of cereals in relation to healthy eating. No significant effects of children's gender were found. These perceptions of food items are confirmed in other responses, where children were asked to state three types of healthy and three types of unhealthy food (summarised in Table 7). Not surprisingly, most of them associated fruit and vegetables with a healthy diet, while sweets were perceived to be the most unhealthy food type. Foods rich in carbohydrates, such as chip (French fries) and pizza, and salty snacks were almost equally associated with unhealthy foods. Although meat and meat products were considered to a large extent to be both healthy and unhealthy food, this was

because children associated unprocessed meats (e.g. fish, meat, chicken) with being mainly healthy foods and processed meats (e.g. hot dog, hamburger) being mainly unhealthy foods. Nevertheless, some foods, such as burek (meat pie) were regarded as both healthy and unhealthy.

Healthy food	N	Unhealthy food	N
fruit	694	sweets	600
vegetables	633	carbohydrates	295
dairy	59	salty snacks	244
cereals	68	meat products	239
meat and meat products	111		
other	134	other	243
Total	1699	Total	1621

Table 7. Children's frequencies of citing healthy and unhealthy food types

All children, regardless of their age, gender or location, recognised the following foods to be healthy: apple, broccoli, cabbage, carrot, milk, nuts. Indeed, all fruits and vegetables included in the questionnaire were recognised to be healthy. The only food that was unanimously cited to be unhealthy was hot-dog. A detailed overview is provided in the table in Appendix 10.

Gender proved to be an important predictor in the evaluation of healthiness for the following food items: hamburger, cheese, croissant, doughnut, ice cream, carbonated (fizzy) drinks and yogurt. For all these foods, females made better judgements than males in terms of the healthiness of the food. Therefore, boys tended to underestimate potentially damaging factors in unhealthy food (sweets and fast food, primarily).

Considering age, younger children demonstrated a lower level of knowledge (either evaluating an item's healthiness incorrectly or not knowing) in some cases compared with older pupils. Although the correlation was statistically weak, it was still significant for the following foodstuffs: beans, bread, chocolate bar, fish, pizza and sausage. This finding implies that all children should be given more education on certain food categories and their properties, such as proteins or fatty food.

Regarding location, children in the rural towns Bajina Bašta, Ivanjica and Osečina (population sizes of 3,000 to 11,000 inhabitants) showed the lowest level of understanding on the healthiness of certain food items, e.g. burek (meat pie), hamburger, candies, muesli, cookies, croissant, doughnut, chips (French fries), ice cream, pizza, rice, and yogurt. Children from the capital city Belgrade also misjudged several foodstuffs: hamburger, cheese, croissant and egg.

As regards the food items causing the highest levels of confusion (i.e. while the majority of children put a particular food in one food health category, more than 10% of children put the same food in the opposite health category), these were bread, burek (meat pie), muesli, cookies, croissant, popcorn and sausage. Thus, it was clear that children had the most difficulty in correctly classifying foods high in carbohydrates. We may assume that this is a consequence of how readily these foods are available to children and misconceptions about these foods as a result of misleading advertising. For instance, television sometimes advertises cookies and

breakfast cereals highlighted to be enriched with milk or some other components (e.g. vitamins and minerals) and therefore to be nutritious. Bureks, croissants and popcorn are readily available for young children to consume in school canteens, frequent roadside food stalls and special events such as carnivals and fetes, and this widespread availability may influence children's perception of these foods as healthy.

In the second stage of the analysis we were interested in understanding why children consider some food stuffs to be either healthy or unhealthy (Tables 8 and 9). Moderately strong correlations were established in terms of a food's healthiness and its specific attributes (Cramer's V = 0.327, p = 0.000), as well as between unhealthiness and food's characteristics (Cramer's V = 0.384, p = 0.000).

Reason	fruit	vegetables	dairy	cereals	meat and meat products	other	Total
contains vitamins	398	235	8	12	18	22	693
contains minerals	12	18	2	1	3	2	38
contains fibres	1	9	0	4	1	0	15
contains proteins	12	7	6	5	22	3	55
it's nutritious	4	5	1	3	1	4	18
good for teeth	15	4	9	0	0	2	30
good for bones	2	2	8	0	3	1	16
good for muscles	4	4	0	0	9	0	17
good for sight or hearing	3	65	1	0	0	0	69
good for our body	22	32	1	5	7	13	80
makes us stronger, better, more dexterous...	17	26	3	4	17	5	72
doesn't contain sugars, preservatives, additives or other damaging substances	8	6	1	0	0	0	15
natural (grown organically)	16	24	4	2	1	1	48
other	134	136	8	22	15	67	382
Total	648	573	52	58	97	120	1548

Table 8. Reasons why children thought particular foods were healthy

Reason	sweets	carbohydrates	salty snacks	meat products (e.g. hamburger, fried chicken)	other	Total
it is fatty	17	59	47	54	21	198
it has a lot of sugar	223	12	7	3	45	290
it has a lot of salt	0	3	39	0	1	43
it contains artificial components	15	13	18	30	14	90
it's unhealthy	25	21	14	14	16	90
it's unhealthy for teeth	149	5	9	0	10	173
it makes you fat	20	32	17	15	18	102
it makes us worse (e.g. how we run/see/learn)	7	6	0	2	2	17
other	89	103	65	93	87	437
Total	545	254	216	211	214	1440

Table 9. Reasons why children thought particular foods were unhealthy

In the majority of cases, healthy foods were associated with a food rich in vitamins. Moreover, healthy foods were also regarded to be those which are rich in proteins or which improve one's physical abilities. Children associated food healthiness least with the absence of some damaging materials or being high in fibre. Fruits were particularly appraised if they were thought to be rich in vitamins, and vegetables both for being thought to have high vitamin contents and for being good for sight or hearing, while meat products were regarded as being rich in proteins and improving strength and body performances. Unhealthiness of food stuffs was usually recognized to be associated with those foods having high amounts of fat and sugar, as well as those being bad for children's teeth. Only 1.5% of kids associated food healthiness with any impact on their achievements or abilities. Even at this very young age, children were very much concerned about their appearance, citing certain food to be bad because "it makes them fat".

Finally, we were interested in children's knowledge of specific nutrients (Table 10). As demonstrated consistently in the above results, children were the most familiar with vitamins (more than 90% knew that fruit and vegetables are high in vitamins) and least familiar with fibres (only a fifth of them correctly recognized that spinach is a relatively good fibre source). Almost equal numbers of children were either aware or not aware of food items high in proteins and fats. These findings suggest that although children seem to have a good knowledge at this age on the benefits of vitamins, they need to be given more information in schools on all nutrients in general, while the importance of fibre, in particular, in a healthy diet needs to be given more emphasis.

Correct choice of food with…	Correct	False	% correct	N
vitamins	523	38	93	561
fibres	118	435	21	553
proteins	281	280	50	561
fats	291	274	52	565

Table 10. Selection of the correct food which is high in a specific nutrient

10. EXCEL MEAL PLANNER TOOL

As part of WP6.2, ZAG calculated the nutritional contents of school lunches, and the proportion of nutrients lost through plate waste. For this, normative quantities of ingredients for the 10 lunches for each of the four Belgrade schools were entered by ZAG into their database and nutrient quantities calculated from the EuroFIR nutrient database for Serbia, for which ZAG took out a licence to access the database. Once the WP6.2 nutrient analyses had been completed, the EuroFIR licence was cancelled. While these analyses were helpful in assessing the nutritional composition of typical lunches in Belgrade schools, WP6.2 could not provide nutritional analyses for all our 27 target schools. A database of macronutrients (energy, carbohydrate, protein and fat) was freely available at http://www.tablicakalorija.com and this was helpful in allowing us to calculate macronutrient contents of meals in our target schools for which we had normative quantities, but the nutrient calculations were slow and in any case gave information only for macronutrients.

Therefore, in December 2019 UNEW took out a new EuroFIR licence to give access to the Serbian EuroFIR nutrient database until the end of the project. This formed the basis of an Excel tool, built using Excel *functions*, to automate the process of nutrient calculations, and the Excel Meal Planner tool evolved to provide estimates of plate wastes (using data from WP6.2), meal carbon emissions (using data from WP6.3), meal prices (using school food procurement contracts) and weekly delivery quantities needed for all the school's meals, as well as detailed nutritional outputs in both tabular and graphical formats (see Strength2Food website article at https://www.strength2food.eu/wp-content/uploads/2020/09/Strength2Food-EDMA-article.pdf and the webinar at https://www.youtube.com/watch?v=d3tSOL00TBo&feature=emb_logo, after *ca.*39 min for more information). A working version in English can be downloaded from https://www.strength2food.eu/resources/ as "Menu and Procurement Planning Tool".

10.1 Background to the Excel Meal Planner and sources of information

The meal planner tool was designed for Serbian primary schools (though the tool is also relevant for other institutions providing meals) to give them information on the nutritional value of their meals, their costs, and their carbon dioxide emission footprints, using a nutritional database for nearly 500 typical Serbian foods and using information provided by the school on the foods it buys and their cost (including VAT), and in the case of vegetables for both conventional and organic produce. The meal planner gives detailed tabular and graphical output for 23 macro- and micronutrients, recommendations for the school and parents on meal composition and quality in relation to Ministry guidelines, and weekly totals of all food ingredients to help schools plan food deliveries. The meal planner tool is designed for entry of ingredients for up to four meals per day (breakfast, morning snack, lunch, afternoon snack) from Monday to Friday for two weeks.

Nutritional and other calculations are based on information databases built into the Excel tool, which come from the following sources. Nutritional recommendations are from MPNTR regulations of 2018 (based on WHO, 2006) and also from EFSA. Nutritional quantities are averages of values recommended for boys and girls, usually of age 7-10 years old, and macro- and micronutrient quantities per meal are calculated according to the proportion of daily energy

intake recommended for each meal in the Ministry regulations. Macronutrient contents are from a range of sources, including manufacturers' own analyses for some processed foods. Micronutrient contents are mainly from the Serbian EuroFIR database. Where EuroFIR micronutrient data are not available, cautious use of USDA nutrient information is added (bearing in mind the use of additives/fortification in many USA foodstuffs).

Plate waste % data are from the Strength2Food plate waste study and are for individual foods as far as possible, or means for food categories where individual food data are not available. Inevitably plate wastes will vary from child to child and from meal to meal for the same food ingredient, so plate wastes are only best estimates, but average estimates per meal should be realistic. Food production CO_2 emissions come from the Strength2Food environmental impact study (WP6.3) using CO_2 emission data from UNED. Thus, CO_2 emissions are for primary production and processing only, and do not take account of emissions from transport, food preparation or waste disposal.

Unit food costs for these spreadsheets are based on procurement contract prices in 2019 for a single school in the demonstration version of the meal planner. In practice, schools would use their own food contract prices. For fresh vegetables, prices are given for both the school food contract for conventional vegetables as well as realistic prices from local growers of organic vegetables (2020 data). Organic vegetable prices were provided by the new organic vegetable cooperative established in February 2020 with support from Strength2Food under WP9.5.1. Users can select either conventional or organic prices to see the effect on meal prices of substituting conventional with organic vegetables.

10.2 Meal Planner input information

Two spreadsheets are provided for entering meal ingredient information for two weeks, and a third spreadsheet for entering the foods procured by the school and their unit weights and prices. Two spreadsheets give meal output information in the form of nutritional contents and recommendations for both schools (cooks) and parents based on those nutritional contents. A third output spreadsheet gives details of food quantities and their costs for all meals each week.

Several, normally hidden, spreadsheets contain ingredient lists, reference data to calculate nutritional contents, plate wastes and CO_2 emissions, and texts for recommendations. Other normally hidden spreadsheets provide calculations used for charts, tables, recommendations and weekly food quantities. Columns not needed by the user are also hidden in several spreadsheets. Access to the nutritional database is password protected to ensure the terms of the EuroFIR licence agreement are not infringed. MPNTR is currently investigating how to take up a licence with EuroFIR for use of the database in the Excel Meal Planner once Strength2Food finishes in 2021.

For meal entry, the school is asked to click a "Yes" button if many of its children walk long distances to school. The default is "No". The % of daily energy provided by school meals is given according to Ministry regulations: usually 30% breakfast, 10% snack, 30% lunch, 10% afternoon snack, totalling 80% of the daily intake (assumed to be 2000 kcal). If many children walk some distance to school (school selects the "Yes" button), 5% more kcal and all nutrients are added to breakfast. If many children have only a snack and no other meal in school, 5%

more kcal, etc are added to the snack. Serbian nutritionists consider that if the morning snack is the only meal a child has in school, it should contain more than the usual 10% daily calories.

For each weekday, schools can give a meal description, for parents for example, as well as a summary of the courses for each meal. The number of children having a particular meal is entered and this information allows weekly quantities for each food to be calculated in the output spreadsheet "Quantities of food items". Individual foods for each meal are entered by first selecting the ingredient category from a drop down menu, and then selecting the specific ingredient within that food category from the drop down menu in the adjacent column. This two-step ingredient selection process reduces the number of food items in the drop down lists to more manageable numbers. Although around 500 foods are in the database, during ingredient entry for a meal, if a food is selected that is not procured by the school, a red cell warning is given against that food. Nutritional information will still be provided for that food, but no cost for that ingredient will be included in the total meal price. The final information to be entered into the meal entry spreadsheets is the quantity of each ingredient used for the meal. This could be either the quantity per serving or quantity for a particular number of servings, in which case the number of servings would also need to be entered in place of the default number of 1.

During ingredient entry for a meal, a warning cell gives a live update of the energy content for each meal, which gradually reduces in intensity as ingredients are entered from dark red to colourless once the meal energy total reaches 80% of the recommended value for that meal. Total meal quantities for each ingredient are automatically calculated, based on number of servings for each meal and weight of ingredient per serving. An extra 10% is built into the calculations to allow for a probable excess prepared by the kitchen. Nutritional quantities, food plate waste, ingredient cost and CO_2 food production emissions are automatically provided for display in other spreadsheets. As ingredient entry for all meals is completed, output spreadsheets are populated with information for each meal.

Entering lists of foods from procurement documents and their contract prices is currently problematic, because schools do not use a standard format for either entering food lists into procurement documentation or recording contract prices for each food, which in any case are often written by hand by the suppliers! This prevents a simple 'copy-paste' approach from those school documents into the Excel Meal Planner. However, considerable redundancy of food names (using Cyrillic Serbian) has been included in the food ingredient database, and an example food list template has been prepared for schools to use with the Meal Planner, which is based on only the foods in the Meal Planner database. This would allow schools to simply 'copy-paste' the list of foods from their procurement documentation into the Meal Planner. However, there has not been time so far to explain the procurement food list template to our target schools. Foods and their unit quantities that are not entered with either the correct spelling or format are not recognised by the Meal Planner and generate a missing food error. For example, a frequent problem with schools' procurement documentation food lists in each lot is a space (" ") at the end of the food name. If 'copy-pasted' into the Meal Planner, this causes the food to be not recognised.

Once a school's foods and unit prices have been entered, the meal planner will extract the relevant information for each food when calculating meal prices, selecting either conventional or organic prices depending on the option selected by the user.

10.3 Meal Planner output information

A spreadsheet on tables and charts gives actual and % recommended quantities of 23 macro- and micronutrients for every meal entered. These are available in tabular and bar chart format, together with cumulative bar chart totals for ingredient quantities, costs and CO_2 emissions for each of 16 food categories (vegetables, fruit, meat, etc). Figure 37 shows a typical example of tabular and bar chart output. The table in Figure 37 shows (columns left to right) nutrient, number of foods with missing nutrient data, meal total nutrient quantity, meal % recommended nutrient quantity, and meal % recommended quantity after subtracting typical plate waste for each food. Here, table columns 4 and 5 are shown as bar charts on the right of Figure 37. Horizontal bar charts (left to right) show cumulative food category costs, cumulative food category weights and cumulative food category CO2 emissions for each day of the week (Monday, top, to Friday, bottom). Each day (top to bottom) in this example is a moussaka lunch for a different school.

Figure 37. Meal Planner spreadsheet of table and chart outputs, illustrating results for a lunch of moussaka on Monday of week 2 using conventional vegetables.

The % contributions of each food category to the meal total are also available as pie charts. In tables of % recommended nutrient quantities, cells are shaded in red if nutrient contents for a meal are less than 80% of recommended values, or greater than 120% of recommended values for saturated fats and sodium content, the intensity of red increasing as the deviation from recommended values increases. Drop down menus are given to select meals for either week 1 or week 2, and to select either conventional or organic food prices. Click buttons are available to select either all meals per day, the weekly average for a particular meal type or individual meals each day.

Recommendations on meal quality and how to overcome any meal nutrient and food category deficiencies, according to Ministry regulations, are given in the "Recommendations" spreadsheet. Recommendations are given for both schools and parents. In particular, parents are given recommendations on how to make up any school meal deficiencies by giving their children extra portions of vegetables or fruit outside school. Recommendation summaries for macronutrients are given for each day and meal type. A drop down menu allows recommendations for week 1 or week 2 to be selected.

If weekly averages for micronutrients are less than 80% of recommended quantities for the daily and weekly averages and meal type, cells in the nutrient tables are shown in shades of red, and a list of foods rich in those deficient micronutrients is provided adjacent to the relevant micronutrient, so that the school may adjust the menu to overcome the micronutrient deficiency, or parents may supplement their child's meals at home with foods rich in those deficient micronutrients.

A spreadsheet on "Quantities of food items" gives each of the foods used for each week of meals, listed in decreasing rank quantity, and procurement lot by lot, with the supplier for each lot named. Quantities are given in both absolute weights as well as number of delivery units. For fresh foods (vegetables, fruit, meat, fish) quantities take account of food preparation waste (such as potato peelings). The cost of each food for the week is also given, rounded up to the nearest unit quantity. This information would allow a school to inform its suppliers how much of each food is required each week, and helps the school to manage its food budget. Click buttons allow foods for week 1 or week 2 to be selected.

10.4 The Meal Planner in practice

The Meal Planner has been demonstrated to a few schools and to the Assistant Minister, Ministry of Education Sector for Preschool and Primary Education and Upbringing, though more widespread dissemination of the Meal Planner has been prevented by the Covid-19 pandemic restrictions in Serbia (see section 12). Therefore, no school so far has been able to test the Meal Planner for itself. The Excel tool was well-received within the Ministry, so the Assistant Minister is currently investigating a licence to use the Serbian EuroFIR nutrient database once Strength2Food has ended.

The Meal Planner also provides schools with a quick method to check the nutritional impact of ingredient substitutions by the cook if all the planned ingredients for a meal are not available for some reason (late delivery, food rejected, ...). Thus, the Excel tool has proved extremely useful for designing sets of weekly lunch menus (described in section 11) to provide an adequate nutritional balance of macronutrients, and micronutrients where possible, for each lunch by substituting ingredients and adjusting their quantities. The Meal Planner has also made it quick and easy to compare the nutritional balance and differences amongst schools serving the same dishes for lunch (see Figure 38 for an example for one school's normative for a lunch with moussaka as the main dish).

The implications of this are discussed in more detail in the next section.

11. STANDARDISED WINTER AND SUMMER LUNCH MENUS

11.1 Justification for standardising menus

Using the Meal Planner to compare 12 school normatives for lunches with the same main dish (moussaka) revealed considerable diversity in both their ingredients and ingredient quantities.

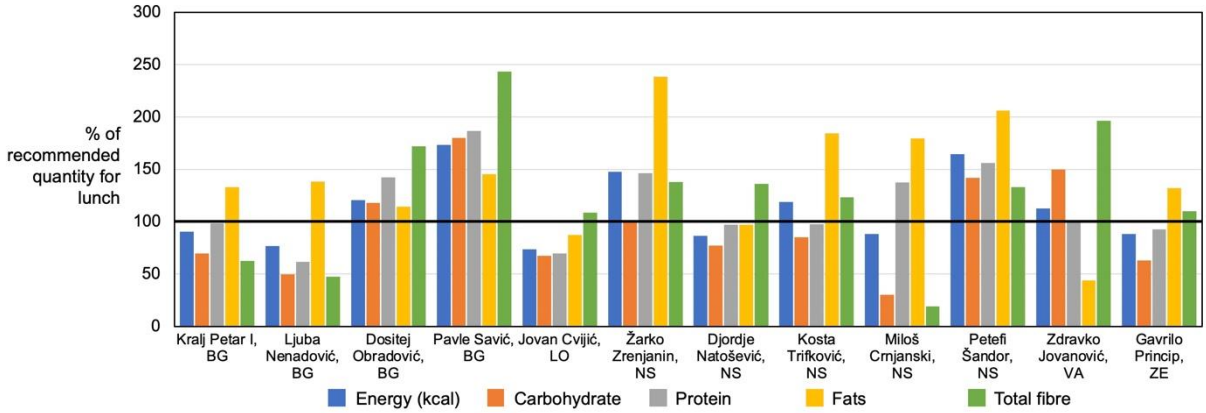


Figure 38. Macronutrient quantities for lunches with moussaka (expressed as % recommended quantities) from normative recipes for 12 schools. Heavy horizontal line indicates the recommended quantity for each macronutrient.

Therefore, children in those schools would be getting both varying amounts of differing ingredients for the same dish as well as different nutritional compositions. Figures 38 and 39 compare the nutritional composition of lunches using moussaka normatives for the 12 schools. From Figure 38, it is clear that some schools are not getting sufficient energy and some macronutrients (CHO, protein, fat) using moussaka lunch normatives, Ljuba Nenadović and Jovan Cvijić in particular. In contrast, other schools are giving far more energy and macronutrients to their children from their moussaka lunches than recommended by the Ministry Regulation (MPNTR, 2018), Pavle Savić, Žarko Zrenjanin and Petefi Šandor in particular. The two schools with the best overall balance of energy and macronutrients for their moussaka normatives, according to Ministry recommendations, were Djordje Natošević, Novi Sad and Gavrilo Princip, Zemun. However, the latter school used courgette instead of potato which all the other schools used.

This diversity amongst schools was reflected in vitamin contents for moussaka lunches for the 12 schools (Figure 39). Vitamin A contents were below recommended quantities in 8 of the 12 schools. Occasional moussaka normatives were also deficient in vitamin B1, B2 and B12, while a few vitamin contents were extremely high in some schools.

These large diversities amongst schools in their meal normative compositions for moussaka had major implications for food quantity per meal, food CO_2 emissions per meal and meal costs. Thus the combined weight of ingredients per child varied from 440 g to an impressive 884 g for lunches with moussaka. The meal ingredient CO_2 emissions varied from 795 g/g to 1998 g/g (a 2.5-fold range), and the moussaka lunch ingredient costs varied from 47.46 to 108.75 dinars (€0.40-0.92), using the contract unit food prices for a single school.

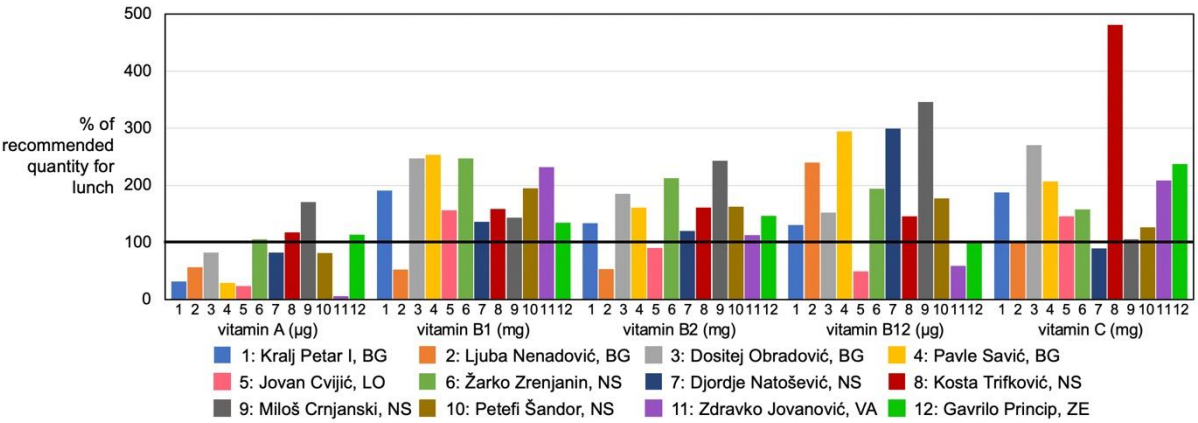


Figure 39. Vitamin quantities for lunches with moussaka (expressed as % recommended quantities) from normative recipes for 12 schools. Other details as for Figure 38.

The Excel Meal Planner provides an opportunity to adjust meal normatives to meet more closely the nutritional quantities recommended by the Ministry's school meal regulations of 2018 (MPNTR, 2018). To illustrate this, the moussaka lunch for Gavrilo Princip was adjusted a) to give macronutrient quantities closer to recommended quantities, while simultaneously testing b) whether the total weight of meal ingredients could be reduced, c) whether the meal's carbon footprint could be reduced, and d) whether the meal price could be reduced. However, at 71.17 dinars, the meal ingredient cost was already slightly below the moussaka average cost for the 12 schools.

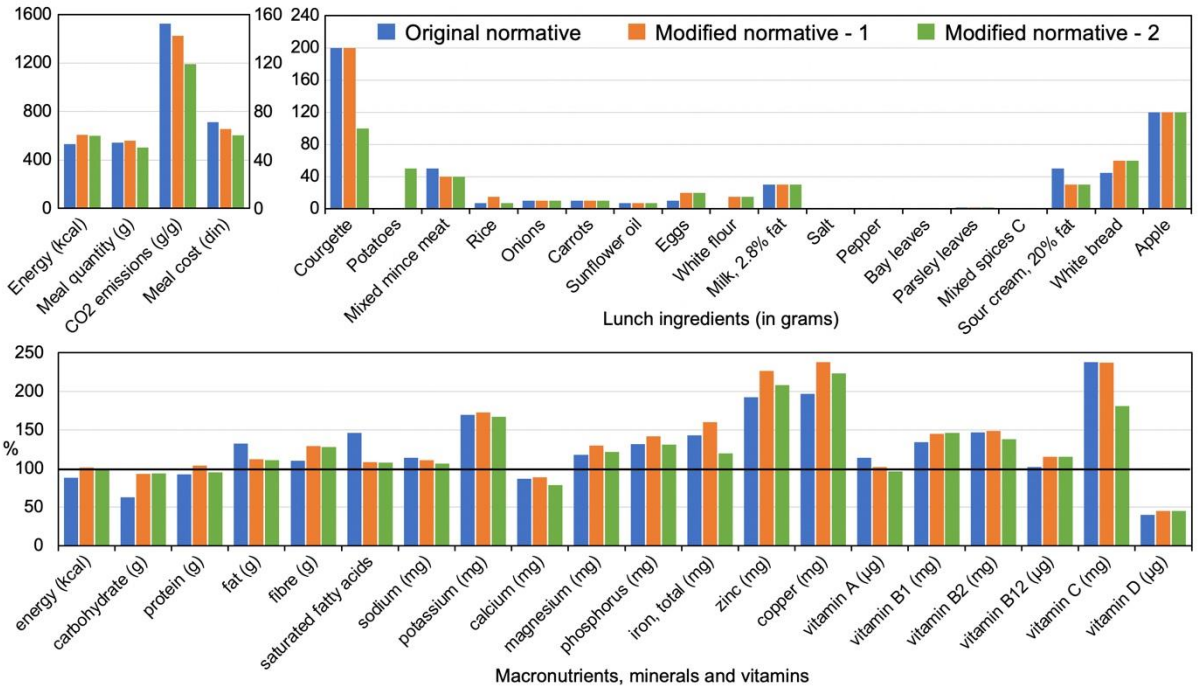


Figure 40. Normative for lunch with moussaka showing ingredient and nutrient quantities for the original normative, a normative adjusted while keeping the quantity of courgette constant and a normative adjusted by replacing some courgette with potato.

In this example, the original normative was slightly deficient in energy, but with an excess of fat, being especially too high in saturated fatty acids. The original normative totalled 542 g, and experience from the WP6.2 plate waste study showed that this amount of food would be difficult for children to eat within the time available for many school lunch breaks. Therefore, reducing

the total quantity of food would also be a useful target to meet. The meal ingredient CO_2 emissions were also above average at 1527 g/g. Figure 40 shows the results for modifying quantities for several of the ingredients, and adding other ingredients.

Modified normative 1 kept the quantity of the main ingredient (courgette), while achieving a much better energy and macronutrient balance, reduced CO_2 emissions and slightly cheaper ingredient cost, though overall meal weight increased slightly. By replacing some of the courgette with potato in modified normative 2, the better energy and macronutrient balance was retained, while reducing CO_2 emissions further, as well as total ingredient cost and, this time, reducing overall meal weight.

So, in this example, the Meal Planner tool allowed an existing menu to be adjusted to improve nutritional balance, reduce total meal weight, reduce CO_2 emissions and reduce meal ingredient costs. Thus, the adoption by schools of a standardised set of lunch menus, where these four meal criteria have been either optimised or minimised, as appropriate, would ensure that any primary school in Serbia making its own lunches would be giving its children a nutritionally well-balanced lunch at the lowest cost to parents possible, while giving a relatively low meal CO_2 footprint and helping schools to reduce plate waste, particularly for those schools where a long lunch break is not an option. Furthermore, these standardised lunch menus would make the inclusion of fresh organic vegetables a realistic possibility for schools (ideally through direct sales from local organic growers).

11.2 Background information on the standardised menus

Therefore, these lunch menus were put together to overcome current weaknesses identified in many normative recipes for lunches in Serbian primary schools. The strategy of using the Excel Meal Planner to adjust existing menus was adopted to put together a set of two weeks of winter and two weeks of summer lunch menus, using existing school lunch normatives as a basis for adjustments to achieve a better nutritional balance in relation to the Ministry Regulation (MPNTR, 2018) for energy intake (calories), macronutrient and micronutrient (mineral and vitamin) contents for children of different ages, as well as to reduce overall meal weight, CO_2 emissions (where possible), meal price (where possible), and to give meal costs using both conventional and organic vegetables (prices for the latter supplied by the new organic vegetable cooperative).

Meal price charged to parents is frequently raised by schools as an issue (too expensive), which would be particularly true for schools in poorer municipalities, such as Loznica and Osečina, where we have four schools on Strength2Food. So, achieving as low a meal price as possible without sacrificing nutritional quality is important for schools. Schools have also seen the introduction of organic vegetables as a major challenge because certified organic vegetables in Serbia are usually at least twice as expensive as conventional vegetables. Therefore, these standardised menus were designed to keep lunch prices similar to existing lunch prices while allowing fresh organic vegetables to be used in recipe normatives.

By using existing school lunch normatives as the basis for the majority of these menus we have ensured that school cooks would already be largely familiar with them, thereby generating less resistance to introducing at least some of these lunch menus into their school kitchens. Very few ingredients were included that were not already typical in school food procurement lists.

For this reason, only one BARILLA recipe was included, as some of their lunch ingredients would not normally be bought by schools.

Particular attention was paid to keeping the total food weight per meal as low as possible because the WP6.2 plate waste study showed that plate waste increased as meal time decreased. Therefore, for several lunches, an alternative, more energy dense, menu was developed for those schools giving children short lunch breaks. Fruit was included in the large majority of menus, and children on short lunch breaks could take the piece of fruit with them to eat outside the canteen (see section 14).

Although the impact of school meals on global warming may not currently be a major priority for schools, to raise awareness of the impact of food production on global warming and climate change, for which CO_2 emissions from growing food are a major risk, the CO_2 equivalent emissions have also been given for each lunch. The introductory notes to the menu document explain that meat, especially, and dairy products are major contributors to CO_2 emissions, and therefore global warming. Thus, for example, a meal using beef or pork will have around twice the impact on global warming as a meal using beans (or other pulses) instead. The contribution of fresh meat to total lunch CO_2 emissions is clearly evident in Figure 37: dark blue horizontal bars in the bottom right hand cumulative bar charts. So, schools using the Excel Meal Planner would be made aware of the impact of their meals' meat contents on global warming!

The Ministry Regulation recommends that lunch should provide 30% daily energy intake. Therefore, these lunch menus are based on 30% daily energy for an active male child 7-9-years old (600 kcal). The equivalent for girls of the same age would be 555 kcal. Menu quantities presented in the document assume that children eat everything they are given for lunch - no plate wastes. In addition to following the Ministry regulations, several other criteria were used for preparing these lunch recipes:

- The majority of menus have used a meal already included in a school normative as a starting point, so that most menus would look familiar to school cooks.

- Lunch ingredient prices have been kept to a weekly average of around 45-50 dinars (€0.40) per lunch using conventional vegetables and 50-55 (€0.45) dinars using organic vegetables (average increase in weekly lunch prices using organic vegetables 14-15% depending on the choice of menus). Conventional lunch costs were based on 2019 prices for a typical Novi Sad school food contract. Organic vegetable prices were based on representative prices from organic growers selling directly to schools (spring 2020). Although, meal prices are only an approximate guide, a comparison of relative prices between meals should be realistic.

- The only fresh fruit included in menus is apples (the most popular fruit used for school meals) as any other type of fruit would increase meal prices. Fruit has been included for almost every meal. Although other fresh fruit can be substituted for apples to give more variety, this will increase the meal cost.

- Salads, where included, have been restricted to those that are relatively cheap, such as cabbage, but which also have high calories per dinar, and which are available fresh during the season.

- To keep meal prices down, the meat content of meals has usually been reduced compared with many normative recipes, though nutritional balance has been maintained by frequently adding eggs to menus.

- To keep macronutrient contents up without considerably increasing the total volume (and price) of food, seeds and pulses (e.g. sweet corn, lentils) have often been added to otherwise typical recipes.

- Although the Ministry recommends fish 1-2 times per week, fish was not always included with each week for lunches, because it was assumed that children would be given tuna or sardines (tinned or paté) occasionally for snacks.

- Menus avoid dishes that need deep-fat frying as well as courses with battered (breaded) foods, such as fish fingers, as much as possible.

- Chicken was often substituted for recipe normatives designed for pork and beef to keep meal costs down, but keeping micronutrients up with other non-meat ingredients. Chicken is also easier for young children to chew than pork or beef.

- Minced meat has often been used because it is a) cheaper than other meats, and b) easy for children to chew.

- It was impossible to give sufficient calcium for some lunches, but it was assumed that milk and cheese may also be given for other meals, especially snacks on those days when insufficient calcium intake would be likely from the lunch.

- Vitamin D content was impossible to keep sufficiently high while keeping meal prices acceptable. Using tuna for the snack would help overcome any vitamin D deficiency for lunches. Milk and spreads fortified with vitamin D could also be used to reduce any vitamin D deficiency in lunches. This becomes an important consideration in view of the current Covid-19 pandemic, for which a healthy immune system supported by increased vitamin D intake, in particular, is vital.

- Calories per unit volume have been kept as high as possible so that children do not fill themselves up with water, in a thin soup for example, before they get to the main course. Note that children can be given water to drink with their meals if they need it, so when water is needed to be added to a particular dish, cooks are advised it should be the minimum possible. Also, vegetables ought to be cooked in the minimum amount of water, and then drained, or if possible steamed so that the excess water is minimised.

- Fruit was occasionally replaced with a tart or cake, a) for a bit of variety, b) to add more calories and avoid macronutrient deficiencies, and c) to keep a meal price down (a slice of cake or tart would typically be cheaper and more calorific than apples).

- Herbs, spices and seasonings in menus were usually kept to the minimum, such as salt and sometimes pepper, to keep menus simple and to help keep the price per meal low. Other herbs and seasonings could be added to menus as preferred by the cook. Although salt intake is not mentioned in the Ministry Regulation, the recent EFSA maximum salt (sodium) intake (EFSA, 2017) is used in the Excel Meal Planner reference database, so the use of salt in recipes is adjusted to keep within the EFSA recommendations where possible.

Lunch menus were provided for the winter months (Oct/Nov - Mar/Apr) and summer months (Apr/May - Sep/Oct), based on vegetables that are normally available fresh during those periods. This would help schools to give children vegetables that are more likely to be locally sourced and fresh with higher nutrient contents, and would also help to keep vegetable prices down by using only those that are in season. Weights of vegetables given in the recipes are after cleaning and peeling or scraping. To encourage children to eat more of the meat with soups or main courses, cooks have been advised to cut meat into ca. 1 cm cubes, or given in courses using minced meat.

This menu document (available in Appendix 11) has 10 menus for winter and 10 menus for summer months. Menus give quantities of ingredients for both one child, and for 20 children. These quantities give the recommended nutritional intake quantities *assuming no plate wastes for meals*. Menus, which include detailed recipes for main courses, also give ***serving*** quantities for the main dishes, based on quantities for one child. The calorie density (kcal/g) is given for

each dish, to help cooks appreciate how more energy-dense foods in a meal can help to reduce plate wastes by reducing the overall volume of food children need to eat. This allows children to eat more of the meal in a given time. When lunch time is short (30 min or less), high-calorie-dense meals are better for children, as research into plate waste from WP6.2 showed that children can eat up to only around 300 grams of food in 20 minutes, and about 400 g of food in 30 min, typically equivalent to around only 420 kcal with existing lunch normatives.

Therefore, those schools that cannot give more than 30 min for children to eat their lunches might prefer to use the alternative menus, which are provided for some days, immediately following the main recipe (heading "Version for short lunch breaks", given in blue text in the document). In addition, where a piece of fruit is given as dessert, schools have been recommended to give children the whole lunch break for eating the main courses (and any accompanying side salad), and to give the piece of fruit to children to eat after the lunch is finished. This should reduce the amount of plate waste for the main courses.

As current lunch normatives used by schools do not take account of children's plate wastes, % recommended quantities of nutrients provided in these standardised lunch menus are given both assuming no plate waste and also using expected levels of plate waste for each ingredient (typically around 25% on average), calculated using the Meal Planner. Therefore, any progress that schools make in reducing plate waste will mean that energy (calorie), mineral and vitamin intakes by the children will approach those recommended by the Ministry's Regulation, and increasing the energy density of menus as much as possible (consistent with good nutritional balance) should also help children to eat more of their meal in the time available.

11.3 Structure and content of the standardised menu document

The document, entitled "Winter and summer lunch menus for 2 weeks" (in Serbian), is divided into the following sections:

- Introduction
- Excel Meal Planner
- Winter menus (two weeks)
- Summer menus (two weeks)
- Nutritional tables and charts for winter lunches
- Nutritional tables and charts for summer lunches
- Weekly nutritional averages for winter and summer lunches
- Weekly quantities of all ingredients for lunches
- Annual quantities of all ingredients for lunches
- Acknowledgement to Strength2Food

The Introduction contains the majority of information of section 11.2, above, followed by a short description of the Excel Meal Planner. Each meal is presented in tables giving the name of the main dishes (courses), and a detailed recipe for the main courses, followed by a column giving each ingredient and two other columns of ingredient quantities for a single serving and for 20 servings. Schools can adjust these quantities for their own use according to the number of servings they prepare for each lunch.

Immediately below the table is summary information about the meal on the basis of quantities per child, such as meal weight, total energy content, meal CO_2 footprint, meal cost for

conventional and organic vegetables, predicted plate waste and energy density. An example of a lunch recipe is given in Figure 41.

Nutritional tables and charts for each menu are given after all the recipes, and an example is shown in Figure 42. Charts are screen captures of the output charts from the Meal Planner. The table provides nutritional data for energy, and 22 macronutients, minerals and vitamins. Three measures of nutrient quantity are provided: actual quantity served for the lunch in kcal, g, mg or µg, actual quantity served as a % of the quantity recommended in the Ministry Regulation, and the final column is an estimate of quantity ***eaten*** by the child as a % of the Ministry recommendations, based on typical plate waste losses for each meal ingredient. A bar chart is provided to visualise the actual quantity served as a % of the Ministry's recommended quantity, with the 100% recommended values for each nutrient clearly identified. Two pie charts are provided to show a breakdown of a) the cost and b) the weight of each food category (vegetables, fruit, fresh meats, etc) comprising the meal. These food category pie charts help schools to see how each food category contributes to the overall meal cost and how rich the meals are in vegetables and fruit. The meal example in Figure 42 (lentils with smoked meat) shows that half the ingredients are vegetables and fruit.

12

Zima - Dan 3 ručak (600 kcal)

Recepti i rezime informacija o obroku

Jelo [kcal/g]	Namirnica	Količina (g)	
		1	20
Sočivo sa dimljenim mesom [1.56] (Na osnovu https://www.oklagija.rs/recepti/glavna-jela/item/320-sočivo-sa-suvim-rebrima Sočivo potopite u hladnu vodu oko sat vremena. Sitno iseckani crni i beli luk, sitno izrendanu šargarepu i karfiol, propržite na ulju, dodajte sočivo i hladne vode. Dodajte rebra koja ste prethodno iseckali i prokuvali u jednu vodu. Kuvajte oko 2h na tihoj vatri. Kada je gotovo napravite zaprška, prelijte sočivo, začinite po želji i kuvajte još nekih 15 minuta. Poslužena porcija je oko 240 g, plus 10 g kisela pavlaka.)	Sočivo	50	1000
	Brašno pšenično belo	5	100
	Ulje suncokretovo	7	140
	Crni luk	15	300
	Beli luk	2	40
	Svinjski vrat, butkica, suvo meso	30	600
	So	0.2	400
	Karfiol	15	300
	Šargarepa sveža	25	500
	Kisela pavlaka, 20% mm	10	200
	Voda	95	1900
Hleb [2.63]	Hleb, beli	60	1200
Voće [0.45]	Jabuka	100	2000

Podaci o obroku na osnovu količina datih po detetu	Količina (Količina bez voća)
Količina obroka (g)	414.2 (314.2)
Ukupno energija (kcal)	599.5
Tipična količina ostatka hrane (g)	96.7
Tipična količina ostatka hrane (%)	23.3
Emisija CO2-ekvivalent (g)	614.0
Ukupna cena namirnica (din)	42.26
Ukupna cena namirnica sa organskim povrćem (din)	47.06
Trošak ostataka hrane sa konvencijalnim povrćem (din)	15.04
Trošak ostataka hrane sa konvencijalnim povrćem (%)	35.6
kcal/gram (konvencijalna povrća)	1.45
kcal/din (konvencijalna povrća)	14.2
din/100 g (konvencijalna povrća)	10.2

Figure 41. Winter lunch menu for day 3 showing, in the table, each course (with energy density in [ ]), a detailed recipe, list of ingredients and quantities for one child and 20 children.

In addition, tables and charts with the same type of information as that shown in Figure 42 are provided for weekly averages for each group of five lunches, with separate tables and charts also given for weekly averages using the higher energy-density meal options, provided for those schools using short lunch breaks. The example in Figure 42 shows, in the table, nutritional information on the meal for energy, macronutrients, minerals and vitamins according to quantities served (by weight and as % of Ministry recommendations), as well as quantities as % of Ministry recommendations after allowing for plate wastes. The figure also shows

quantities served as % Ministry recommendations as a bar chart, and the proportions of food category costs (left) and weights (right) as pie charts.

The final sections of the document give lists of ingredients aggregated at the level of each week of menus and finally, for the whole school year of 180 days (36 weeks), with an illustration for winter menu week 1 shown in Figure 43. Foods are listed in decreasing rank order, with two columns of food weights. The first column gives weekly quantities for each meal ingredient as served to the children. The second column gives quantities based on ingredients as procured by the school, using 100 as the number of children. These food quantities take account of a 10 % surplus built into each meal to allow for eventualities, as well as quantities of fresh ingredients lost during food preparation (potato peelings, etc). Schools can adjust quantities in this column for their own needs according to the number of children having lunches each day. Annual ingredient quantities for the 10 winter menus and the 10 summer menus, based on a school year of 36 weeks, are given in the final set of tables, calculated as 9 times each of the 2 weekly menu ingredient quantities per season (9 x 2 x 2 x 5 = 180 days).

Zima - Dan 3

Nutritivne informacije o obroku

Prosečni dnevni iznosi svih obroka tokom nedelje	Količina koji se daje	Količina koji se daje: % preporučeno	Količina koji deca jedu: % preporučeno
energija (kcal / obrok)	599.5	99.9	65.2
ugljeni hidrati (g)	78.9	95.7	65.3
belančevina (g)	24.3	116.3	73.4
mast (g)	19.8	98.9	61.1
vlakna (g)	15.3	254.3	178.9
masne kiseline, ukupno zasićene (g)	4.8	72.6	45.0
natrijum (mg)	481.7	107.9	67.8
kalijum (mg)	923.8	171.1	118.3
kalcijum (mg)	131.6	55.5	37.4
magnezijum (mg)	93.6	156.0	107.4
fosfor (mg)	268.1	144.1	97.0
gvožđe, ukupno (mg)	7.4	225.7	154.7
cink (mg)	5.6	264.9	165.7
bakar (mg)	0.8	275.6	187.5
vitamin A (µg)	255.3	106.4	76.8
vitamin B1 (tiamin) (mg)	0.5	173.6	109.3
vitamin B2 (riboflavin) (mg)	0.3	109.9	70.1
niacin ekvivalenti (mg)	5.8	149.4	99.3
vitamin B6, ukupno (mg)	0.6	229.3	146.0
folata, ukupno (µg)	104.1	138.8	96.7
vitamin B12 (µg)	0.2	22.6	12.4
vitamin C (mg)	24.3	101.1	74.8
vitamin D (µg)	0.8	51.1	25.3

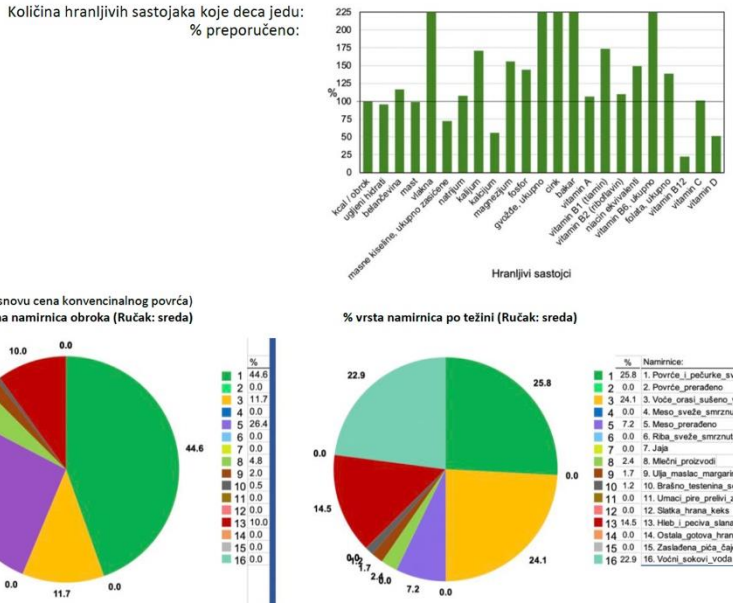


Figure 42. An example of tabular and graphical outputs for winter lunch menu for day 3.

Extensive hyperlinks are provided in the document to allow the reader to navigate easily around it.

So far, the standardised menus have been sent to only one school, which asked to see them. Further distribution of these menus has been disrupted by the Covid-19 pandemic. Discussion of these menus within the Ministry is planned, to promote their dissemination and encourage uptake by primary schools around Serbia. That will ensure nutritionally balanced lunches for schools using their own kitchens, and the generally lower costs of these lunches compared with current lunch normatives may encourage more parents to take up school lunches for their children.

Količina namirnica

Zima - 1. sedmica ukupna količina namirnica

Namirnica	Nedeljna količina po detetu (g)	Nedeljna količina za 100 dece (kg)
Hleb, beli	300.0	33.00
Jaje kokošje, celo (broj jaja, oko 60 g)	1.65 (broj)	165 (broj)
Jabuka	500.0	55.00
Krompir beli	230.0	31.62
Kupus beli svež	120.0	16.50
Šargarepa sveža	97.0	11.86
Sočivo	85.0	9.35
Boranija	60.0	6.60
Paradajz pire	60.0	6.60
Pileće belo meso (prsa)	50.0	5.50
Ulje suncokretovo	49.0	5.39
Crni luk	37.0	4.52
Kisela pavlaka, 20% mm	40.0	4.40
Testenina fusili	40.0	4.40
Mešano povrće za čorbu (supu)	40.0	4.40
Brašno pšenično belo	37.0	4.07
Svinjsko mleveno meso	35.0	3.85
Karfiol	22.0	3.46
Mleko kravlje 2,8% mm	30.0	3.30
Svinjski vrat, butkica, suvo meso	30.0	3.30
Kukuruz šećerac (smrznuti)	25.0	2.75
Mleveno mešano meso	25.0	2.75
Pirinač, belo zrno	15.0	1.65
Rezanci sa jajima	6.0	0.66
Sirće	5.0	0.55
Margarin mlečni	5.0	0.55
Beli luk	2.0	0.24
So	0.8	0.09
Začin C	0.3	0.03
Peršun list, suvi	0.2	0.02
Mirođija list, suvi	0.1	0.01

Figure 43. Annual food quantities for winter week 1 lunch menus, with ingredients listed in decreasing rank order.

12. IMPACT OF COVID-19 PANDEMIC ON THE SCHOOL MEALS PILOT SCHEME IN SERBIA

Covid-19 has effectively turned Strength2Food into a four-year project in Serbia, as far as the school meals pilot scheme is concerned. The Covid-19 pandemic influenced project activities from mid-March 2020, with a state of emergency declared in Serbia on 17th March, followed by lockdown and a strict curfew lasting until 7th May. All schools were closed in March until the end of the school year (mid June). During that period no school visits were possible, so no presentations of Strength2Food findings to schools or their parent council representatives, and no discussions with school directors on modified/improved food procurement procedures. With the resurgence of the pandemic since the reopening of schools in September, school directors have been overwhelmed with responding to changing educational circumstances as staff and children have gone down with the disease. Indeed, at least two directors, as well as project coordinators at a few of our schools, have themselves caught the disease. Telephone calls to schools went unanswered; email requests to provide and exchange information were ignored, and face to face visits to schools were either not allowed (Ministry regulations were introduced to prevent any non-school personnel, even parents, from entering school buildings), or extremely risky. Attempts to organise meetings by Zoom or Skype were not successful because schools were focused 100% on coping with the virus infections whilst still providing some sort

of education for their children. Any travel to schools outside Belgrade has been essentially impossible since September, 2020. One day after having a relatively short meeting with the project coordinator of a Belgrade school in October 2020, the coordinator developed Covid-19. In early December 2020, Serbia achieved the dubious milestone of the country with the highest Covid-19 infection rate in Europe, so many restrictive measures were reintroduced that month.

A further negative impact of the pandemic has been its effect on meal provision by schools since they reopened in September. Over half of our target schools have had to make changes in their meal provision until the pandemic is over, either by reducing the number of meals or cutting out a particular meal. In one school, the cook caught Covid-19. This means the impact of Strength2Food on these schools will be difficult to predict as food procurement arrangements and meal provision will be difficult for schools to plan until widespread vaccinations in Serbia have been carried out. Vaccinations will not be completed until well after the project has finished. During December 2020, years 5 to 8 of primary schools transferred to 100% online teaching. Thus, for those schools that normally give meals either to their older children or to those children on all-day teaching (because their parents are at work) meal provision will cease.

The impact of Covid-19 both on school visits by Strength2Food personnel and on meal provision by our target schools have made any further monitoring of these schools with the children's and parents' monitoring instruments (section 7) both technically impossible to implement and pointless in its purpose because of the limited interventions by Strength2Food personnel since the initial monitoring.

Instead, more emphasis is currently being directed towards the Serbian Strength2Food website (see section 6.1), to act as a surrogate for school visits. A series of video interviews, webinars and podcasts are now planned with a range of key people to demonstrate aspects of the project's recommendations. For example:

- an interview with our school now buying organic vegetables to explain the impact that these are having on school meal finances, their children and parents;
- an interview with a nutritionist to explain the benefits of improved meal nutrition;
- an interview with MPNTR personnel to explain the importance the Ministry gives to school meal provision;
- an interview with the organic cooperative to explain how they want to support schools;
- an interview with a procurement specialist to give advice on how to prepare food procurement documentation to allow local small food suppliers to bid, and how to improve food quality criteria;
- an interview with a former school director who developed a school vegetable garden and the impact this had on the children's and their parent's eating habits, ... and so on.

These website changes are planned to be followed by a publicity campaign (supported by MPNTR and media channels available to EUTA) to recommend *all* Serbia's primary schools (not just those working with Strength2Food) to visit the restructured Serbian project website to learn about the project and how its activities have led to recommendations that schools can implement themselves to improve their children's food habits. Nevertheless, the passive website can never effectively replace the impact of active face-to-face meetings with school stakeholders that were originally planned.

Therefore, despite the solid basis, described above in sections 2 to 11, upon which to make progress, *Strength2Food in Serbia is unlikely to achieve its full potential in improving the quality of school meals and the use of more SFSCs for the provision of school food, despite the 3-months project extension.*

13. OVERALL PROGRESS AND ACHIEVEMENTS

13.1 Overall progress and achievements from action research described above

The extensive Strength2Food questionnaire for schools of section 2, associated internet searches and information analyses have provided the Ministry of Education with its first comprehensive database on meal provision in its primary schools. Of its approximately 1135 primary schools, we collected meal information for 1025 of them (90.3% of primary schools). We established how many schools were using their own kitchens to make their own meals, and how many schools would like to use their kitchens for meals but are not able to. We established how many children were having each type of meal, and how much parents were charged for these. Around 59% of schools used an external caterer to provide meals, though a third of schools (33%) used their own kitchens and staff to prepare meals of various types, mainly snacks. Around 186 schools (18%) provided their own either lunches or cooked breakfasts, which were to be the focus of the WP9.1.1 pilot meal scheme.

Although most kitchen staff had received no in-service training, a small number of schools were implementing HACPP procedures to ensure the safety of their meal provision. We learnt a lot about the foods most disliked by children for breakfast, snack and lunch, as well as the schools' attitudes and policies towards food provision and the extent to which other activities, such as Healthy Food day, were being implemented to improve children's appreciation of food and good nutrition. Valuable information was also collected on school food initiatives that had failed and reasons for their failure. This information from the schools' questionnaire will be passed on to schools in the form of recommendations on how to improve children's attitudes towards food and food habits.

An important aspect that emerged from this questionnaire was the extent of diversity amongst schools in terms of food provision, the numbers and types of meals and the mechanisms used by schools for meal provision. Apart from the city of Novi Sad, for most regions of Serbia there appeared to be no coordination amongst schools on how meals were provided, with decisions being made by individual school directors, with input from each school's Parent Council.

Analysis of school food procurement documents in section 3 gave valuable information on the type and quantities of food being bought for school meals. Well over 4000 food procurement documents were downloaded for at least 386 schools, though food procurement documents for many other large schools known to be serving meals were not available. Together with information from the questionnaire, this allowed us to assess the food categories (vegetables, fruit, pastries, etc) being bought for different meal types in schools using either their own kitchen staff or external caterers. This gave evidence that the quality of meals prepared by the schools' own staff (in terms of proportions of processed foods and bread-based products) was better than in schools using external caterers.

The most frequent number of lots for those schools buying individual food ingredients was one, for convenience, to reduce the administrative paperwork, and to reduce the risk of nobody wanting to bid. However, this meant that the majority of food suppliers were large distributors of foods, sometimes making it difficult to maintain quality for fresh foods, and removing opportunities for local food producers to bid. For example, one of our Novi Sad schools, which puts all foods in a single lot, wanted to buy organic vegetables for school meals but didn't want to create a separate lot just for organic vegetables because of the good relationship the school had with a local food distributor. The school director wanted the new organic vegetable

cooperative to supply vegetables to the distributor, for the distributor to supply them to the school. We advised the new cooperative not to accept this arrangement, so the school went ahead with its procurement without organic vegetables.

As for school meal provision, criteria used by schools for food procurement documentation were also very diverse, with some schools dictating, for example, the minimum storage size available to a supplier and the length in cm of carrots, and other schools using minimal criteria for bidder organisations and just one word, "carrots" for example, to describe fresh vegetables. The lowest bid was nearly always selected, though occasionally schools used their discretion, and previous experience of suppliers to reject the lowest bid.

Two peaks during the year were found for food procurements: March-April and September-October, and the time of year for food procurements could be having an impact on prices for bids for fresh produce, depending on their availability and prices on wholesale markets at the time of year that a school's food procurement documentation was published. Food contracts with suppliers were always for one year, with prices expected to be maintained for the duration of the contract. Some schools struggled to persuade any bidder to bid, with around 15% of all lots having to be readvertised because nobody bid the first time, leading to more administrative work, and frustration for cooks from delays in signing food contracts. The majority of bidders were within 10 km of schools, though some of the large companies were prepared to drive over 100 km for deliveries, presumably because other customers on the delivery round made the distance still sufficiently profitable.

This analysis of school food procurement documents, the first in Serbia for primary schools, has given the Ministry a valuable insight into the main challenges that schools face and gave schools the reassurance that help would be available for them from Strength2Food. The close working relationship developed between Serbian partners and experts in public sector procurement has given schools the confidence to consider changes to their food procurement documentation to improve the procurement process and the quality of food it delivers. This is a major achievement for the project.

Visits to 35 primary schools around Serbia, described in section 4, allowed us to build working relationships with school directors, administrators and kitchen staff, and the large majority of schools were welcoming and cooperative. The time spent working directly with schools during our visits was rewarded by information readily copied and handed to us during visits, or forwarded to us afterwards by email. In addition to clarifying and expanding on information given in the questionnaire and procurement documents, several schools also collected food labels, which allowed us to identify that some of their fresh foods originated many kilometres away in Serbia, while many other foods were foreign imports.

The information collected from the questionnaire, procurement documents and school visits allowed us to make a selection of 30 schools to take part in Strength2Food, though by the time MPNTR had prepared the formal Ministry letter notifying schools of its "Decision" for them to take part, and schools had notified us of their local coordinators, the project was nearing the end of year 2 (January 2018).

Development of the Serbian website (section 6.1), initiated in 2018, ensured that educational resources collected from other project partners (and translated into Serbian), together with project findings from years 1 and 2, and with recommendations from BARILLA following their food preparation demonstrations in two Serbian schools (section 6.2) were available to all school stakeholders by the beginning of the 2018-2019 school year. This is a major achievement for Strength2Food in Serbia, as the website is currently being further developed to include recommendations for each school stakeholder group, and MPNTR will be able to direct schools

towards this website once the project is completed, to provide the project with sustainability and maintain its impact on schools. Thus the stage was set in 2018 to start monitoring schools for the impact of Strength2Food suggestions on school meal provision and educational resources on children's attitudes towards food during the remainder of the project.

The two monitoring instruments, one for children and one for their parents (described in section 7) were available for schools to implement at the beginning of the 2018-2019 school year, and templates have been put on the project's Serbian website. Already a school not on the MPNTR list of project schools has requested to use one of the monitoring instruments for its own purposes. Once the two monitoring instruments had been returned from schools, all the 22,346 completed sheets of paper had to be transcribed into Excel. This took a further 6 months, so results from the two monitoring instruments to establish baseline knowledge and attitudes of children and parents towards food were not available until around the beginning of project year 4 (April 2019).

Analysis of the children's instrument showed how much children's food preferences varied not only from child to child, but also from school to school, with rurality having a major impact on their preferences. It was a major achievement to collect and analyse the knowledge, attitude and practices of over 2000 of their parents, relying solely on schools to distribute the instruments and explain to children how their parents should complete the instrument. This is the first time such comprehensive studies of children's food preferences and their parents' attitudes towards food have been completed in Serbia. However, the scale and complexity of the dataset, which includes information on many other factors both internal and external to the schools, has meant limited statistical analysis so far.

The main findings from combined analyses of the two instruments which demonstrate how parents can improve their children's food habits (to like more foods) were getting children to eat at the same time as their parents, getting parents to try new meal recipes at home, getting their children to do sports activities outside school, and regulating the time their children spend on the TV and electronic devices. Children of parents who gave their children fresh fruit and vegetables every day also liked more fruit and vegetables.

These overall findings for each school would provide a solid baseline upon which to compare any subsequent changes following Strength2Food interventions within those schools. However, as explained in section 12, onset of the Covid-19 pandemic in Serbia has effectively brought regular interactions with our project schools to a halt, and the two monitoring instruments are now not planned to be used again in the project, because worthwhile interventions through school visits have not been possible.

Although the monitoring instruments for children and parents have not been used a second time, children have given the project further useful information on their eating habits, through the food diaries that were completed for a week (section 8). The major finding from these was the very low frequency of eating fruit by many children, with nearly a quarter of children eating no fruit at all during the week. Although vegetables were recorded more frequently, this still amounted to vegetables being eaten no more than once per day. We established that eating vegetables (apart from potatoes) was more frequent amongst Belgrade children, though potatoes and beans were much more frequent amongst rural children.

Section 8 also established a wide diversity amongst normatives amongst schools for meals with the same dishes, despite these normatives being prepared most likely in the past by nutritionists. This was leading to some meal normatives giving insufficient calories and nutrients in some schools. Clearly, it is time for schools making their own meals to be more consistent in the meal recipes that are used, particularly for lunches (and cooked breakfasts), and the resources

prepared by Strength2Food, described in sections 10 and 11), will help schools to be more consistent in providing their children with highly nutritious, but relatively cheap meals.

The Excel Meal Planner, described in section 10, makes it easy for schools to check the nutritional content of their existing meals, and also to test the effect of modifying quantities of individual ingredients to optimise meals for macro- and micronutrients. The Meal Planner outputs are designed to be easily interpreted by the users in the form of graphical presentations as well as numerical formats, based on both actual quantities and relative to MPNTR recommended quantities per meal, a particularly important feature. The Excel tool also allows schools to calculate the realistic cost of each of their meals, and it was clear that our Strength2Food schools could only guess at the cost of their meals, which typically bore little association with the amounts parents were being charged. The Meal Planner also makes schools aware of, not only the amount of plate waste typically generated by a particular meal, but also the school's environmental impact on global warming through CO_2 emissions from meal ingredients.

The other key project resource to help schools be more consistent with their meal normatives was a set of winter and summer lunch recipes (section 11), developed with the help of the Excel Meal Planner. Implementation of these recipes by schools would ensure they are all serving their children lunches with the same nutritional value for minimum cost, no matter where in Serbia the school is located - a particular concern of schools in higher poverty regions of Serbia.

The challenge for the remainder of the project is to get the key findings and recommendations to the schools and their stakeholder groups in the absence of face-to-face meetings. The Strength2Food Serbian website has been restructured in 2021, to target schools and other relevant stakeholder groups with videos and podcasts giving recommendations on how improvements to food procurements, meal nutrition and children's food habits can be made. These are currently being placed on the Serbian project website, which was restructured to improve Strength2Food's impact and compensate for the lack of face to face contact with schools or other stakeholders since March 2020 because of the Covid-19 pandemic restrictions on school visits.

13.2 Dependence of progress and achievements on other S2F project activities

13.2.1 Interactions with other Strength2Food WPs

Activities for the school meals pilot scheme have benefited considerably from work carried out for other WPs, particularly WP2 Hybrid Forums (2.4), WP6 Plate waste (6.2) and School meal procurement strategies (6.3). By careful choice of complementary expert participants for the series of three Hybrid Forums we ensured that our schools were able to learn at first hand about the opportunities to make improvements to their food procurement procedures, to learn about the benefits of using fresh vegetables and fruit from local growers, and to appreciate the possibilities of introducing organic vegetables into the weekly meal menus. Nutritionists were able to emphasise the health risks for children associated with current diets and gave advice to schools on how to improve child nutrition. Each Hybrid Forum provided an opportunity for schools and vegetable growers to interest, for each to gain trust in the other. This led to Serbia's first primary school providing organic vegetables to its children during 2020, as described in section 13.2.2.

WP6 tasks provided the school meals scheme with information on plate wastes and food CO_2 emissions which have been incorporated into the Excel Meal Planner (section 10). The detailed analysis of food procurement documentation, lot numbers, food supplier locations, and weekly food delivery schedules for schools, needed for WP6.3, gave us valuable information to discuss with schools on how they might improve their procurement procedures.

13.2.2 Cross-fertilisation with WP9.5.1

The pilot school meals initiatives of WP9.1.1 to stimulate SFSC could not succeed in increasing the uptake of more food from local suppliers and to improve meal quality using modified food procurement procedures without close integration with the supply side of the equation of WP9.5.1. The two sets of activities have essentially worked side by side, and visits to schools have also frequently been combined with discussions with suppliers and other stakeholders, such as the Ministry of Agriculture and local authorities, that have been essential to provide the necessary joined-up thinking, procedures and support to make progress within the schools. Having decided to focus on organic vegetable growers because of their relative proximity to schools in Novi Sad and Belgrade, synchronising the timing of activities with both schools and organic growers was essential to ensure we had a suitable organic vegetable grower organisation set up to bid for school food contracts at the same time that we had persuaded schools to commit to buying organic vegetables for their kitchens.

Because of the considerably higher prices in Serbia for locally-grown organic vegetables, compared with the relative cost of organic vegetables in many other European countries, we had to convince schools that, not only would the substitution of conventional fresh vegetables with organic vegetables be economically realistic (by keeping overall meal prices low), but that we could provide schools with organic growers that had the capacity to maintain steady supplies of vegetables throughout the school year and that schools could trust the organic veracity of the vegetables provided (false organic certificates are occasionally an issue in Serbia that makes schools wary of small suppliers).

Thus we had to use school food contract prices and organic vegetable prices from the cooperative growers to calculate annual increases for schools of procuring organic vegetables. While organic prices for individual vegetables were typically over twice those of conventional fresh vegetables, on an annual basis for all foods purchased, total food budgets would increase by only around 5% (2.5-8.2% for eight schools). This was sufficient evidence to convince schools that substituting conventional vegetables with organic vegetables would be an economic proposition, and several schools were in the process of discussing organic vegetables in their procurement documentation when the Covid-19 pandemic closed down all schools, and Strength2Food discussions with schools stopped.

13.3 Overall progress and achievements against objectives

The text of WP9.1.1 of the GA provided guidelines to steer the activities with schools. Activities carried out in accordance with the proposal texts are described briefly in this section.

"The work to be done will start with a combination of encouraging schools to change their procurement policy in areas where we know suitable food producers exist"

Work in Sub-Task 9.5.1 identified suitable organic food producers around Belgrade and Novi Sad, so changes in food procurement policy focused on schools in these two cities, with the first school to include organic vegetables in its procurement documentation being in Belgrade.

"For the school pilot schemes we shall test a range of educational resources provided by BARILLA, UNED and BEL"
Educational resources have indeed come from BARILLA, UNED and BEL, as well as from ZAG and EUFIC and from others external to the project in Serbia. After translation where necessary, these have been uploaded onto the Serbian Strength2Food website. Testing with these resources in schools has not been possible because of the Covid-19 pandemic.

"We shall compare at least 10 schools adopting new, more nutritious meals with 10 similar schools continuing with their existing meals."
MPNTR invited 30 primary schools to take part in Strength2Food, to act as target schools to adopt new and more nutritious meals. A further 9 schools contributed to the monitoring programme and food diaries, acting as control schools which either used caterers for their meal provision or served no meals.

"We shall focus the improved meals in primary schools providing at least 50 school meals per day."
To broaden the scope of the school meals scheme to be more representative of both urban and rural communities, several rural schools serving fewer than 50 lunches per day were included amongst the 30 schools.

"starting in autumn of year 1 we shall monitor those schools using their current meals procurement practice to test methodology and identify potential problems in introducing the new meals."
A detailed data-gathering exercise was needed at the beginning of the project to establish where schools making their own meals (particularly lunches) were located. Because of this, and the need to clarify/confirm information through an extensive programme of school visits, which also helped project personnel to gain the schools' trust, MPNTR was not able to invite schools to join the pilot school meals initiatives until near the end of year 2, with school monitoring beginning during year 3. Nevertheless, extensive information on actual and potential problems in introducing new meals were collected from schools during the programme of school visits which began during year 1.

"New meals will be introduced in project year 2 and the pilot scheme monitored for three school years"
Independently of Strength2Food, MPNTR decided to implement its own initiative to improve the nutritional quality of school meals by introducing Serbia's first Regulations on meal provision in September, 2018 (MPNTR, 2018), during project year 3. While Strength2Food was able to contribute recommendations for inclusion in the new Regulations, it meant that schools were already making changes to their meals before the set of Strength2Food winter and summer lunch menus, described in section 11, was available to be introduced to schools. Because of the time taken to select schools and intervention by the Covid-19 pandemic restrictions, it was not possible to monitor schools for three school years.

"This pilot scheme will provide information on strategies to encourage schools to change their procurement policy, strategies to get children to change their eating habits, reduce food waste, as well as information on how to put schools and suitable local food suppliers together."
The activities described in sections 2 to 10, above, together with the plate waste study of WP6.2, have provided a wealth of information from which strategies have been identified to encourage schools to change their procurement policy (one school now buying organic vegetables), to get

children to change their eating habits (findings from the two monitoring instruments), and to reduce plate waste (described in the new menus of section 11). A new Strength2Food-facilitated organic vegetable cooperative is now supplying organic vegetables to its first school and 2-3 other schools are currently considering similar changes to their procurement arrangements. However, Covid-19-induced uncertainties regarding future school meal provision are making decisions on food procurement difficult.

"MPNTR will use the outcomes of these school meals pilot initiatives to develop future policy on school meal nutrition, and encourage all its over 1200 primary schools to adopt more nutritious meal procurement policies."
As stated above, Strength2Food activities fed recommendations to MPNTR for its new school meals Regulations. These Regulations apply to all '1200' primary schools.

"a) BARILLA will provide advice on preparing tasty and nutritious school meals (culinary, technical equipment etc.)"
BARILLA provided advice on lunch preparation and meal nutrition to representatives, mainly cooks, of most of the Strength2Food target schools during two visits of BARILLA personnel to Serbia, one of those visits being demonstrations of culinary procedures.

" b) To encourage further the acceptance by children of more nutritious school meals, culinary recommendations will be collated into a selection of up to 40 recipes with text and pictures."
BARILLA provided a set of 45 recipes which have now been translated into Serbian and uploaded to the Serbian Strength2Food website.

"Videos for some of these recipes are planned (with suitable sub-titles) to improve the cooking proficiency of school chefs."
BARILLA provided videos of three of these recipes, which are uploaded on the Serbian Strength2Food website with sub-titles in Serbian.

"c) A prize scheme will be introduced to stimulate cooks of school canteens/caterers to improve the nutritional content and attractiveness to children of school meals."
This activity was not completed because of lack of time (selection of schools and monitoring their meals starting in September, 2018, project year 3) and, by that time, lack of resources.

14. RECOMMENDATIONS FROM OUR FINDINGS

Recommendations have been developed for each target group of our pilot school meals initiatives: school directors and administrators, teachers, children, kitchen staff, children's parents and the Ministry of Education, representing the key relevant policymaker. While most of these recommendations have arisen directly from our action research, we also give examples of best practice collected from elsewhere, and either reworked or translated for Serbian stakeholders. Recommendations are summarised here, with detailed information given in WP10.7. Our project's stakeholders can also find recommendations on the restructured Serbian Strength2Food website (see section 6.1), available at https://www.strength2food.rs.

14.1 Recommendations for schools and administrative staff

Key requirements of the 2018 Ministry Regulations on school meal provision are listed, which include recommendations on sales of snacks and pastries to children on school premises. Recommendations on PSFP procedures include an example of procurement documentation illustrating suitable criteria for both bidder eligibility and food quality, with standard formatting to make it easier for every school serving its own meals to ensure the same standards for food being procured. Number and type of lots are discussed to optimise prospects for receiving good quality food from local suppliers.

Schools are also given recommendations on how plate waste from meals can be minimised by optimising meal timing and canteen arrangements.

Schools are recommended to revue carefully their meal pricing policies for parents. Regulations require schools to charge parents only for the cost of meal ingredients, yet our analyses of ingredient costs based on menu normatives show that schools are often charging parents more than the cost of ingredients, and this over-charging would be even greater for schools adopting the cheaper lunches described in the Strength2Food standardised menus (section 11), which schools are recommended to use.

Schools are also advised to use the Meal Planner tool (section 10) which is freely available, in their future planning and setting up of school meals.

Procurement food categories showed that engaging a caterer to provide meals can lead to a less healthy children's diet compared with meals prepared on school premises. Therefore, active measures (such as, equipping schools with facilities, utensils and appliances and increasing the kitchen staff) should be employed and nationally regulated to improve children's health. We recognise these measures would need financial support from the Ministry or elsewhere.

14.2 Recommendations for teachers

A collection of educational resources targeting teachers is provided on the Serbian Strength2Food website, together with further details given in WP10.7. These include workshops on aspects of food and nutrition for teachers to use during classes. The full report is available at https://www.strength2food.eu/2021/02/25/report-on-educational-resources-for-schools/.

14.3 Recommendations for children

Inevitably, recommendations for primary school children would need to be passed on to them by either teachers or parents/carers. As well as a number of presentations to be shown to children in school by their teachers, a collection of 5 video animations has been prepared by BEL targeting the schools' youngest children to give them easily understood and enjoyable information on healthy foods and eating, as well as the importance of drinking plenty of water during the day.

14.4 Recommendations for their parents

Analysis of results from the two monitoring instruments of section 7, led to recommendations on the parent practices that would have most impact on their children's eating habits and food preferences. Apart from giving children more vegetables and fruit, parents should get their children to eat meals at the same time as they do as far as possible. Parents who enjoy experimenting with new recipes for meals at home have children who like a wider range of foods. Parents who encourage their children to be more active physically outside school and who are more strict in regulating their children's time on electronic games, etc. will tend to have children who like more foods and leave less food waste.

Parents are also recommended to get their children to eat meals provided by the schools, instead of giving their children money to buy food on the way to school. Section 11, above, has demonstrated that highly nutritious school meals can cost less (only 40-60 dinars for lunch) than the amount of money many parents give their children to buy lunch outside the school (90-150 dinars).

We also recommend that parents should encourage their schools to improve the quality of their children's school meals, which can be done either without any increase in meal prices, using conventional vegetables, or with only small increases in food prices if organic vegetables are used.

14.5 Recommendations for cooks and kitchen staff

Recommendations have been prepared for cooks on how they can improve the nutritional balance of their lunches (section 11), and how they can reduce plate waste by serving more energy-dense meals, which allow children to take in more nutrients in a given time. Rearrangement of meal presentation and serving arrangements in the canteen can also help to reduce plate waste.

The BARILLA videos (section 6.2) give recommendations on saving time with food preparation and how to prepare dishes in the most nutritious way, and the new Ministry Regulations give cooks recommendations on weekly frequencies of using different food categories, such as fruit, eggs, fish and pulses in lunches.

14.6 Recommendations for policy makers

Recommendations for policy makers that would lead to increased expenditure on primary schools are unlikely to be adopted. On the one hand, the Ministry emphasises the importance of schools providing nutritious meals, though on the other hand, during the course of the project financial regulations for schools have changed, making it more challenging for schools to resource the kitchen staff essential to make (and serve and clear away) enough meals in the time available for lunch breaks. School cooks are also on minimum wages, which is a poor reward for their dedication to work unsocial hours and to be responsible for ensuring the health and nutritional well-being of their children. A recommendation to the Ministry to reverse their recent financial strictures would obviously help schools to encourage more children to eat school meals, but is unlikely to be enacted.

However, the Ministry is much more likely to accept recommendations to adopt the Excel Meal Planner for Serbian schools and to encourage schools to refer to the resources now available on the Serbian Strength2Food website, which will be maintained either by EUTA or by MPNTR after the project finishes.

15. SUMMARY AND CONCLUSIONS

The pilot school meals initiatives in Serbia were aimed at stimulating SFSCs through improvements in school food procurement procedures which, together with changes in school meal nutrition, would help tackle Serbia's increasing problems of childhood obesity and malnutrition, as well as encourage schools to support local food producers. This task (WP9.1.1) could not have achieved these objectives without parallel activities of task 9.5.1 to tackle the supplier side of the equation, and the two tasks required close coordination, both in terms of timing and phasing of activities. Despite the severe curtailment of activities during the final project year caused by the Covid-19 pandemic, the majority of initial objectives were met. The following activities were completed to deliver new insights into meal provision in Serbia's primary schools and progress achieved in reaching WP9.1.1 objectives.

* Schools questionnaire: Strength2Food primary schools questionnaire generated a wealth of information on primary schools that was new to MPNTR. The Ministry now has extensive details on meal provision in its primary schools. MPNTR is now also more familiar with the challenges schools have faced with implementing the procedures for PSFP. However, some of our findings on the workings of procurement Law have become redundant during the last year (2020) following the implementation of a new Procurement Law, which has provisions that will take several of our schools outside the need to use Procurement Law for food procurement.

* Food procurements: analysis of food quantities from over 4000 school food procurement documents showed that meals in schools making their own meals on average had better nutritional balance than schools serving meals provided by caterers. For schools serving their own meals, the most frequent number of procurement lots was one, and around 15% of lots received no bidders, requiring re-tendering and delays in signing food contracts. March-April and September were the most favoured times during the year for food procurements, though some food procurements occurred every month of the year. The majority of food suppliers were major distributors located within 10 km of schools.

* School visits to collect information: these provided useful information on where food bought for meals originated. While the majority of foods originated in Serbia, many were imported, including some vegetables that are widely grown in Serbia (such as beans and sweet peppers). Contract food prices allowed us to compare effects of procurement time of year, and some schools procuring food in the winter were paying higher prices for vegetables than schools with food procurements during the summer.

* Criteria for selecting schools: the wealth of background information on schools allowed us to select 30 that were providing their own meals, particularly lunches or cooked breakfasts, that were accessible to the Strength2Food teams in Serbia, and that represented a spread of urban and rural locations, differing markedly in school size and levels of poverty.

* Website educational resources and BARILLA demonstrations: to ensure Strength2Food educational resources, prepared by several partners, were as widely accessible as possible to schools, teachers, cooks, children and children's parents, a dedicated Strength2Food website

was established to provide all resources in Serbian, targeting each of those stakeholder groups, and giving news items and recommendations for each stakeholder group. Educational resources, including video animations, BARILLA menus and cookery demonstrations were all translated into Serbian, or given Serbian subtitles. Three BARILLA demonstrations of meal preparations (using locally grown organic vegetables) were demonstrated in two schools, with cooks attending from 13 schools.

* Children's instrument: the target schools were screened to monitor children's current food preferences using an instrument of 90 food images to be scored by7-8-year-old children with happy or sad smileys. Around 4000 children completed the monitoring instrument in 33 schools, six being schools using caterers for meals. As expected, vegetables were the foods with the most sad smileys, and fruits the foods with the most happy smileys. Rural children liked more traditional foods than urban children, and urban children liked more non-Serbian foods, like pasta and rice.

* Parents' instrument: over 2000 parents completed an instrument to test their knowledge, attitudes and practices towards food using a five-point Likert scale. Analysis focused on parents' practices and the effects these had on their children's food preferences. Parents in rural schools gave their children less fruit and vegetables than urban parents, but they enjoyed trying new recipes more than urban parents. Children of parents who got their children to eat at the same time as they did like more foods. Giving children fresh fruit and vegetables every day also led to their children liking more foods.

* Normatives and food diaries: meal normatives varied considerably amongst schools in the quantities given and nutritional contents, and frequently providing fewer calories than recommended. Quantities actually served also varied up to 40% compared with normative quantities, which, allowing for plate wastes, meant that many children were not getting the recommended quantities of energy and nutrients from school meals. Food diaries completed by 419 children showed high intake of flour-based processed foods, vegetables eaten around once per day, but fruit only around three times a week, and nearly a quarter of children recording ***no*** fruit per week.

* Children's nutritional knowledge: Although children seem to have good knowledge of the benefits of vitamins, they need to be given more information in schools on all nutrients in general, while the importance of fibre, in particular, in a healthy diet needs to be emphasised more. All children should be given more education on certain food categories and their properties, such as proteins or fatty food. Younger children, boys and children in the rural towns appear to have lower levels of knowledge on healthy diet than older children, girls and children from the capital city. These differences across groups should be taken into account in preparing educational materials, while some materials are developed within task 10.5.

* Excel meal planner: to help schools adjust their menu normatives according to Ministry recommended quantities of energy, macro- and micro-nutrients, and to plan food quantities for a week of menus, a meal planner tool was prepared in Excel. This allows schools to enter meal ingredients and quantities for up to four meals per day (breakfast, 2 snacks and lunch) and gives tabular and graphical outputs of energy, macronutrients, minerals and vitamins, as well as meal costs and CO_2 emissions for food production. Quantities of each ingredient used per week are given to help schools plan weekly food deliveries.

* Standardised winter and summer menus: to overcome the diversity amongst schools in their meal normatives, a set of two winter and two summer menus for lunches was prepared, based on existing school meal normatives, but with ingredients adjusted to provide Ministry of Education-recommended quantities of energy, macronutrients, minerals and vitamins.

Alternative menus are also given for schools with relatively short lunch breaks, so that total meal quantities are reduced by giving more energy-dense dishes.

* Impact of Covid-19: restrictions imposed by the Covid-19 pandemic in Serbia meant that meetings with school personnel or other project stakeholders essentially ceased in March 2020, and schools focused their efforts on keeping the schooling going rather than respond to queries about Strength2Food. The pandemic has effectively brought an end to any major interactions with schools during the final project year.

* Overall progress and achievements: together with the achievements of WP9.5.1, Strength2Food can report a success story with at least one of our target schools, which changed its annual food procurement documentation during July, 2020 to include a separate lot for organic fresh vegetables. Only one organisation bid for the lot, which was a new organic vegetable cooperative established in February 2020 through WP9.5.1. The contract was signed in August 2020 and this school is now receiving organic vegetables for its school lunches - *the first primary school in Serbia to do so*. Deliveries of organic vegetables continue during 2021.

* *This is a major achievement for the project* and if it were not for the untimely intervention of Covid-19, we expected 2-3 other schools in the Belgrade and Novi Sad areas to introduce organic vegetables into their procurement documentation during 2020/2021. This may still be possible, as schools have their procurement procedures at varying times during the calendar year, including the final month or two of Strength2Food, though school meals are still affected by Covid-19-enforced reorganisation of meal delivery (numbers and types of meals).

* Recommendations: recommendations have been prepared separately for schools and administrative staff, for teachers, children, and their parents, for cooks and kitchen staff and also for policy makers. These have been placed on the revised Serbian Strength2Food website.

* The resources developed during the project to help schools improve their meal nutritional quality (Excel Meal Planner and standardised menus), as well as other educational resources on the website targeting each of the schools' key stakeholder groups will be a lasting legacy of the project for use by MPNTR and Serbian schools.

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APPENDICES

Where documents were prepared to be used in Serbia, Appendices are given for both Serbian and English versions of the texts. Most Appendices are available as hyperlinks to the relevant document on Strength2Food website.

Appendix 1:

Questionnaire: Basic data on schools and meals

English: App 1 Online questionnaire on meals in primary schools
Serbian: App 1 Upitnik o ishrani učenika u osnovnim školama sr

Appendix 2:

Ministry of Education, Science and Technological Develop letter to schools

English: App 2 Odluka Ministry of Education school invitation
Serbian: App 2 Odluka o izboru skola

Appendix 3:

Children's monitoring instrument food images and score sheet

English: App 3 Children food images with numbers
Serbian: App 3 Children food images with numbers
English: App 3 For children smiley score sheet
Serbian: App 3 Upitnik o ishrani učenika u osnovnim školama en

Description of food categories for the children's monitoring instrument, internal controls, strategy used to select foods for the instrument, and methods of use by schools:

- 19 vegetables, a mixture of fresh, cooked, processed, main course and salads, but excluding potatoes
- 11 fruits, including 2 colours of a whole apple
- 7 pasta dishes, with different types of pasta
- 5 rice dishes, including plain boiled rice
- 3 soups, typical for Serbia
- 7 main course dishes, based on meat, cheese or legumes, mixed with other vegetables
- 7 meats in chunks, minced (meat balls of various sorts), chicken meats
- 3 fish dishes, including two images of different types of white fish fillets
- 4 dairy products, milk and yogurt, plain and sweetened
- 3 potatoes prepared in different ways
- 6 flour-based dishes with wheat or maize flour, such as pizza, sausage roll, maize bread, wheat bread
- 2 sweet foods, including one typical lunch dessert
- 5 unclassified foods, not fitting easily into any other category, such as eggs and mushrooms
- 8 never-tasted foods (foods that children would be very unlikely to have tried – typically non-Serbian foods), which would act as 'negative' controls in most cases (100% "?" smileys). These included some foods proposed by BARILLA, such as vegetable lasagne.

Three pairs of identical food images were included (chopped cabbage, sliced apple, rice with vegetables), as well as three pairs of different images of the same food (2 types of apple, 2 types

of stuffed peppers and 2 images of cooked fish) to act as internal controls. These were randomly distributed amongst the 90 food images.

Within each category, several foods were likely to be familiar to children, including several that they would almost certainly like (typical Serbian school meal foods), as well as foods that they almost certainly would be less keen on, and foods that they may not be familiar with (at least by sight). Where appropriate and possible, images of foods were selected to show the food as it would be found in a typical meal. A major criterion for selecting images was that the food should be recognisable by sight alone. Thus, images were cropped occasionally to exclude other potentially confounding meal components. For several foods, different colours, shapes and forms were included (such as apples, pasta and potatoes), in case it is primarily colour or shape that determines a child's food preference. For example, children might prefer a red apple to a yellow apple, or a sliced apple to a whole apple.

Images for the children's instrument were designed to be given to children as a PowerPoint™ document (with images of foods, containing the food name and a number, from each food category distributed randomly in the document) to be used with a projector and screen. However, a couple of small rural schools asked for images to be printed in colour to be handed to children as the schools lacked projection facilities. This version of the instrument had 15 colour images per page.

Appendix 4:

Parents' monitoring instrument of statements

English: App 4 Parents' monitoring instrument
Serbian: App 4 Parents' monitoring instrument

Appendix 5:

Monitoring instrument instructions

English: App 5 monitoring instrument instruction
Serbian: App 5 Children's monitoring instrument

Appendix 6:

Internal and external variables used for multi-level analyses, and multi-level methodology

Table of Variables: App 6 Table of variables used for multi-level analyses
Details of methodology: App 6 Details of methodology for multi-layer analyses

Appendix 7:

Food diary instructions and template for one week of meals

English: App 7 Food diary teacher instructions
Serbian: App 7 Food diary teacher instructions

Appendix 8:

Questionnaire to assess children's nutritional knowledge

English: App 8 Questionnaire on children's nutritional knowledge
Serbian: App 8 Questionnaire on children's nutritional knowledge

Appendix 9:

Instruction sheet to accompany questionnaire to assess children's nutritional knowledge

English: App 9 Instruction sheet for nutritional knowledge questionnaire
Serbian: App 9 Instruction sheet for nutritional knowledge questionnaire

Appendix 10: Children's knowledge on the healthiness of individual food items according to gender, age and school location

Food item	Location	Age	Gender	Children answers by modalities (N)
Apple	Everybody knows it's healthy			healthy – 570 I don't know – 1
Beans	In Arilje and Ivanjica they don't know	Younger children don't know or think it's unhealthy. Spearman = - 0.149***		healthy – 506 unhealthy – 12 I don't know – 50
Bread	Cramer's V = 0.138** 0.021	Spearman = -0.084**		healthy – 298 unhealthy – 146 I don't know – 116
Broccoli	Everybody knows it's healthy			healthy – 546 unhealthy – 8 I don't know – 14
Burek (meat pie)	In Ivanjica a lot of them consider it to be healthy or they don't know			healthy – 55 unhealthy – 427 I don't know – 74
Hamburger	In Belgrade and Ivanjica about 10% of children consider it to be healthy. Cramer's V = 0.133*		Cramer's V = 0.092*	healthy – 41 unhealthy – 472 I don't know – 46
Cabbage	Everybody knows it's healthy			healthy – 552 unhealthy – 6 I don't know – 4
Candy	In Bajina Bašta 10% of them think it's healthy. Cramer's V = 0.143**	About 5% of the youngest participants think it's healthy		healthy – 20 unhealthy – 525 I don't know – 14
Carrot	Everybody knows it's healthy			healthy – 555 unhealthy – 5 I don't know – 2
Muesli	In Bajina Bašta, Ivanjica and Latvica a lot of children didn't know. Cramer's V = 0.127*			healthy – 429 unhealthy – 46 I don't know – 91
Cheese	In Belgrade about 20% think it's unhealthy or they don't know		Cramer's V = 0.095*	healthy – 488 unhealthy – 28 I don't know – 46
Chocolate bar	In Bajina Bašta 20% of them think it's healthy. Cramer's V = 0.226***	Younger children slightly more think it's healthy Spearman = -0.085**		healthy – 33 unhealthy – 518 I don't know – 12
Cookies	Apart from Belgrade and Obrenovac, a lot of children think cookies are healthy. Cramer's V = 0.152**			healthy – 106 unhealthy – 370 I don't know – 84
Croissant	In Ivanjica a third of children and in Belgrade and Arilje it is about 15% of kids that don't know. Cramer's V = 0.143**		Cramer's V = 0.135**	healthy – 55 unhealthy – 427 I don't know – 78
Doughnut	In Bajina Bašta and Osečina about 20% of children consider doughnuts to be healthy, while in Latvica and Ivanjica they are		Cramer's V = 0.160***	healthy – 52 unhealthy – 479 I don't know – 29

	ambiguous. Cramer's V = 0.215***			
Egg	Everybody knows it's healthy In Belgrade and Ivanjica about 10% of children think either it's unhealthy or they don't know. Cramer's V = 0.161; 0.004			healthy – 511 unhealthy – 20 I don't know – 31
Fish		Older kids better know it's healthy. Spearman = - 0.147***		healthy – 507 unhealthy – 28 I don't know – 29
French fries	In Ivanjica, Osečina and Latvica a 13-19% of children think it's healthy. Cramer's V = 0.202***			healthy – 58 unhealthy – 466 I don't know – 33
Hot-dog	Everybody knows it's unhealthy			healthy – 34 unhealthy – 473 I don't know – 44
Ice cream	In Bajina Bašta a fifth of children think it's healthy. Cramer's V = 0.155**		Cramer's V = 0.104**	healthy – 44 unhealthy – 477 I don't know – 32
Milk	Everybody knows it's healthy			healthy – 529 unhealthy – 13 I don't know – 20
Nuts	Everybody knows they're healthy			healthy – 513 unhealthy – 17 I don't know – 32
Pizza	In Ivanjica and Osečina about 20% of children think either it's healthy or they don't know. Cramer's V = 0.151**	Spearman = 10.1**		healthy – 30 unhealthy – 485 I don't know – 36
Pop corns	In Ivanjica and Osečina about 30% of children think it's healthy. Cramer's V = 0.161**			healthy – 112 unhealthy – 373 I don't know – 65
Rice	Only in Bajina Bašta 10% of children think it's unhealthy. Cramer's V = 0.140**			healthy – 492 unhealthy – 25 I don't know – 45
Sausage		Younger children are more prone to think it's healthy Spearman = -0081*		healthy – 103 unhealthy – 384 I don't know – 65
Carbonated drink	In Bajina Bašta a lot of them don't know. Cramer's V = 0.223***		Cramer's V = 0.107**	healthy – 16 unhealthy – 524 I don't know – 17
Yogurt	In Ivanjica 17% don't know. while in Osečina 17% think it's unhealthy. Cramer's V = 0.173***		Cramer's V = 0.090*	healthy – 493 unhealthy – 24 I don't know – 41

Note: * - significant at the level 0.10; ** - significant at the level of 0.05; *** - significant at the level of 0.001.

Appendix 11:

Winter and summer standardised menus. Note, only the introductory information and section headings are translated into English.

English: App 11 Winter and summer menus for school lunches 0% waste
Serbian: App 11 Winter and summer menus for school lunches 0% waste

PART 2. PILOT SCHOOL MEALS INITIATIVES IN CROATIA IN SCHOOLS WITH GARDENS

Deliverable 9.1.2 (March 2021)

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LIST OF TABLES

Table 1. Recommended daily intake of energy and nutrients according to age and gender for planning the school nutrition 121
Table 2. Daily recommended intake of vitamins and minerals 122
Table 3. School with garden poverty rate 127
Table 4. School without garden poverty rate 129
Table 5. Description of the garden space, names of activities, users and timetable 130
Table 6. Number and type of meals in 14 primary schools 135
Table 7. National recommendation for energy and nutritive values of school meals and daily menu models 136
Table 8. Energy and nutritive values in breakfast at schools with and without garden 138
Table 9. Energy and nutritive values in lunch at schools with and without garden 139
Table 10. Energy and nutritive values in snack at schools with and without garden 140
Table 11. Adjusted quantity of recommended fruit and vegetables according to Croatian nutritional guidelines 146
Table 12. Average annual daily amount of fruits and vegetables in school with and without garden 146
Table 13. Preference of fruit and vegetables of students from schools with/without garden 151
Table 14. Students preference scores of fruits and vegetables 151
Table 15. Total and category plate waste in schools 156
Table 16. Like score of selected dishes in students from schools with and without garden .. 157
Table 17. Preference of fruit and vegetables of students from schools with and without garden after implementation of education 162
Table 18. Students preference scores of fruits and vegetables school with garden 162
Table 19. Student preferences scores of fruits and vegetables school without garden 164
Table 20. Preference scores of students from schools with and without garden after the implementation of education, based on selected dishes 166
Table 21. Quantity of consumed fruits and vegetables among the students from schools with and without a garden 167
Table 22. Frequency of consumed fruits and vegetables among the students from schools with and without garden 168

LIST OF FIGURES

Figure 1. School selection algorithm 123
Figure 2. Location of school with and without garden 124
Figure 3. Pictures of schools' gardens 134
Figure 4. Average proportions of macronutrients in daily menus of schools with and without garden 141
Figure 5. Distribution of menus whose macronutrient ratio meet the recommendation 142
Figure 6. Proportion of daily menus in school with and without garden that met National recommendations for energy and macronutrients 143
Figure 7. Proportions of daily menus in schools with and without garden that met National recommendations for vitamins 144
Figure 8. Proportions of daily menus in schools with and without garden that met National recommendations for minerals 145
Figure 9. Percentage of meals in which were offered fruits and/or vegetables in menus in schools with and without a garden 147
Figure 10. Distribution of procured types of fruits in schools with and without garden 148
Figure 11. Distribution of procured types of vegetables in schools with and without garden 148
Figure 12. Distribution of different vegetable categories 149
Figure 13. Distribution of different fruit categories 149
Figure 14. Percentage of offered local and seasonal vegetables in annual menus of primary schools with and without garden 150
Figure 15. Percentage of offered local and seasonal fruits in annual menus of primary schools with and without garden 150
Figure 16. Reasons for not finishing the meal among students (n=7620) who did not eat whole served food from vegetable category in schools with and without garden 158
Figure 17. Reasons for not finishing the meal among students (n=269) who did not eat whole served food from fruit category in schools with and without garden 158
Figure 18. Examples of teaching aids 160
Figure 19. Insights from nutritional educations 161
Figure 20. Four different meals made of kale (stew, chips, smoothie, fritter) 170
Figure 21. Study in progress 170
Figure 22. Acceptance of kale dishes by age (n=63) 171
Figure 23. Muffin with polenta and vegetables 172

1. INTRODUCTION

Adequate nutrition is extremely important in childhood not only because it provides enough energy and nutrients for adequate growth and development (Wijnhoven et al., 2015), but also because it can protect against obesity and non-communicable chronic diseases in adulthood (Nicklas and Hayes, 2008). Eating habits adopted in childhood are often maintained in adulthood (Mikkilä et al., 2005; Kelder et al., 1994), so it is important to expose children to foods with a positive impact on health and teach them proper food choices. Primarily, this applies to fruits and vegetables that have shown a protective effect on a large number of diseases (Hartley et al., 2013; WCRF, 2017), and children often do not consume them in sufficient quantities (Kuzman et al., 2012; Williams et al., 2020). As many as 66% of children in Croatia do not eat fruits every day, and 76% of them do not eat vegetables every day (Kuzman et al., 2012; Williams et al., 2020).

While parents and family environment constitute a fundamental factor in influencing children's nutrition (Scaglioni et al., 2008), schools where children spend a good part of the day also play an important role in children's nutrition (Buzby and Guthrie, 2004). Children participating in a school nutrition program consume at least one meal prepared at school and this affects their daily intake of nutrients and energy (Smith and Cunningham-Sabo, 2013).

The Ministry of Health of the Republic of Croatia has issued National Guidelines for the Nutrition of Students in Primary Schools that provide practical instructions for planning meals and compiling menus in primary schools (Capak et al., 2013). They list daily energy and nutritional needs with respect to age and gender for children aged 7 to 18, with examples of menus. Among other things, the recommendations prescribe the energy value of individual daily meals with regard to age and suggest which types of food and meals are desirable and which should be limited or consumed infrequently.

Children at school can have up to four meals, each of which contributes a different share to the overall energy intake: morning snack 20%, breakfast 15%, lunch 35%, snack 10%. The national guidelines recommended daily intake of water, milk, dairy products, cereals, cereal products, potatoes, fruits and vegetables. A group of foods that includes meat, poultry, eggs, legumes, nuts, and seeds is also recommended daily, noting that meat is limited to five times a week. Fish is recommended to be consumed once to twice a week, and foods high in fat, sugar and salt should not be consumed more than twice a month. It is important to pay special attention to the way food is prepared: meals should be acceptable in taste, appearance and odours to children, who can often be picky and have difficulty accepting new dishes (Capak et al., 2013).

When meals are prepared in schools according to guidelines and served in portions that meet the needs of children, the problem arises when children do not eat as much as anticipated. This means that children, in nutritional terms, do not realize all the benefits of that meal, and in the end, a lot of food is thrown away (Buzby and Guthie, 2004). In addition, the rest of the food on the plate represents a waste of energy and resources used to produce it, as well as a financial cost (FAO, 2011).

Given the worrying eating habits of children in Croatia (Kuzman et al., 2010; Williams et al., 2020), the Ministry of Agriculture launched the School Fruits and Vegetables Scheme in 2013 with the aim of preventing and reducing obesity, and increasing the intake of fresh, seasonal fruits and vegetables in the daily diet of students from 1st to 4th grade schools in the Country. The program ensures a weekly delivery of subsidized fresh fruits and vegetables to all schools involved, which are responsible for the preparation and distribution of these foods to students.

Pollak et al. (2016) state that the consumption of fruits and vegetables among children has increased since the beginning of the implementation of the program. A questionnaire conducted among 4th, 6th and 8th grade students indicates that almost 50% of children consume fruits and vegetables every day during the workweek, while on weekends this share rises to 70%. The program was well received and expanded over the years, and ultimately included older elementary school students as well as high school students. It is estimated that in the school year 2016/2017, about 290,000 primary school students and about 160,000 secondary school students received free portions of fruit and vegetables throughout the year, in about 1,200 schools throughout the Republic of Croatia (Government of the Republic of Croatia, 2016).

In the context of national efforts to improve children's eating habits, school gardens have emerged as an innovative and potentially engaging strategy to improve vegetable intake among children, as they increase students' exposure to vegetables, which may positively impact attitudes, preferences and eating behaviours. Garden-based experiences provide a context for understanding seasonality, add a sensory domain to learning, and foster a better understanding of how the natural world is sustained and where food comes from (Ozer, 2007). School gardens provide an opportunity to teach life skills such as gardening, cooking, working cooperatively on real tasks and they involve students in planting, harvesting and food preparation.

The Croatian pilot school meal scheme led by ZAG studies the benefits of school gardens on school meal nutrition and children's awareness and acceptance of healthy eating habits, with particular aims:

- to encourage more nutritious food habits in children,
- to increase awareness of regional, seasonal and organic food.

This pilot scheme compared 7 schools with gardens and 7 schools without gardens in and around Zagreb to assess the impacts of school gardens and garden-enhanced nutrition education on children's fruit and vegetable consumption and longer-term eating habits.

2. SCHOOL FOOD POLICIES IN CROATIA

In Croatia, all primary schools are required to provide meals for pupils. In Zagreb primary schools, meals are co-financed for about 43,000 pupils. For students in daycare (from 8 am to 4 pm), the school is obliged to organize the possibility of consuming three meals (breakfast, lunch and a snack). All children are served with the same dish per day (i.e. there are no multiple options between dishes on the same day). The price of breakfast is 5.00 kuna (0,66€), lunch 9.00 kuna (1,20€), and snacks 2.50 kuna (0,33€). All pupils are entitled to co-financing the price of meals, in accordance with previously nationally established criteria. The difference between the determined full price of free and co-financed meals for the school is remitted from the state budget. Free school meals are ensured for the following groups of children: whose family receives social help; whose parents (refers to both parents, or single-parent household) are unemployed; children of Homeland War invalids; children of persons with disabilities (100% and 90%).

Two documents provide the legal basis for the organization and functioning of school meals in Croatia: the Law on Education in Primary and Secondary Schools (Official Gazette 87/08, 86/09, 92/10, 105/10, 90/11, 16/12, and 86/12) and National Pedagogical Standard for Elementary Education (Official Gazette 63/08 and 90/10).

The document titled “National guidelines for school meals for children in primary schools” (Capak et al., 2013) was prepared by the Working Group of the Ministry of Health. This document is intended for all employees involved in the service of school meals. The focus is on the key elements in order to ensure national guidelines to improve the quality of nutrition in schools. In this sense, the document provides guidance for the organization and administration of the service of school meals, the definition of public procurement contracts, and conditions of work, preparation, and delivery of meals to meet the needs of the relevant age groups of children while teaching and encouraging children to adopt proper eating habits. National dietary guidelines are an integral part of the Standards for nutrition of the students at primary schools, which provide the recommended types of foods and dishes, the optimal intake of energy and nutrients, as well as the number of meals and the allocation of the recommended energy intake for each meal.

In order for a school nutrition system to be compliant with the national recommendations, each school should have systems at its disposal, enabling the procurement and preparation of healthy meals.
The guidelines contain practical nutrition planning and menu design in elementary Schools taking into account the reference values of daily energy, protein, carbohydrates, fibre, fat, minerals, vitamins and water for children ages 7-18 years (Table 1 and 2).

Table 11. Recommended daily intake of energy and nutrients according to age and gender for planning the school nutrition (Capak et al., 2013)

Component	**7-9 years**	**10-13 years**	**14-18 years**
Energy (kcal/day)	1740 f 1970 m	1845 f 2220 m	2110 f 2755 m
Proteins (% of energy/day)	10-15	10-15	10-15
Proteins (g/day)	43.5-65.3 f 49.3-73.9 m	46.1-69.2 f 55.5-83.3 m	52.8-79.1 f 68.9-103.3 m
Fats (% of energy/day)	30-35	30-35	25-30
Fats (g/day)	58.0-67.7 f 65.7-76.6 m	61.5-71.8 f 74.0-86.3 m	≤ 70.3 f ≤ 91.8 m
Saturated fatty acid (% of energy/day)	≤ 10	≤ 10	≤ 10
Saturated fatty acid (g/day)	≤ 19.3 f ≤ 21.9 m	≤ 20.5 f ≤ 24.7 m	≤ 23.4 f ≤ 30.6 m
Carbohydrates (% of energy/day)	> 50	> 50	> 50
Carbohydrates (g/day)	> 217.5 f > 246.3 m	> 230.6 f > 277.5 m	> 263.8 f > 344.4 m
Simple sugars (% of energy/day)	< 10	< 10	< 10

Simple sugars (g/day)	< 43.5 f < 49.3 m	< 46.1 f < 55.5 m	< 52.8 f < 68.9 m
Fibre (2.4 g/MJ or 10 g/1000 kcal)	> 10	> 10	> 10
Fibre (g/day)	> 17.4 f > 19.7 m	> 18.5 f > 22.2 m	> 21.1 f > 27.6 m

Note: f – female; m – male

Table 12. Daily recommended intake of vitamins and minerals (Capak et al., 2013)

Component	7-9 years	10-13 years	14-18 years
Vitamin A (equivalent)	0.8	0.9	1.03
Vitamin D (calciferols) (µg)	5	5	5
Vitamin E (mg equivalent)	9.5	12	13.25
Vitamin K (µg)	30	40	57.5
Vitamin B_1 (tiamin) (mg)	1.0	1.1	1.2
Vitamin B_2 (riboflavin) (mg)	1.1	1.3	1.4
Niacin (mg equivalent)	12	14	15.75
Vitamin B_6 (pyridoxine) (mg)	0.7	1.0	1.4
Folate (µg equivalent)	300	400	400
Pantothenic acid (mg)	5	5	6
Biotin (µg)	15-20	20-30	27.5-47.5
Vitamin B_{12} (µg)	1.8	2.0	3.0
Vitamin C (mg)	80	90	100
Sodium (mg)	1380	1380	1600
chloride (mg)	690	770	830
Potassium (mg)	3800	4500	4700
Calcium (mg)	900	1100	1200
Phosphor (mg)	800	1250	1250
Magnesium (mg)	170	240	342.5
Iron (mg)	10	13.5	13.5
Iodine (µg)	130	150	175
Fluor (mg)	1.1	2.0	3.05
Zinc (mg)	7.0	8.0	8.38
Selenium (µg)	20-50	25-60	27.5-65
Copper (mg)	1.0-1.5	1.0-1.5	1.0-1.5
Mangan (mg)	2.0-3.0	2.0-5.0	2.0-5.0
Chromium (µg)	20-100	20-100	30-100
Molybdenum (µg)	40-80	50-100	50-100

3. SELECTION AND DESCRIPTION OF THE SCHOOLS

3.1 Profile of school cases

In the preparatory stage, the ZAG team conducted a screening of schools in and out of Zagreb, to find compatible schools with gardens and without gardens according to the selection criteria (outlined below). For the purpose of this project the team has ensured and obtained the approval of the Ministry of Science and Education of the Republic of Croatia to engage schools in the pilot and the approval of the Ethics Committee Institute for Medical Research and Occupational Health to recruit schools' children aged 7-10 years.

The questionnaire related to the presence of school gardens was sent to all of the 107 primary schools in Zagreb, and 7 schools with gardens expressed their interest to participate in the project. The team had several rounds of meetings in the process of school recruitment. Statistical randomization algorithm (figure 1) was developed to select schools without a garden. This algorithm was implemented in C# programming language and Oracle Express database using PL/SQL.

Selection criteria are:

- Two schools cannot be in the same part of the city (adjacent to each other)
- Are willing to participate
- do not have a garden

We set a minimal number of schools 7 to have the best possible statistical power (ANOVA ω2 >= 0.14).

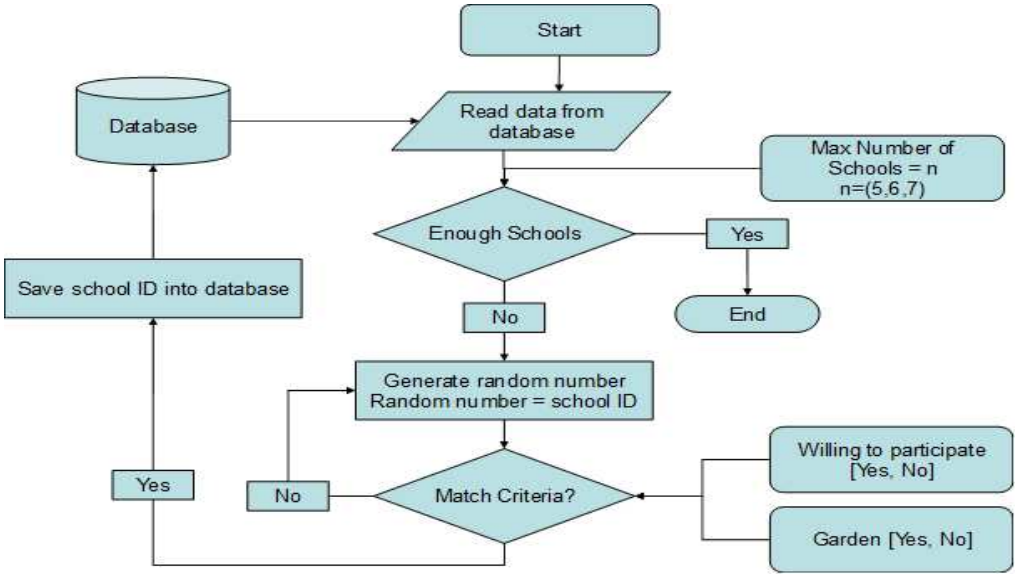
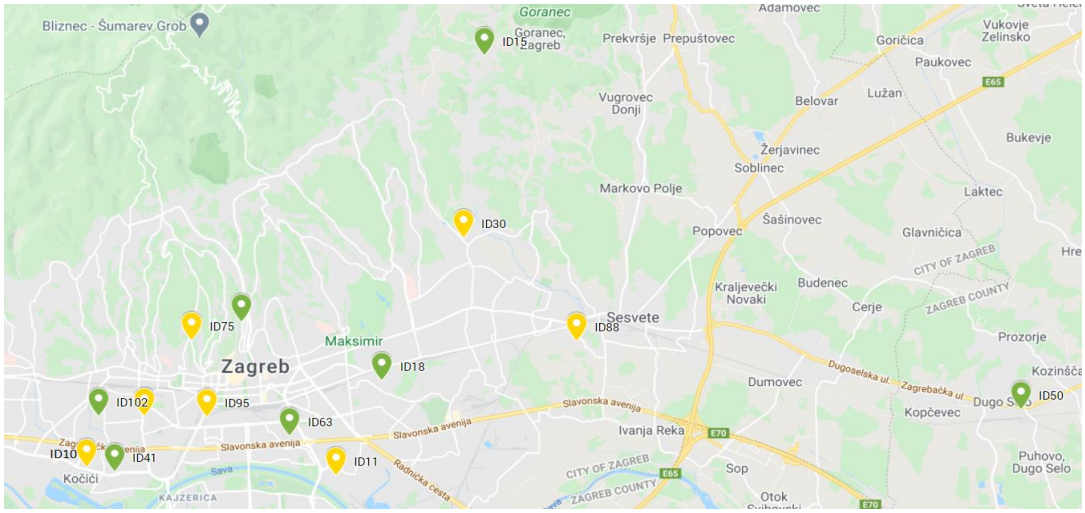


Figure 44. School selection algorithm

A total of 13 primary schools from the Zagreb City and 1 from Zagreb County participated in the project (figure 2).



Note: schools with garden are labelled green and school without garden are labelled yellow

Figure 45. Location of school with and without garden

In order to evaluate the social, economic and demographic status of the selected schools, the official poverty rate in the locality of the school (district of Zagreb) was checked. The incidence of poverty varies significantly across districts of Zagreb; in the most affluent locality 6.8% of households were officially classified as poor, while in the least affluent locality the poverty rate was 2.5 times higher.

3.2 Schools description

Elementary schools in Zagreb were selected to access a population of children from different socioeconomic backgrounds. Information about schools was collected with in-depth interview method (with the schools' principles, administrators, teacher and cooks)

3.2.1 Schools with garden

School ID15 - is located in the eastern part of the city of Zagreb and has an area of 2569 m2. The school has 361pupils (189 males, 172 female), and only 12 students are enrolled in the daycare program. There are 17 classrooms and 3 work programs in this school. The school was built with the self-contribution of the locals, their active participation in the construction and with the great material help of the district. Residents are actively involved in school life. Students and school staff have excellent collaborations with local societies to promote culture. Through persistent educational work, the students of the school achieve more and more valuable results in numerous competitions and contests. Students in grades 1-4 are very active in school gardens. At the promotion of international Eco-schools from the Republic of Croatia, school representatives received a charter (certificate) and a prestigious green flag.

School ID18 is a primary school serving an east part of Zagreb City. It was opened on 1st October 1964 in the district Borongaj-North, on vegetable farmers' land. It has 368 pupils, which makes it a medium-sized school for the region. In the past two years, an increased number of pupils is registered at this school. The reasons for that are the moving of families to their admission area and earlier admission of older siblings. Most of the parents have secondary education qualifications. There are a small number of pupils who are eligible for free meals. School ID18 has pursued a number of health and food-related initiatives in recent years, reflecting the personal enthusiasm and commitment of the head of the school. These include a School scheme (fruit) Association and O.A.Z.A children and Urban Gardens. Association Udruga O.A.ZA. – Održiva Alternativa Zajednici (a Sustainable Community Alternative) was founded in January 2013 in Zagreb. Its aim is to organize various youth programmes, during which they can – in a pleasant and motivating atmosphere – develop their own potential and become responsible and exemplary leaders of a sustainable social change. This school possesses urban gardens. The uptake of school meals is 58% which is above the average for schools in this region.

School ID41 is located in the western part of the city of Zagreb. It is one of the largest schools in this City area, having 719 pupils, all of which have the right to have school meals. Meals are usually taken by younger grades (1^{st}-4^{th}) who are staying in the school in day-care (48% uptake). A relatively low percentage of children (c. 0,05) are eligible for free school meals (children of disabled parents, unemployed parents, children from families that receive social welfare). The current administrator for food procurement, who has been in the post for 3 years, has initiated a range of projects and activities on food, health and nutrition, which reflect a personal interest and commitment to these issues. This school presents a true exception in the school meal supply scheme. Due to its infrastructure and location, it is providing meals for 12 other schools as well, therefore running a true and efficient “small business”. The school functions completely within the public procurement framework and uses the same suppliers as everyone else (that won the tenders). However, due to a surplus in the budget, they have the possibility to enrich the standard meals with other products, usually from local, organic and family-owned suppliers. They have large bargaining power and run their “kitchen” in a very efficient way – not only in terms of food processing but also in terms of logistics (optimisation of routes and operations).

School ID50 is located in Zagreb County. The enrolment area of this school consists of: the town of Dugo Selo and the settlements of Leprovica, Velika Ostrna, Mala Ostrna, Kozinščak, Puhovo and part of the settlement of Lukarišće. The school has a total of 850 students (416 males, 434 females), works in 2 rotating shifts (42 classrooms). This primary school does not have an organized daycare program (extended stay). The vision of the school is to be an active participant in the local community. The school is actively involved in projects such as the Classroom Best Project (combating violence and encouraging creativity) and in the project of creating a philanthropic culture. The school has a large canteen where breakfast is served for students in the morning shift and lunch for students in the afternoon shift. The school is surrounded by 6000 m^2 of green area where there is a school garden 1345 m^2 of playground. The school acquired the status of Eco-school in the spring of 2012 and its goal is to meet the set criteria and promote care for the environment as a lasting value and way of life. Special attention is paid to waste reduction and disposal issues (actions for collecting old paper, electronic waste, old batteries and plastic packaging). Almost every year the students, together with their teachers, participate in the environmental action "Green Cleanup" which aims to raise awareness of the importance of a clean environment among individuals and institutions. In 2015, within the project "The most beautiful school garden", the school was in the finals and the school garden was declared one of the ten most beautiful school gardens in the Republic of

Croatia. In 2016 the school garden won the HRT Golden Charter and was declared the most beautiful school garden in continental Croatia. Also, the school is carrying out actions to green the school environment – such as planting greenery.

School ID55 is located in the north of the City. The school surroundings belong to the historical urban complex, which is part of the Cultural Heritage of the Republic of Croatia based on a Decision of the Ministry of Culture. In the school surroundings, there are ca. 4,000 m2 of green space, a hedged school playground, and open space for playing and learning. Two classrooms lead to the garden, which is used by students during classes and day-care. The school was awarded a status of a European eco-school in 2001, and has realized a number of activities and projects since then. In 2011, it was awarded a Golden Status of an International Eco-School (https://www.eko.lijepa-nasa.hr/users/profile_user/46). The school has 281 pupils, which is the average size for the county, and 56% of pupils are eligible for free school meals. The lunch is delivered from the elementary school ID41, the rest is planned by the cook in cooperation with the biology teacher. In the last couple of years, there were no initiatives related to a healthy diet and healthy food. However, the headteacher is very active in promoting learning in nature (for example – educational path - determining and listing plant species in the school environment). The school is located in an affluent district, therefore a small number of children requested a free meal.

School ID63 is located in the Zagreb City district Trnje which is located in the southern part of the city. The school building was built in 1959 and is surrounded by a beautiful alley of Japanese cherries, linden trees and an orchard. Apart from the orchards, there was also an urban garden on the green surface of the school environment. School staff work hard on educational work, in the cultural, health and environmental fields. After a long decline in the number of students, since 2015 the school has recorded a steady increase. In 2020, the number of enrolled students is 435 (235 males, 200 females), 19 classes, 3 programs. The school's secretary and principal take care of the work of the school kitchen and meal organisation. Health and other conditions on the work of the school kitchen are constantly managed by the sanitary inspector of the City Secretariat for Health and the competent service of the Health Centre Trnje. In the school kitchen, three meals (breakfast, lunch, snack) are prepared for students in the care program and only breakfast for other students. In total 582 meals a day (285 breakfasts, 149 lunches and 148 snacks) are served in the school kitchen. Food is served in the dining room, which is dislocated from the kitchen, and makes it difficult to serve lunches.

School ID102 is located in an older blue-collar district, where poverty rates are high and where several families receive welfare and/or child support. The school has 475 pupils, slightly above average for the county. Despite the high poverty rate of this area, just a small percentage of parents were able to submit full documentation and request free school meals (0,04%). The school has pursued several food and health related initiatives in the past, including gardening and cooking clubs. The headteacher expressed enthusiasm for health projects, for example – within a joint project conducted in cooperation with the Faculty of food technology and biotechnology, the school has participated in a project of retail store Kaufland's as a "VIP school". Kaufland retail chain donated once a week 100 kg of fruits and vegetables in the school year 2017/2018 – for every pupil of the school. Also, for the past 4 years, the school has been taking part in the project School fruit, vegetables and milk, which once a week enables free portions of fruit and milk for the pupils of the school. In 2017, the Croatian Academic Center of Applied Nutritional Science in cooperation with the Scout Unit Plamen organized an interesting event in the school yard - Food Revolution Day – whose initiator was the famous Jamie Oliver. Educational workshops for parents and children were organized, as well as scout games and preparation of healthy meals in order to promote healthy nutrition and physical

activity as an important health factors. Also, in cooperation with the associations 'Vestigium" and “Zeleni klik”, they organized a green eco-market, where teachers and parents planted spice plants, medicinal herbs, and decorative plants. The uptake of school meals is 42%, which is lower than average for schools in the county.

Table 13. School with garden poverty rate (Croatian Bureau of Statistics, 2016)

School ID	POPULATION in the school area	POVERTY RATE in the area	SOCIAL STATUS in the area
ID 15	60.882	16.10	poor
ID 18	55.057	16.00	poor
ID 41	60.555	6.80	wealthy
ID 50	17.201	16.80	poor
ID 55	29.750	5.50	wealthy
ID 63	41.021	7.30	average
ID 102	54.197	9.90	average

We can conclude that incidence of poverty varies significantly across those selected schools (table 3); in the most affluent locality, 5.5 % of households were officially classified as poor, while in the least affluent locality the poverty rate was 3 times higher (16.80%).

3.2.2 Schools without garden

School ID8 is located in the city neighbourhood Trešnjevka-sjever. Near the school are located: Ericsson-Tesla factory, church Bl. Marko Križevčanin, the Kindergarten "Bajka" and the city theatre "Trešnja". The school has 531 pupils, which places it slightly above average size for the county. Although School ID8 procures lunches from School ID41 and other food (for breakfasts and snacks) from the same suppliers used by most schools in the county, the head teacher has a personal commitment to pursuing food and health issues in the curriculum and in the wider school life. This means School ID8 has undertaken various projects not typical of most schools, for example, a workshop on healthy diets. The uptake of school meals is 68%, which is very high for a school in this kind of district.

School ID10 is the biggest school located in a western area, with 0,01% of pupils being eligible for free school meals. The pupil roll is 803, making it one of the larger schools in the county.

The statistics of the 1st grade: out of the total of 108 pupils, 15 of them live in single-parent families, 93 of them live with both parents. By the principal's decision and due to socially disadvantaged circumstances, 4 pupils receive free food (a milk meal and a lunch). The head teacher actively pursues a healthy packed policy, and encourages peers to make healthier choices. In the school year 2017/2018, the healthy diet project was started under the name Child Diet Optimization in the elementary school ID10. The uptake of school meals is 36%, which is less than average for the county. Lunches are delivered from the elementary school ID41. At the school, they prepare a milk meal and snack according to the menu. The menu is planned in accordance with the report of the Dietary Team, which keeps track of wishes, critiques of pupils, parents and form masters. The menu is planned seasonally and according to general rules and guidelines for elementary school pupils' diet of the Croatian Ministry for Health.

School ID11 is a primary school located in the western part of Zagreb. It has 390 pupils, (185 girls, 185 boys) which makes it a medium-sized school for the region. In in-class teaching, a total of 200 pupils are schooled, 105 of which are girls and 95 boys. In subject teaching, there are a total of 170 pupils (80 girls and 90 boys). The pupils come from different family types and are of different socio-economic statuses. Their admission area covers localities in which war veterans, disabled veterans, and socially threatened families are accommodated as a result of which a certain number of pupils come from such families. Also, their settlement is close to the mosque, so there are pupils strictly adhering to Islamic customs. Therefore, the social structure of their pupils is diverse. Extended stay is organized for the pupils of the first and second grade, so that in the school year 2017/2018 they had a total of 73 pupils in the extended stay programme. As part of the Ersasmus + The healthier, the happier, project from 2014 to 2016, an EU funded project, the school engaged in promoting a healthy lifestyle. This took place through campaigns related to the development of healthy diet habits, public discussions, tasting of healthy, locally grown foodstuffs, setting up a billboard promoting seasonal and healthy foodstuffs, and drafting of a healthy cookbook. Another important project to this school is the School scheme (a scheme of school fruits and school milk) – a national/European project promoting the availability of one fruit and one milk meal once a week to every school child. Moreover, they are engaged in a project Hidden Calories – workshops for the pupils of the third grade conducted by the students of Medical faculty in Zagreb in cooperation with the Public health institute "Dr. Andrija Štampar" on a healthy diet and hidden calories in industrially processed food. The uptake of school meals is 37%, which is slightly higher than the average for all schools in this region.

School ID30 is a primary school serving the east region. The socio-demographic profile of this school consists mainly of blue-collar class, numerous families with three or more children. School ID30's admission area includes a part of the city area stretching 10 km from northwest to southeast and encompassing 9 districts. The school area is of predominantly rural character and – aside from this school, a kindergarten, and Grad mladih (Youth town) – there are no other educational or cultural institutions. The districts are expanded through individual housing construction; therefore, the number of students increases for one class unit yearly. A large number of students take city buses, and for some students, the transportation is organized by a school bus. The local community is agricultural. It has 824 pupils, which makes it the largest primary school in the region, and 0,02% of School D's pupils are eligible for free meals. The school is not actively pursuing food and health-related initiatives. The uptake of school meals is 35%.

School ID88 was founded based on a Decision of the City Council from 17th May 2007. In the year 2020/2021 school has 439 pupils. The school is located in a suburban area. A part of their admission area is in the district of Donja Dubrava, another part is the district of Sesvete. The

latter is a neighbourhood characterised by the presence of family houses. The majority of families moved here and built family houses during the Croatian war of independence and post-war period. From the onset (2007), the number of pupils has decreased due to moving the families abroad. Ten percent of the total number of pupils is of Roma nationality. Most of them live in good socio-economic conditions. However, they are absent from classes a lot (both excused and unexcused absence). 25 pupils have a free school meal (lunch and/or breakfast). The current head teacher has a personal enthusiasm for food and health issues, and several additional projects about food and healthy eating are ongoing. Within the school prevention programmes, the following topics are covered: Healthy diet – the first grade obesity prevention; Child obesity prevention – the second and third grade; Food and drink – the fifth grade; Proper diet – the seventh grade. They are also involved in the School fruit scheme and they are Kaufland's VIP school (once a week Kaufland donates fruit for all pupils and a certain amount of vegetables). The uptake of school meals is 33%, which is the average size for a school in this kind of district.

School ID75 is located in Pantovčak area known as the elite part of the city, which extends near the centre from Ilica street to Prekrižje. In total, 438 students (221 males and 217 females) attend classes in 21 classrooms and 3 programs. The school works in one shift. The school is involved in numerous international projects (Erasmus - Mobility and Partnership Projects (K1 and K2), Twinning Projects, Schools - Partners for Future. The school is organized, for students who request it, breakfast, lunch and snacks. Lunch is being delivered from school ID41, while breakfast and snacks are prepared at school. The school continues to implement the project "School Fruit and Vegetable Scheme" for all students from 1st to 8th grade and "School Milk Program" for students from 1st to 4th grade.

School ID95 is a primary school located in the centre of Zagreb Town. It has 362 pupils, which makes it a large-sized school for the region. In the past few years there have been few extracurricular activities related to healthy food and eating, with the exception of household maintenance as extracurricular activity. An interesting event in this school is role substitution -- students assume the role of the staff and help out in the preparation and serving of meals. There are regulated meal portions for students at this school – students from the 1st and 2nd grade receive smaller portions than the ones from the 3rd and 4th grade. The uptake of school meals is 58%, which is more than an average for a school in this kind of district.

Table 14. School without garden poverty rate (Croatian Bureau of Statistics, 2016)

School ID	POPULATION in the area	POVERTY RATE in the area	SOCIAL LEVEL in the area
ID 8	54.197	9.90	average
ID 10	65.555	6.80	wealthy
ID 11	55.057	16.00	poor
ID 30	60.882	16.10	poor
ID 88	68.924	12.70	poor

ID 75	29.750	5.50	wealthy
ID 95	41.021	7.30	average

The official poverty varies significantly across selected schools of Zagreb (table 4); in the most affluent locality 5.50 % of households were officially classified as poor, while in the least affluent locality the poverty rate was 3 times higher (16.10%).

4. EXAMINING THE DIFFERENCES BETWEEN SCHOOLS WITH AND WITHOUT GARDEN

In this part first we will describe activities that are carried out in those seven schools with gardens that were willing to participate in this project. Furthermore, we will explore the difference between schools with and without gardens regarding school meal nutrition (school menus, fruit and vegetable availability in school menus) and children eating habits (plate waste and fruit and vegetable preference). All information about school activities has been gathered by in-depth interviews with schools' management and by content analysis of the official school web pages.

4.1 Description of activities in schools with gardens

Education in school gardens is carried out by the schools themselves. The education (table 5) in the school garden (figure 3) is part of extracurricular activities in which students enroll voluntarily.

Table 15. Description of the garden space, names of activities, users and timetable

SCHOOL ID	GARDEN SPACE	NAMES OF ACTIVITIES	POSITION OF THE PERSON WHO LEADS ACTIVITIES	USERS	TIMETABLE
ID15	Orchard 1,500 m^2 Garden 420 m^2 Horticulturally arranged area of 1,200 m^2 Meadow 530 m^2	Little gardeners	Primary education teacher	Students from 1st to 8th grade A total of 13 students per year	2 school hours per week (autumn and spring) A total of 35 hours per year
ID18	Green area 10,000 m^2 There are two sections inside	An oasis for children	Members of O.A.Z.A. association and primary education teachers	Students from 1st to 8th grade	A total of 35 hours per year

	the school garden: 1. Flower garden 2. Eco-garden	Florists	Primary education teacher	1st grade students A total of 30 students per year	A total of 35 hours per year
		Eco Eco	Primary education teacher	Students from 1st to 4th grade A total of 20 students per year	A total of 35 hours per year
ID41	There is a school garden inside the extended stay playground	Small gardeners - section within the cooperative Eko Meštri	Primary education teachers	Students from 1st to 4th grade	1st grade - 20 hours 2nd grade - 35 hours 3rd grade - 35 hours 4th grade - 10 hours
ID50	Green area of 6,800 m^2 - part of the area is an orchard, and the vegetable garden is in a separate part	Little gardeners	Primary education teachers	2nd grade students	A total of 35 hours per year
		Gardeners	Biology teacher	7th grade students	A total of 70 hours per year
		School cooperative	German language teacher	Students from 1st to 8th grade	A total of 35 hours per year
ID55	Green areas (orchard) 16,211 m2	Eco group	Primary education teachers	Students from 1st to 4th grade	A total of 53 hours per year
		Ecological group	Biology teacher and teacher of Fine Arts	Students from 5th to 8th grade	A total of 53 hours per year
ID63	Green area 8,050 m^2 Orchard 550 m^2	Eco group	Biology teacher	Students from 1st to 4th grade	A total of 53 hours per year
ID102	2 atriums inside the school - school gardens Green area 6,350 m^2 - only in the western part there is an orchard and vegetable garden	Little Botanists - section within the student cooperative Voltino	Primary education teachers	8th grade	1 per week 2 school hours

In school ID15 there is an activity "Little gardeners", targeted at students who show interest in nature and landscaping of school space, garden and environment. Some of the goals of this

activity are to protect the school environment from devastation, to develop the awareness that people are more comfortable in a beautiful environment, to mark important ecological dates, to encourage a better relationship between students and to develop a sense of positive value. The activities that are carried out are various mini-projects, making photos and posters, getting to know potted plants and their planting and propagation, planting ornamental plants, maintaining the school garden and autumn apple harvest.

In school ID18 there are three activities that are carried out within the school garden, and they are "Oasis for children", "Florists" and "Eco eco". Students from all three activities collaborate with each other through various projects. Beyond the above activities, all students are in charge of arranging and maintaining the school environment, with 1st and 2nd grade students participating in arranging and cleaning green areas, 3rd grade students in arranging and maintaining an urban garden, and 4th to 8th grade students organizing a garden festival. The project "Oasis for Children" is implemented in cooperation with the association O.A.Z.A. and the European Voluntary Center. The very goal of this activity is to educate students and teachers about sustainable development and urban organic gardening, and to encourage positive values and a healthy lifestyle. The program is realized through various work actions of students, teachers, parents and volunteers. Over the years, students have planted Mediterranean and continental plants and a school organic garden. Also, the students built a composter, feeders and bird houses, a hotel for insects, a garden for butterflies and a hedgehog house. Also as part of the project with the help of Zrinjevac d.o.o. and the Peščenica City District (Gradske četvrti Peščenica), two outdoor classrooms were built An extracurricular activity called "Eco eco" is organized with the aim of developing students' environmental awareness and raising awareness of the need for sustainable development. All activities are realized through appropriate environmental actions and projects, and teaching activities are carried out in the school garden, Botanički garden (Botanički vrt), Maksimir Park and ZOO. The activity "Florists" is carried out as a group of extracurricular activities with the aim of arranging the interior of the school, school flower garden and yard. Through a series of activities, students are introduced to the cultivation, nurturing and sowing of different types of plants. In addition to the school garden, activities are also carried out in the ZOO and Maksimir Park.

In school ID41 extracurricular activity "Little Gardeners" is taking place, which is one of the sections within the student cooperative "Eko Meštri", and includes the curriculum area of science and entrepreneurship. Students from 1-4th grade can participate in those activities. The goal of this extracurricular activity is to arrange and maintain a flower garden and an organic garden while learning the basics of gardening. In addition to learning about maintaining an organic garden, students also learn about preserving the environment through composting and the botany of the plants they grow. All work in the organic garden takes place depending on the seasons.

In school ID50 there are two extracurricular activities that are oriented to work in the school garden. "Small gardeners" are held for lower grade students, and "Gardeners" for higher grade students. The goals of these extracurricular activities are to provide a systematic way of learning about nature, society and human achievements in relation to the environment. It encourages the continuous improvement of nature and the environment, a healthy lifestyle and intellectual, physical and moral development. The very purpose is to encourage environmental awareness in students and to introduce students to plants, herbs, fruits and vegetables and their cultivation. These goals are realized through participation in group research, self-research and field activities. In addition to these two extracurricular activities, the school garden is also used for the work of the school cooperative, which in addition to participating in the maintenance of the garden and vegetable garden makes various products from cultivated fruits and plants. As part

of the "Most Beautiful School Garden" project, the garden of the Josip Zorić Elementary School was among the 10 most beautiful gardens in the Republic of Croatia in 2015, while in 2016 it won the HRT Golden Charter (Zlatnu povelju) and was declared the most beautiful garden in continental Croatia.

In school ID55 extracurricular activities "Eco group" for lower grades of primary school and "Ecological group" for higher grades of primary school are carried out. The goal of the "Eco Group" is to develop love and a proper relationship with nature and protect the environment. The goal is achieved through the maintenance and care of plantations in the school yard, the care of potted plants in the school space and the planting of flowers in classrooms and outdoors. The goal of the "Ecological Group" is to supplement the knowledge related to the teaching material of biology and nature and to develop the ability to observe, describe, conclude and apply knowledge in everyday life. Students participating in the Ecological Group are active in cleaning and landscaping schools, studying protected plant species in the environment, planting flowers and trees in the school environment, studying biodiversity, and developing healthy eating habits and lifestyles. The activities take place in the school district and in the field, and include trips to “Zbaočke brege” and Oroslavlje, as well as to the Faculty of Science (PMF). The ecological group also cooperates with a number of ecological groups of other schools and associations.

In school ID63 extracurricular activity "Eco group" is conducted for lower grade students. The aim of this extracurricular activity is to develop an awareness of the harmfulness of environmental pollution and to identify environmental pollution in order to build the correct attitude of students towards nature. Teaching activities that are carried out include landscaping, planting and nurturing flowers, making educational messages and marking important dates related to the environment and ecology.

In school ID102, students are organised in the cooperative Voltino, whose goal is to develop the entrepreneurial spirit and organizational skills of students. Through a series of activities, students work to preserve the tradition of growing fruits, flowers, herbs and spices in the school garden and cultural heritage. These activities aim to develop motor skills, work habits, communication and togetherness through cooperation and tolerance of students. The program itself is implemented through 12 combined sections (Little Botanists, Glagolitic and Light, Ethno Flute, Crochet School "Flower", Guardians of Native Heritage, Small / Large Potters and Glagolitics, Glagolitic and We, Green Oasis of Ozana and Voltino Elementary School, Creative workshops for small and great co-operative 3.c, Household and Voltino verbs). The section "Little Botanists" is intended for 8th grade students with the aim of developing environmental awareness, love for nature and the planet. Also, this section enriches the regular school curriculum with research work that enables the knowledge needed to understand everyday life and the ability to be independent and build a scientific attitude. The program is realized by arranging the school garden and planting medicinal herbs, making ointments and syrups, going to the Botanical Garden (Botanički vrt) and making educational materials using magazines, the Internet and documentaries related to the subject of botany.

Figure 46. Pictures of schools' gardens

4.2 Evaluation of menus between schools with and without garden

Based on the results obtained from WP 6.2., it was observed that a large proportion of daily menus did not meet National recommendations. However, this was explored only on small sample size (only 4 schools and 40 daily menus). Therefore, the analysis was extended to all 14 schools and included one-year school menus per school.

Out of a total of 14 investigated primary schools, 12 of them are serving all three meals per day (breakfast, lunch and snacks) while the other two schools serve two meals per day (breakfast and lunch) whereby in one of these two schools students consume only lunch or breakfast depending on the class shift. During one school year a total of 2469 different menus were collected (2379 breakfast, 2376 lunches and 1051 snacks) (table 6). Menus were obtained from

the school staff while normative provisions (standard quantities of ingredients) were obtained (where required) from direct conversation with the cooks or with catering staff/responsibilities. The nutritive values of school lunch recipes were calculated using national composition tables (National food composition tables, Kaić Rak and Antonić, 1990). For those foods not in the national food composition database, energy and nutritive values were obtained, where possible, from the food labels. The energy and nutrient values of the offered meals were evaluated regarding referent Croatian National guidelines for primary school meals (Capak et al., 2013).

Table 16. Number and type of meals in 14 primary schools

ID school	Days	Breakfast	Lunch	Snack
School with garden				
15	176	176	176	176
18	176	175	176	176
41	180	178	180	176
50	174	88	85	-
55	175	175	175	175
63	173	173	172	173
102	176	175	176	174
Total	***1230***	***1140***	***1140***	***522***
School without garden				
8	176	176	176	176
10	176	176	176	176
11	178	178	178	-
30	177	177	175	172
75	179	179	178	178
88	174	174	174	174
95	179	179	179	177
Total	***1239***	***1239***	***1236***	***701***

The Croatian National guidelines for the nutrition of primary school students give recommendations for the energy and nutritive values of each school meal and their combinations. Table 7 provides recommended energy and nutritive values (nutrients which are in the National food composition table) of school lunches, which is calculated on the national guideline which propose that breakfast should provide 15% energy, lunch should provide 35% energy and snacks should provide 10% energy of total daily intake. Therefore, the menus which include breakfast, lunch and snack (model 2) should provide 60% energy and menus which include breakfast and snack (model 4) should provide 50% energy of total daily intake.

Table 17. National recommendation for energy and nutritive values of school meals and daily menu models (Capak et al., 2013)

Parameters	Breakfast (15%)	Lunch (35%)	Snack (10%)	Model 2 (60%)	Model 4 (50%)
ENERGY AND MACRONUTRIENTS					
Energy (kcal)	278 (250 – 306)	649 (584 – 714)	186 (167 – 205)	1113 (1002 – 1224)	928 (835 – 1020)
Total proteins (g)	7.0 – 10.4	16.2 – 24.4	4.6 – 7.0	27.8 – 41.8	23.2 – 34.8
Total carbohydrates (g)	> 34.8	> 81.2	> 23.2	> 139.1	> 116.0
Dietary fibre (g)	> 2.8	> 6.5	> 1.9	> 11.1	> 9.3
Total fat (g)	9.3 – 10.8	21.6 – 25.3	6.2 – 7.2	37.1 – 43.3	30.9 – 36.1
Saturated fatty acids (g)	< 2.8	< 6.5	< 1.9	< 11.1	< 9.3
VITAMINS					
Vitamin A (µg RE)	135.00	315.00	90.00	540.00	450.00
Vitamin B_1 (mg)	0.17	0.39	0.11	0.66	0.55
Vitamin B_2 (mg)	0.20	0.46	0.13	0.78	0.65
Niacin (mg)	2.10	4.90	1.40	8.40	7.0
Vitamin B_6 (mg)	0.15	0.35	0.10	0.60	0.50
Vitamin C (mg)	13.50	31.50	9.00	54.00	45.00
MINERALS					
Sodium (mg)	207.00	483.00	138.00	828.00	690.00
Potassium (mg)	675.00	1575.00	450.00	2700.00	2250.00
Calcium (mg)	165.00	385.00	110.00	660.00	550.00
Magnesium (mg)	36.00	84.00	24.00	144.00	120.00
Phosphor (mg)	187.50	437.50	120.00	750.00	625.00
Iron (mg)	2.03	4.73	1.35	8.10	6.75
Zinc (mg)	1.20	2.80	0.80	4.80	4.00
Copper (mg)	0.15 – 0.23	0.35 – 0.53	0.10 – 0.15	0.60 – 0.90	0.50 – 0.75

This section presents the results of the nutritional composition analysis of the selected menus at the seven schools with and seven schools without garden. The nutritional analysis begins with consolidated summaries of average daily energy, macronutrients and micronutrient profiles of breakfast (table 8), lunch (table 9) and snack (table 10) at school with and without garden, respectively. These data were produced by averaging the energy, macronutrients and micronutrient profiles of all breakfast, lunches and snacks in schools with and without garden and the results are expressed per standard portion as mean value ± standard error.

As Table 8 shows, the energy provided in a portion of the average breakfast in schools with gardens amounted to 360 kcal (± 3), compared with 311 kcal (± 3) in school without a garden. Table 8 also shows that the provision of all macronutrients, in the average breakfast in schools with gardens was higher than in schools without gardens, with the exception of dietary fibre. Also, breakfast in schools with gardens provides more vitamin A, B_1 and B_2, and more sodium, calcium, magnesium, phosphorus and zinc.

As Table 9 shows, the energy provided in a portion of the average lunch in schools with garden amounted to 472 kcal (± 5), compared with 552 kcal (± 6) in school without a garden. Therefore, lunch in schools without garden provides more macronutrients than lunch from schools with garden. In terms of vitamins and mineral lunch in schools without garden provide more vitamin B_1 and B_2, calcium and phosphorus. The average sodium composition of lunch for the school with garden and the schools without garden was 1085.85 mg and 1234.61 mg respectively, both exceeding lunch recommendation of 483 mg but also almost exceeding the daily sodium recommendation of 1380 mg.

As Table 10 shows, the energy provided in a portion of the average snack in schools with garden amounted to 174 kcal (± 3), compared with 198 kcal (± 3) in school without garden. According to higher energy values the snacks in school without garden provide more macronutrients, with the exception of dietary fibre. Also, snacks in schools without garden provide more vitamins and minerals.

Table 18. Energy and nutritive values in the average breakfast at schools with and without garden

Parameters[1]	School with garden	School without garden	P[2]
ENERGY AND MACRONUTRIENTS			
Energy (kcal)	360 ± 3	311 ± 3	< 0.001
Total proteins (g)	12.2 ± 0.2	10.0 ± 0.1	< 0.001
Total carbohydrates (g)	50.8 ± 0.5	45.9 ± 0.5	< 0.001
Dietary fibre (g)	3.6 ± 0.1	3.4 ± 0.1	0.251
Total fat (g)	12.5 ± 0.2	10.0 ± 0.1	< 0.001
Saturated fatty acids (g)	5.9 ± 0.1	4.6 ± 0.1	< 0.001
VITAMINS			
Vitamin A (µg RE)	81.83 ± 2.51	64.81 ± 5.38	< 0.001
Vitamin B_1 (mg)	0.10 ± 0.00	0.10 ± 0.02	< 0.001
Vitamin B_2 (mg)	0.22 ± 0.01	0.19 ± 0.02	< 0.001
Niacin (mg)	0.96 ± 0.05	1.01 ± 0.17	0.946
Vitamin B_6 (mg)	0.14 ± 0.01	0.16 ± 0.02	0.677
Vitamin C (mg)	17.56 ± 0.55	16.28 ± 0.92	0.123
MINERALS			
Sodium (mg)	557.38 ± 9.76	468.97 ± 8.91	< 0.001
Potassium (mg)	313.40 ± 7.17	297.19 ± 6.73	0.276
Calcium (mg)	178.18 ± 3.37	135.68 ± 3.57	< 0.001
Magnesium (mg)	22.07 ± 0.65	16.52 ± 0.50	< 0.001
Phosphor (mg)	149.62 ± 3.56	120.04 ± 3.42	< 0.001
Iron (mg)	0.69 ± 0.02	0.65 ± 0.03	0.350
Zinc (mg)	0.49 ± 0.01	0.37 ± 0.01	< 0.001
Copper (mg)	0.09 ± 0.00	0.08 ± 0.00	0.292

[1] mean value ± standard error
[2] Mann U Whitney test ($p<0.05$)

Table 19. Energy and nutritive values in the average lunch at schools with and without garden

Parameters[1]	School with garden	School without garden	P[2]
ENERGY AND MACRONUTRIENTS			
Energy (kcal)	472 ± 5	552 ± 6	< 0.001
Total proteins (g)	20.2 ± 0.2	20.9 ± 0.2	0.016
Total carbohydrates (g)	60.6 ± 0.7	65.8 ± 0.8	< 0.001
Dietary fibre (g)	6.0 ± 0.1	6.3 ± 0.1	0.003
Total fat (g)	17.4 ± 0.3	20.5 ± 0.3	< 0.001
Saturated fatty acids (g)	5.0 ± 0.1	5.8 ± 0.1	< 0.001
VITAMINS			
Vitamin A (µg RE)	140.22 ± 3.96	150.51 ± 4.52	0.998
Vitamin B_1 (mg)	0.26 ± 0.00	0.28 ± 0.00	0.004
Vitamin B_2 (mg)	0.22 ± 0.00	0.24 ± 0.00	0.002
Niacin (mg)	4.21 ± 0.08	4.23 ± 0.08	0.821
Vitamin B_6 (mg)	0.33 ± 0.01	0.34 ± 0.01	0.136
Vitamin C (mg)	22.60 ± 0.53	24.30 ± 0.65	0.782
MINERALS			
Sodium (mg)	1085.85 ± 22.08	1234.61 ± 29.73	0.129
Potassium (mg)	635.69 ± 11.84	952.32 ± 15.02	0.928
Calcium (mg)	63.70 ± 1.65	66.12 ± 1.62	0.019
Magnesium (mg)	32.22 ± 0.80	34.27 ± 0.96	0.568
Phosphor (mg)	222.60 ± 3.36	234.27 ± 3.35	0.024
Iron (mg)	2.88 ± 0.06	2.89 ± 0.05	0.867
Zinc (mg)	0.83 ± 0.02	0.88 ± 0.02	0.703
Copper (mg)	0.24 ± 0.01	0.26 ± 0.01	0.035

[1] mean value ± standard error
[2] Mann U Whitney test ($p<0.05$)

Table 20. Energy and nutritive values in the average snack at schools with and without garden

Parameters[1]	School with garden	School without garden	P[2]
ENERGY AND MACRONUTRIENTS			
Energy (kcal)	174 ± 3	198 ± 3	< 0.001
Total proteins (g)	4.6 ± 0.1	5.5 ± 0.1	< 0.001
Total carbohydrates (g)	26.7 ± 0.4	29.6 ± 0.5	< 0.001
Dietary fibre (g)	1.7 ± 0.0	1.9 ± 0.1	0.963
Total fat (g)	5.6 ± 0.2	6.5 ± 0.2	< 0.001
Saturated fatty acids (g)	2.7 ± 0.1	3.0 ± 0.1	< 0.001
VITAMINS			
Vitamin A (µg RE)	20.19 ± 1.20	25.74 ± 1.35	0.018
Vitamin B_1 (mg)	0.02 ± 0.00	0.03 ± 0.00	0.006
Vitamin B_2 (mg)	0.06 ± 0.00	0.08 ± 0.00	0.001
Niacin (mg)	0.16 ± 0.01	0.31 ± 0.02	< 0.001
Vitamin B_6 (mg)	0.06 ± 0.00	0.08 ± 0.00	0.002
Vitamin C (mg)	3.44 ± 0.28	4.95 ± 0.29	< 0.001
MINERALS			
Sodium (mg)	197.13 ± 7.51	254.08 ± 7.36	< 0.001
Potassium (mg)	116.54 ± 4.55	157.86 ± 6.72	0.001
Calcium (mg)	58.61 ± 3.04	69.57 ± 3.18	0.004
Magnesium (mg)	7.59 ± 0.37	9.66 ± 0.52	0.003
Phosphorous (mg)	47.10 ± 2.67	58.76 ± 2.89	0.009
Iron (mg)	0.20 ± 0.01	0.24 ± 0.01	0.007
Zinc (mg)	0.14 ± 0.01	0.18 ± 0.01	0.001
Copper (mg)	0.03 ± 0.00	0.08 ± 0.00	0.001

[1] mean value ± standard error
[2] Mann U Whitney test ($p<0.05$)

The next set of results focuses on the daily menus, and show the proportions of the menus in schools with and without garden that met the national nutritional guidelines. First, we report the macronutrient content of the daily menus and compare it against national guidelines. The macronutrient content was evaluated by calculating the energy percentage of each macronutrient and comparing the school with and without garden, as shown in Figure 4. The energy contribution of carbohydrates in both models reached 50% of energy, which is the minimum level of the national recommendation of carbohydrates. Therefore, menus in both schools with and without garden achieve the national guidelines for carbohydrates. The nationally recommended daily fat intake amounts to 30-35% of energy. Figure 4 shows that school lunches from both schools with and without garden achieve national standards for fat. Finally, in terms of protein, Figure 4 shows that menus from the school without garden are within the National recommendation for proteins (10-15 %) while the menus from school with garden slightly exceeds that recommendation. Excessive protein is not a concern for children in this age group, as proteins are a significant building component in children who are growing and developing. Therefore, it can be concluded that the average proportions of protein in daily menus in both schools with and without garden achieve the national recommendations. As Figure 5 shows, only 14.0% menus in schools with garden and 13.2% menus in school without garden meet the National standards for macronutrient ratio of daily menus.

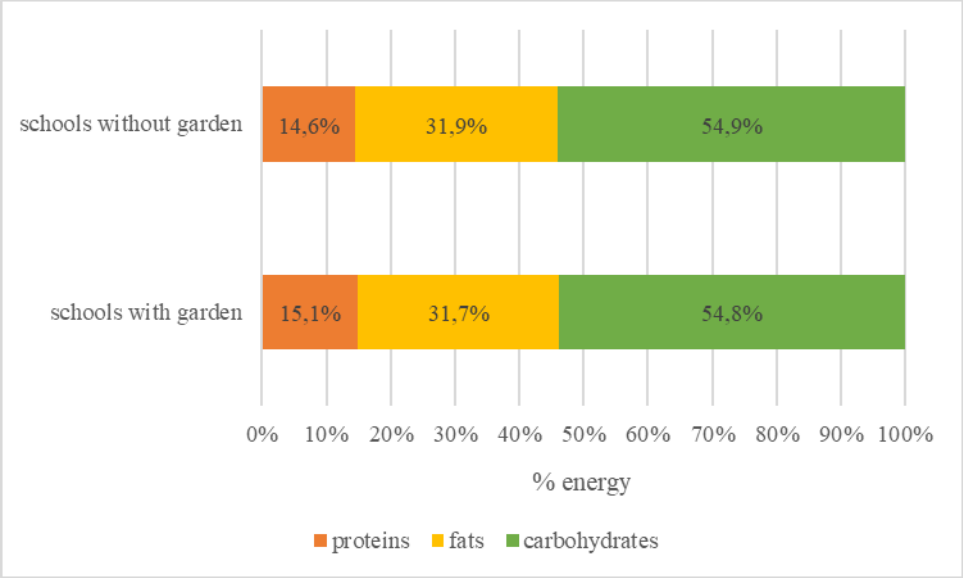


Figure 47. Average proportions of macronutrients in daily menus of schools with and without garden

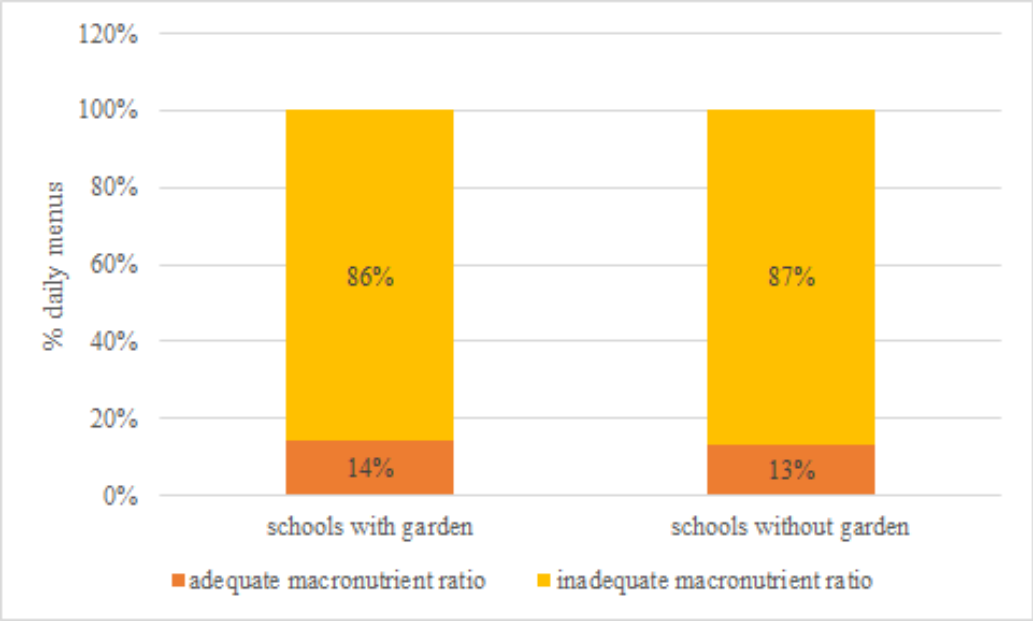
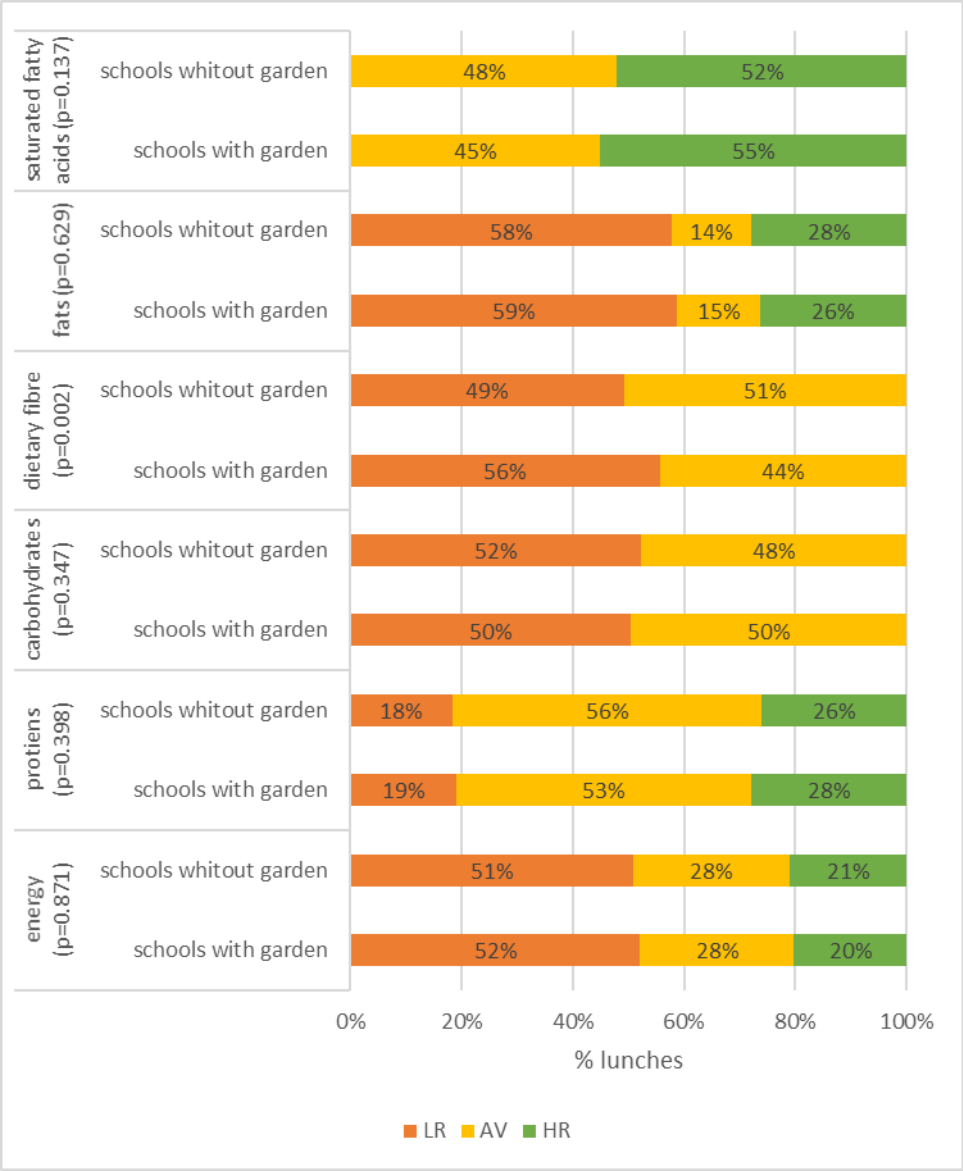


Figure 48. Distribution of menus whose macronutrient ratio meet the recommendation

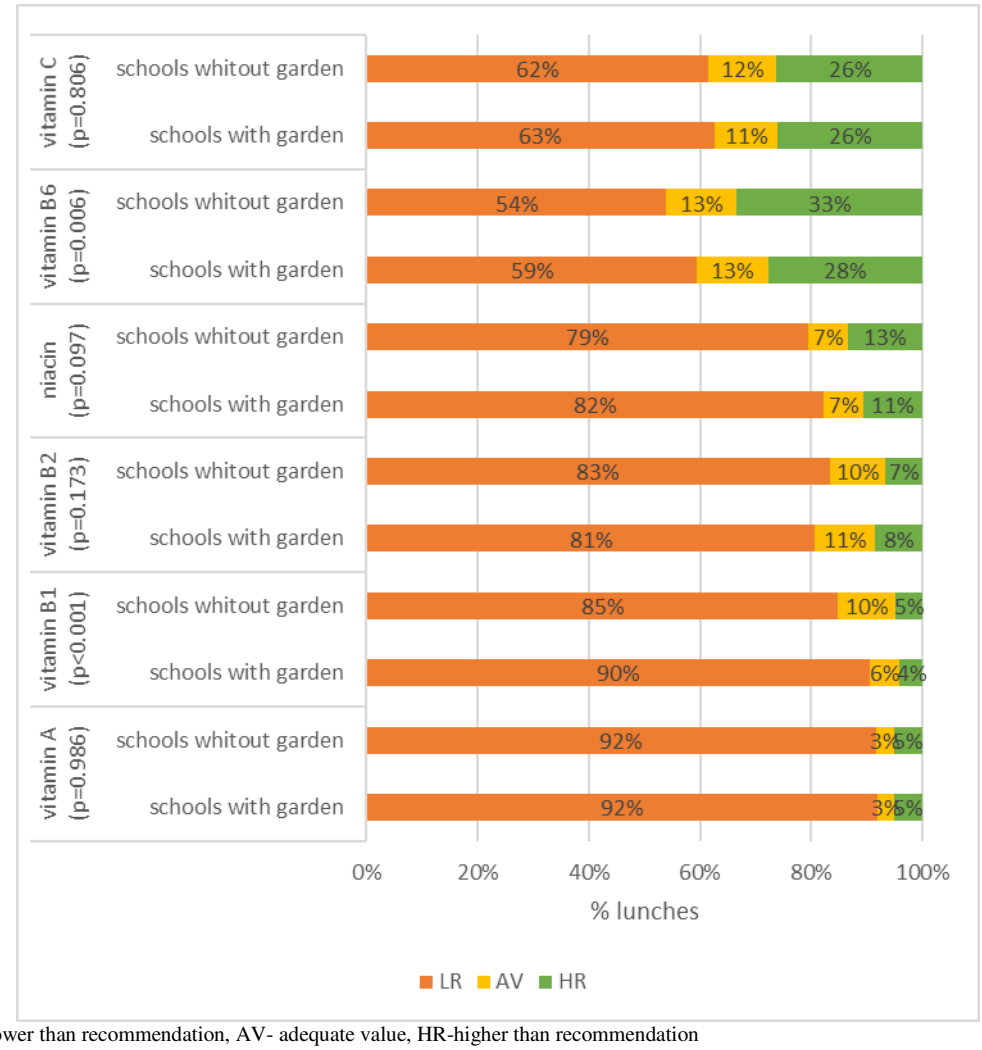
Next, we present the energy and macronutrient provision of the daily menus. According to the National guidelines, our results show that only 28% of school menus from both schools with and without garden are of adequate value (Figure 6). Half of school menus in both schools with and without garden have a lower energy value than the one recommended in the National guidelines. Over a long period of time, this could constitute a significant problem, which, ultimately, could result in a lower daily intake of energy. An inadequate intake of energy in school meals can at the same time indicate an inadequate intake of total carbohydrates, proteins and fats, which is also presented in figure 6. In terms of saturated fat, over half of daily menus in both schools with and without garden provided excessive saturated fat. As a part of a healthy diet, it is important not only to reduce the amount of total fat, but also to replace saturated fats with unsaturated fats. In terms of dietary fibre, our results show the fibre content of the menus in both schools with and without garden is worryingly low. The menus in schools without garden provide more ($p=0.002$) dietary fibres (51%) than the menus in schools with garden. School menus should be designed to increase the content of naturally-occurring plant-based foods that are high in dietary fibre, including whole-grain foods, cooked dry beans and peas, vegetables, fruits, and nuts.



Note: LR- lower than recommendation, AV- adequate value, HR-higher than recommendation
chi-square test ($p<0.05$)

Figure 49. Proportion of daily menus in school with and without garden that met National recommendations for energy and macronutrients

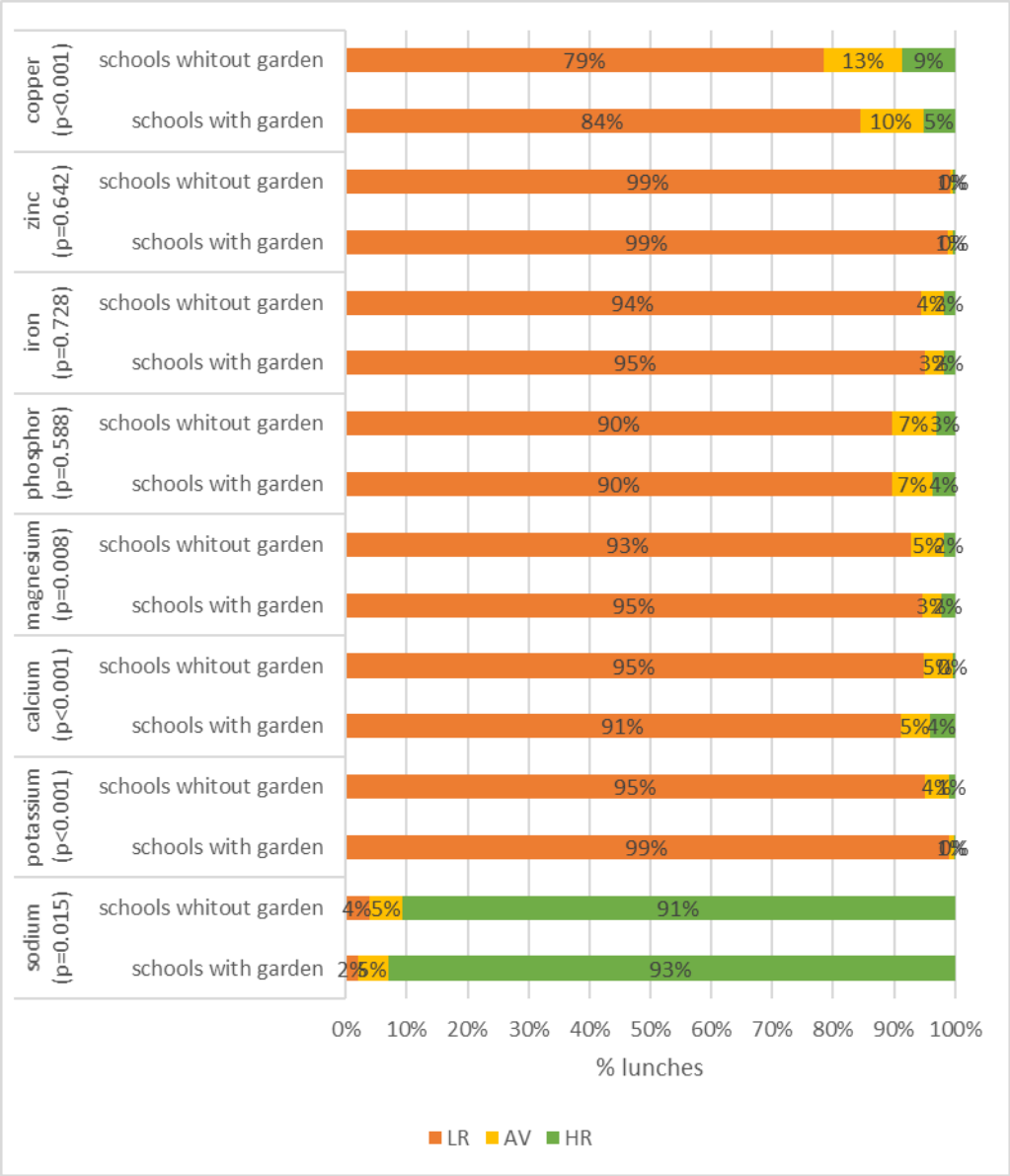
Next, we report the vitamin content of the daily menus (Figure 7). As can be seen, the majority (50% or more) of menus in both schools with and without garden provide lower than national guidelines for all vitamins. In addition, analysis results show that schools with garden had more menus with inadequate vitamin B_1 and B_6 content.



Note: LR- lower than recommendation, AV- adequate value, HR-higher than recommendation
chi-square test ($p<0.05$)

Figure 50. Proportions of daily menus in schools with and without garden that met National recommendations for vitamins

Finally, we report the mineral content of the menus (Figure 8). As it can be seen, the majority (75% or more) of menus in both schools with and without garden provide lower than the national guidelines for seven out of the eight minerals analysed. In terms of sodium 91% of menus exceeded national guidelines for both schools with and without garden. In order to allow for the correction of sodium content in the school lunch, it is necessary to determine the reasons behind the high levels of sodium (e.g. natural sources, salt added to dishes during food preparation, processed food). Moreover, it can be noticed that schools with garden had more menus with inadequate copper, magnesium and potassium content, but schools without garden had more menus with the inadequate calcium content.



Note: LR- lower than recommendation, AV- adequate value, HR-higher than recommendation
chi-square test (p<0.05)

Figure 51. Proportions of daily menus in schools with and without garden that met National recommendations for minerals

4.3 Assessment of fruit and vegetable availability in schools with and without garden

Type, quantity and frequency of offered fruits and vegetables were estimated from the annual menus of all 14 schools. Menus were obtained from the school staff while standard quantities of ingredients were obtained from direct conversation with the schools' chefs. There were a total of 1230 menus from schools with garden and 1239 menus from schools without garden.

The estimation of the percentage of local fruits and vegetables was made using a list of availability of local fruits and vegetables from school food suppliers. Mostly, suppliers were contacted personally or information about them was provided by the school management. The

estimation of the percentage of seasonal fruits and vegetables was made using a pre-existing list of seasonal fruits and vegetables for our territory.

Estimation of served fruits and vegetables included all fresh, frozen and canned fruit and vegetables except potatoes, dried legumes, fruit and vegetable juices, and nuts. For the analysis of frequency, fruit and vegetables were grouped as fresh/frozen and canned fruit and vegetables. Fresh/frozen fruit and vegetables were further divided into categories according to national guidelines. The quantity of served fruits and vegetables were compared against World Health Organisation (WHO, 2003) recommendations. The WHO recommendation of 400 g of fruit and vegetables per day per child was proportionally adjusted according to number and meal type, as served according to recommendations from Croatian national nutritional guidelines for elementary school students (table 11)

Table 21. Adjusted quantity of recommended fruit and vegetables according to Croatian national nutritional guidelines for elementary school students

School food service model	Recommendation for daily offer of fruits and vegetables (grams)
breakfast + lunch + snack	240
breakfast + lunch	200
breakfast	60
lunch	140

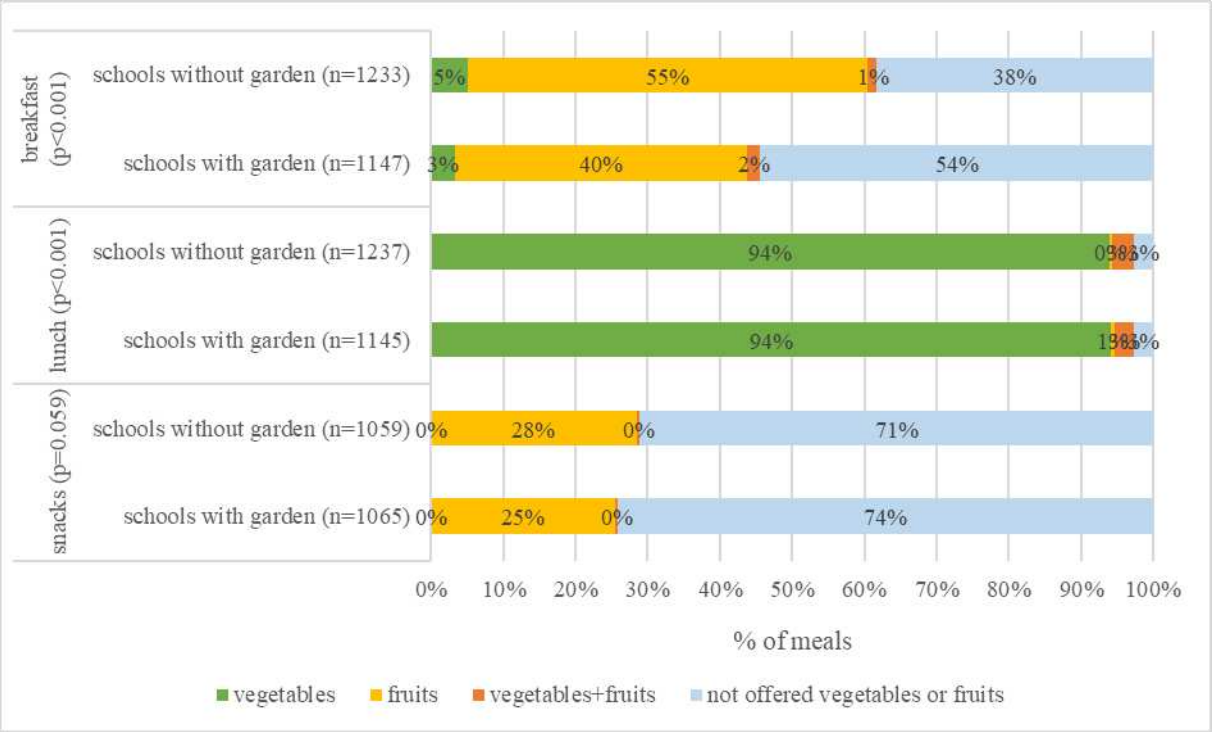
In schools with garden, annual school menus offered on average a 126.39 g fruit and vegetables daily (55% of recommendation) which is significantly lower than in school with garden where annual menus offered on average 159.85 g fruit and vegetables daily (69% of recommendation) (table 12).

Table 22. Average annual daily amount of fruits and vegetables in school with and without garden

Type of school	N of school menus	Minimum	Maximum	Mean	St. error	P[1]
School with garden	1230	0 g	491.98 g	126.39 g	2.55 g	< 0.001
School without garden	1239	0 g	688.16 g	159.85 g	3.16 g	
School with garden	1230	0%	273%	55%	1%	< 0.001
School without garden	1239	0%	287%	69%	1%	

[1] Mann U Whitney test ($p<0.05$)

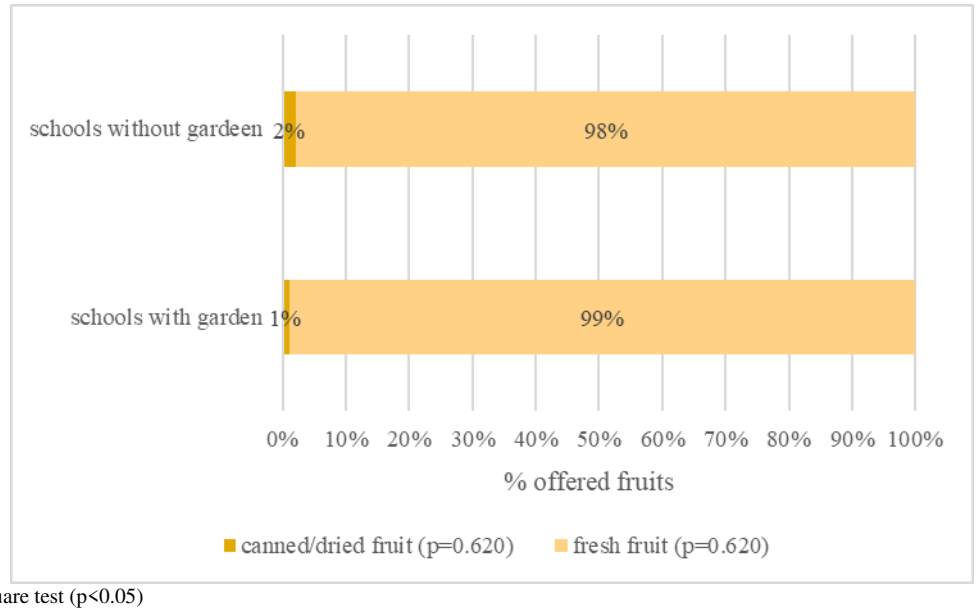
The results from figure 9 show that schools without garden offered more (p<0.001) fruits in breakfast and had fewer breakfasts without offered fruits and vegetables than schools with garden. In both schools with and without garden menus offered vegetables in 94% of lunches, but schools with garden offered more (p<0.001) fruits during the lunches. In both schools with and without garden one quarter of served shacks had fruits, but more than 70% of snacks didn't offer fruits or vegetables.



Note: chi-square test (p<0.05)

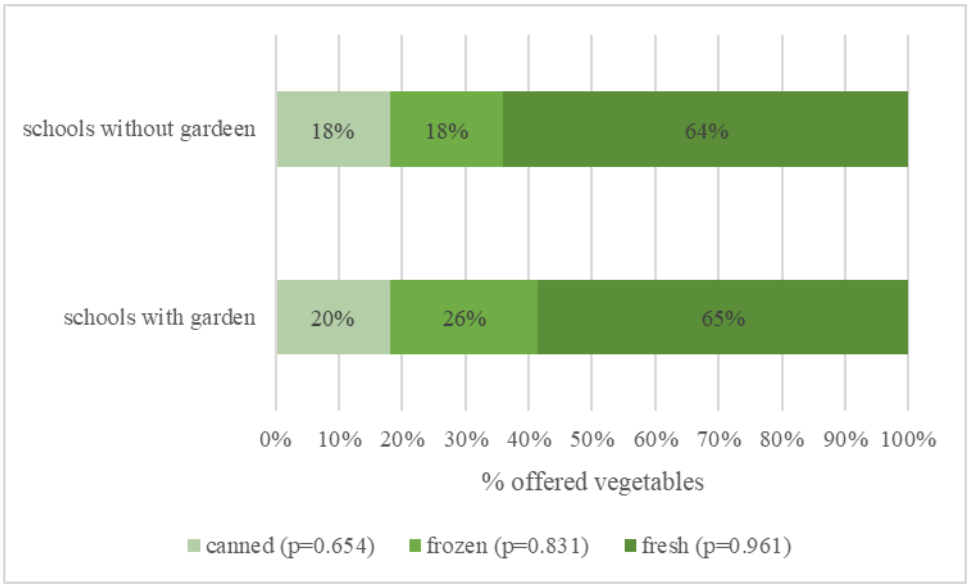
Figure 52. Percentage of meals in which were offered fruits and/or vegetables in school menus in schools with and without a garden

Annual school menus in school with garden offered 98% fresh fruits and 65% fresh vegetables, while school menus in school with garden offered 99% fresh fruits and 64% fresh vegetables. There were no significant differences between types of offered fruits (figure 10) and vegetables (figure 11) between the schools with and without garden.



Note: chi-square test (p<0.05)

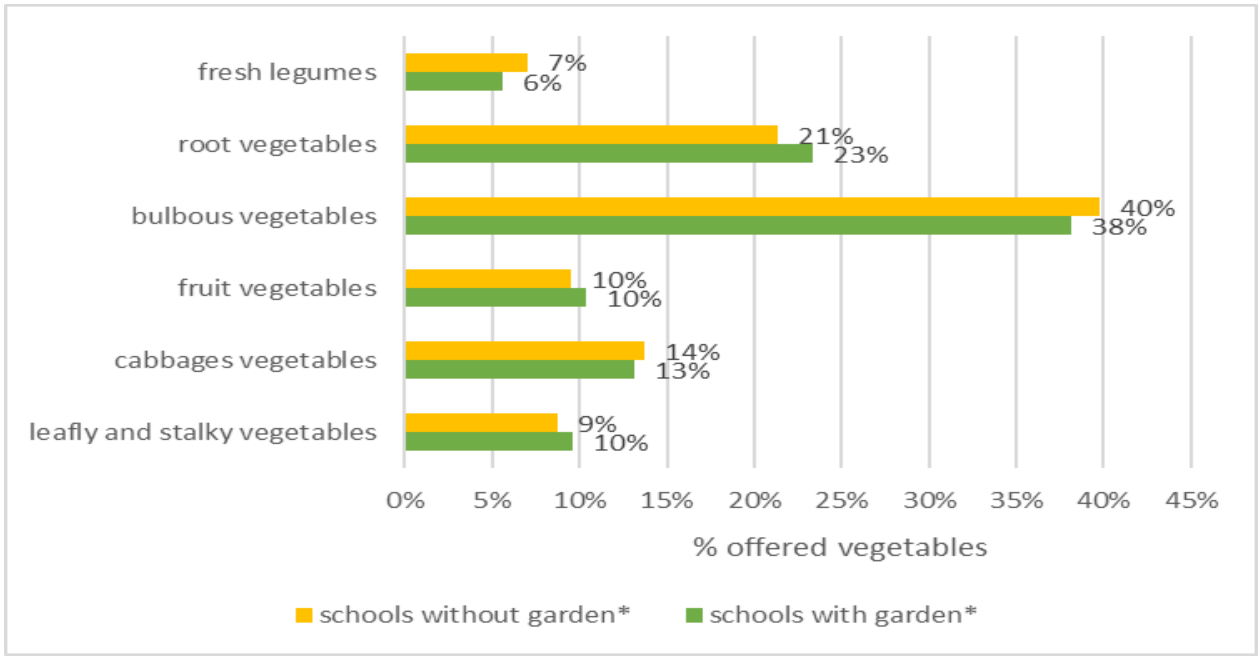
Figure 53. Distribution of procured types of fruits in schools with and without garden



Note: chi-square test (p<0.05)

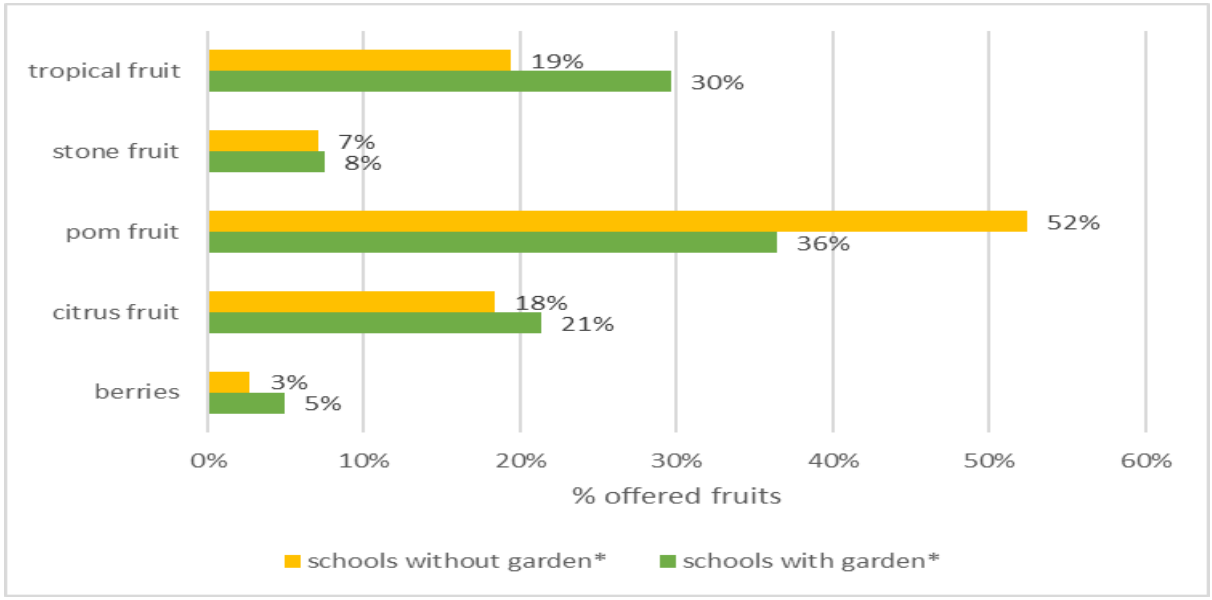
Figure 54. Distribution of procured types of vegetables in schools with and without garden

The most two frequently-served categories of vegetables (figure 12) were bulbous (40% schools without garden and 38% school with garden) and root vegetables (21% schools without garden and 21% schools with garden) in both schools with and without gardens, although there was a difference (p=0.024) between their frequencies. Also, the differences (p<0.001) between the frequency of offered fruit were analysed (figure 13). The two most frequently-served categories of fruits were pome (52% in schools without garden and 36% school with garden) and tropical fruits (19% in schools without garden and 30% in school with garden).



Note: chi-square test (p<0.05)

Figure 55. Distribution of different vegetable categories

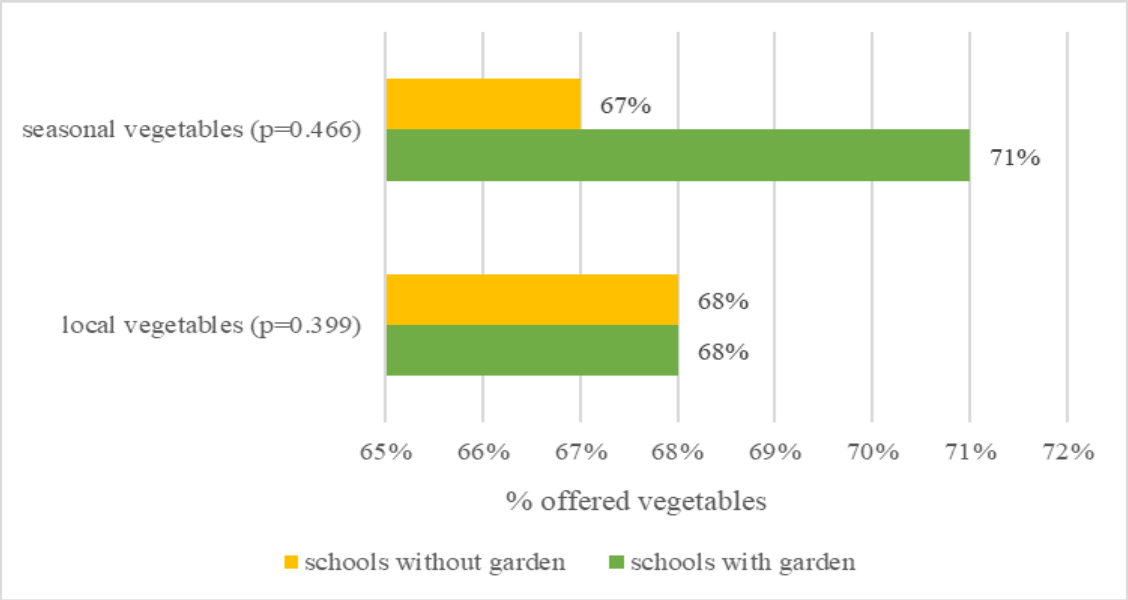


Note: chi-square test (p<0.05)

Figure 56. Distribution of different fruit categories

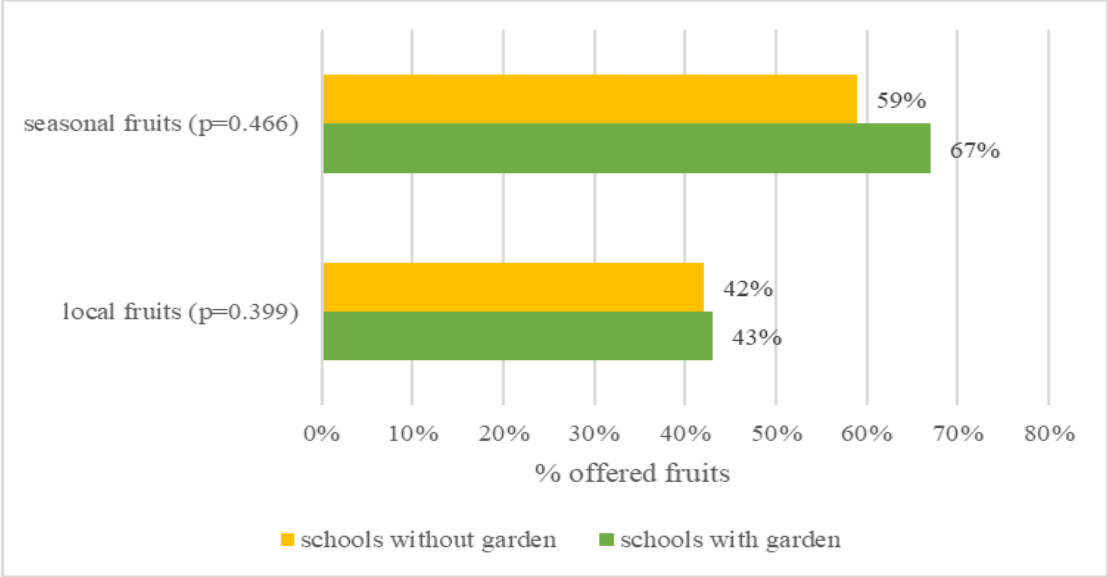
From school food suppliers we obtained data of local cultivation for 43% types of vegetables and 90% types of fruit, which were procured for the preparation of meals in schools.

The results of the analysis showed that schools with and without garden procured and offered local vegetables (p=0.399) and seasonal (p=0.466) in the same frequency through annual menus (figure 14). Also, schools with and without garden equally offered local (p=0.399) and seasonal (p=0.466) fruits in annual menus (figure 15).



Note: 1230 daily menus of schools with garden and 1239 daily menus of schools without garden

Figure 57. Percentage of offered local and seasonal vegetables in annual menus of primary schools with and without garden



Note: 1230 daily menus of schools with garden and 1239 daily menus of schools without garden

Figure 58. Percentage of offered local and seasonal fruits in annual menus of primary schools with and without garden

4.4 Students preference toward fruit and vegetable

A 5-degree hedonistic scale was used to assess fruit and vegetable preference (Birch and Sullivan, 1991). Students self-assessed preference for 26 types of fruits and for 28 types of vegetables. In total, 1895 students rated the fruit and vegetables (1001 from schools with gardens and 894 from schools without gardens). The procedure was following: each student was given a printed questionnaire in the classroom, they were asked to answer preference toward fruits and vegetables individually, using a 5 point hedonistic scale. The questionnaire was designed based on the more frequently consumed fruits and vegetables in Croatia, according to national consumption data (https://www.efsa.europa.eu/en/food-consumption/comprehensive-database).

The results in table 13 show that students preferred fruits more than vegetables in both schools with and without gardens. Also, there is no difference in preference for fruit and vegetables between students in both schools with and without gardens.

According to mean like score, students from both schools with and without garden (table 14) most preferred fried potato, carrot and lettuce among the vegetables. Students from schools with garden most preferred apples, mandarins and strawberries, while students from schools without gardens most preferred apples, strawberries and watermelon among fruits (table 14).

Table 23. Preference of fruit and vegetables of students from schools with and without garden

Parameters	School	Mean[1] ± st. error	P[2]
Vegetables	**Schools with garden**	3.08 ± 0.18	0.682
	Schools without garden	2.99 ± 0.18	
Fruits	**Schools with garden**	3.86 ± 0.14	0.621
	Schools without garden	3.92 ± 0.14	

[1] 1-I don't like it a lot; 5- I like it a lot
[2] Mann U Whitney test ($p<0.05$)

Table 24. Students' preference scores of fruits and vegetables from schools with and without garden

School with garden	Mean	St. error	Schools without garden	Mean	St. error
Vegetables					
Fried potato	4.74	0.03	**Fried potato**	4.66	0.03
Carrot	4.36	0.03	**Carrot**	4.29	0.04
Lettuce	4.16	0.05	**Lettuce**	4.06	0.05

Beans	4.11	0.04	**Beans**	3.96	0.05
Cucumber	3.96	0.05	**Cucumber**	3.93	0.05
Peas	3.88	0.04	**Cooked potato**	3.87	0.05
Spinach	3.85	0.05	**Spinach**	3.79	0.05
Cooked potato	3.83	0.05	**Tomato**	3.77	0.06
Tomato	3.80	0.05	**Peas**	3.65	0.05
Green beans	3.73	0.05	**Green beans**	3.57	0.05
Cabbage	3.58	0.05	**Cabbage**	3.51	0.05
Beetroot	3.43	0.06	**Beetroot**	3.45	0.06
Pepper	3.34	0.06	**Pepper**	3.32	0.06
Onion	3.21	0.06	**Onion**	2.98	0.06
Leek	3.05	0.06	**Kale**	2.85	0.06
Kale	2.94	0.05	**Broccoli**	2.82	0.05
Radish	2.85	0.06	**Leek**	2.80	0.06
Mushroom	2.84	0.06	**Mushroom**	2.68	0.06
Broccoli	2.76	0.05	**Zucchini**	2.59	0.06
Zucchini	2.65	0.06	**Radish**	2.53	0.06
Celeriac	2.46	0.06	**Cauliflower**	2.45	0.06
Cauliflower	2.42	0.06	**Celeriac**	2.32	0.06
Pumpkin	2.04	0.06	**Pumpkin**	2.10	0.06
Brussel sprouts	1.77	0.05	**Eggplant**	1.76	0.06
Eggplant	1.75	0.06	**Chickpeas**	1.75	0.06
Asparagus	1.67	0.06	**Brussel sprouts**	1.67	0.05
Chickpeas	1.61	0.06	**Asparagus**	1.38	0.06

Kohlrabi	1.34	0.06	**Kohlrabi**	1.23	0.06
Fruits					
Apple	4.69	0.03	**Apple**	4.77	0.03
Mandarin	4.65	0.03	**Strawberries**	4.68	0.03
Strawberries	4.63	0.03	**Watermelon**	4.68	0.03
Watermelon	4.56	0.04	**Mandarin**	4.61	0.04
Grapes	4.44	0.04	**Banana**	4.57	0.03
Banana	4.40	0.04	**Cherry**	4.52	0.04
Cherry	4.39	0.04	**Orange**	4.45	0.04
Orange	4.37	0.04	**Grapes**	4.45	0.04
Pears	4.33	0.04	**Pear**	4.44	0.04
Apricot	4.16	0.05	**Peach**	4.33	0.05
Peach	4.12	0.05	**Apricot**	4.31	0.05
Raspberries	4.11	0.05	**Raspberries**	4.12	0.05
Blackberries	4.07	0.05	**Nectarine**	4.09	0.06
Nectarine	4.02	0.05	**Plum**	4.06	0.05
Plum	3.96	0.05	**Blackberries**	3.94	0.06
Sour cherry	3.94	0.05	**Sour cherry**	3.94	0.05
Lemon	3.82	0.05	**Blueberries**	3.85	0.06
Blueberries	3.74	0.06	**Kiwi**	3.83	0.06
Kiwi	3.67	0.06	**Lemon**	3.80	0.05
Pomegranate	3.56	0.06	**Pomegranate**	3.66	0.06
Pineapple	3.44	0.06	**Pineapple**	3.51	0.06
Currants	3.25	0.07	**Fig**	3.04	0.06

Fig	2.97	0.06	**Currants**	2.99	0.07
Apple quince	2.58	0.06	**Apple quince**	2.69	0.06
Grapefruit	2.46	0.07	**Grapefruit**	2.49	0.07
Mango	2.15	0.07	**Mango**	1.98	0.07

4.5 Plate waste between schools with and without garden

Food waste can occur at all stages of the food service system, but specific plate waste refers to the volume or percentage of served food, the edible part that remains uneaten by subjects to whom it is served (Buzby and Guthrie, 2002). Although there is no standard for an acceptable level of plate waste, it's suggested that 12% of plate waste is not excessive (Buzby and Guthrie, 2002). According to results obtained in WP.6.2 plate waste in Croatian schools ranged were between 78-494 kg (12 to 28%) depending on the different PSFP model. However, these results were based on only 4 schools (two schools per model). This research represents a continuation of previous efforts, and is based on the 14 schools selected. The analysis included two steps: plate waste measurement and students' questionnaires (children preference toward vegetable dishes questionnaire).

The plate waste measurements were conducted in the school year 2017/2018 in all 14 elementary schools. In each school, plate waste data were collected for five consecutive days (one school week) per two seasons (autumn/winter season and spring/summer). In total, there were 70 days of collection activities per case. The measurement involved collecting plates/trays from all students aged 7 to 10 years (1st-4th grade) who have taken a school meal during collection, therefore 17163 students were involved (8648 from school with garden and 8515 from school without garden).

Modified aggregate selective plate waste was the method used for the collection of plate waste data (Comstock et al., 1979). Firstly, on each data collection day, three random samples of the served meals were weighed, and an average from these was calculated as a reference point for the weight of the served meal. The second step was a collection of plates/trays from all students from 1st to 4th after they had finished eating their meal at the waste station. The leftovers were separated into 6 bins defined according to the nutritive value of the food category: (1) fruit (fresh fruit); (2) vegetables (including mixed vegetable stews, legume stews, vegetable soup, fresh and canned salads, side dishes that encourage the intake of vegetables and contain more than 30% of vegetables in the composition, and meal components that couldn't be divided, e.g. rice and peas, mixed vegetable with rice, pasta with cabbage); (3) meat and fish (all meat and meat products, fish and fish products, and poultry and poultry products, eggs); (4) starchy foods (e.g. bread, pasta, rice, potatoes, cereals, bakery products, main dishes mainly containing starchy foods with other items that couldn't been separated, e.g. pasta with Bolognese sauce, risotto with beef); (5) desserts (foods that are part of the school menu and listed as "dessert", e.g. puddings, cakes, shakes, dairy desserts, fruit yoghurt); and (6) other food (food served during lunch time in school, which is not included in the first five groups, e.g. soup with noodles, juice made with syrup). At the end of the lunch services, the total weight of each bin

was recorded. The number of students who have taken a school meal and the number of plates/trays from which waste has been scraped were recorded on each data collection day.

After data collection the plate/tray food waste was calculated using the following formulas:

$$\%\ waste = \frac{edible\ waste\ weight}{weight\ of\ mean\ serving\ size\ of\ edible\ food}\ x\ 100 \quad [1]$$

$$\%\ of\ plate\ waste\ of\ food\ category = \frac{\frac{total\ plate\ waste\ of\ each\ category}{no.of\ students}}{sample\ weight\ of\ each\ food\ category}\ x\ 100 \quad [2]$$

$$\%\ of\ plate\ waste = \frac{\frac{total\ plate\ waste}{no.of\ students}}{sample\ weight\ of\ each\ food\ category}\ x\ 100 \quad [3]$$

$$food\ intake\ per\ student\ (g) = sample\ weight\ (g) - \frac{total\ plate\ waste}{number\ of\ students} \quad [4]$$

This method did not require direct contact with children and the children preference toward vegetable dishes questionnaire was anonymous without any personal identifying information, except for the students' grade and gender. Furthermore, we were interested in differences in plate waste between the seven schools with garden and seven schools without garden. We summed the daily waste from all 20 data collection days in schools with garden and schools without garden, respectively.

In total, schools with garden waste more served food (25%) than schools without gardens (18%). According to statistical analysis (table 15) there was a difference between the amount of plate waste according to category plate waste (p=0.04) and schools (p=0.002). The results show that the most wasted food category was vegetables, followed by meat, starchy food, other food, fruit and desserts in both schools with and without garden. Although the pattern in category waste was similar, it has been observed that schools with a garden waste more food in all categories than schools without a garden, except in the fruit category.

Table 25. Total and category plate waste in schools

Parameters		Served food		Waste	
		n	kg	kg	% [1]
Total plate waste					
Total waste	**Schools with garden**	8648	3293	833	25
	Schools without garden	8515	3509	623	18
Category plate waste					
Starchy food	**Schools with garden**	13513	1449	326	23
	Schools without garden	12838	1473	229	16
Vegetables	**Schools with garden**	7263	1039	355	34
	Schools without garden	6573	1152	276	24
Fruit	**Schools with garden**	232	30	3	10
	Schools without garden	206	17	2	12
Meat	**Schools with garden**	2897	76	240	32
	Schools without garden	2850	239	59	25
Desserts	**Schools with garden**	2104	162	9	5
	Schools without garden	2423	247	7	3
Other food	**Schools with garden**	1956	373	64	17
	Schools without garden	1832	380	50	13

1 Two-factor ANOVA without replication ($p<0.05$) between plate waste categories and school with and without garden

4.6 Student preferences for fruit and vegetable dishes

The assessments of student preferences for fruit and vegetable dishes were carried using a five-point 'faces' scale (scores 1 to 5; 5 being the most preferable) (Birch and Sullivan, 1991).

In parallel with plate waste measurements, students were surveyed about their food preferences and reasons for not finishing their meals. Therefore, student preferences for fruit and vegetable dishes were collected during the plate waste measurements in the school year 2017/2018 in all 14 elementary schools from all students aged 7 to 10 years (1st-4th grade) who have taken a meal during plate waste collection days. After students finished their meal, they rated their dishes which included fruit or vegetable. Also, if the students did not finish their meal, they were offered to choose the reasons why: "I didn't like the taste of the food", "I didn't like the smell/looks of the food", "I don't eat this at home", "I am not hungry", "I cannot eat that much food", "I didn't have enough time". In total, 11960 responses were collected, of which 6768 (6499 vegetable dishes and 269 fruit dishes) from schools with garden and 5192 (5192 vegetable dishes and 0 fruit dishes) from schools without garden.

This section reports our analysis of the students' preferences for fruits and vegetable dishes and reasons for not consuming meal items which included fruits or vegetables.

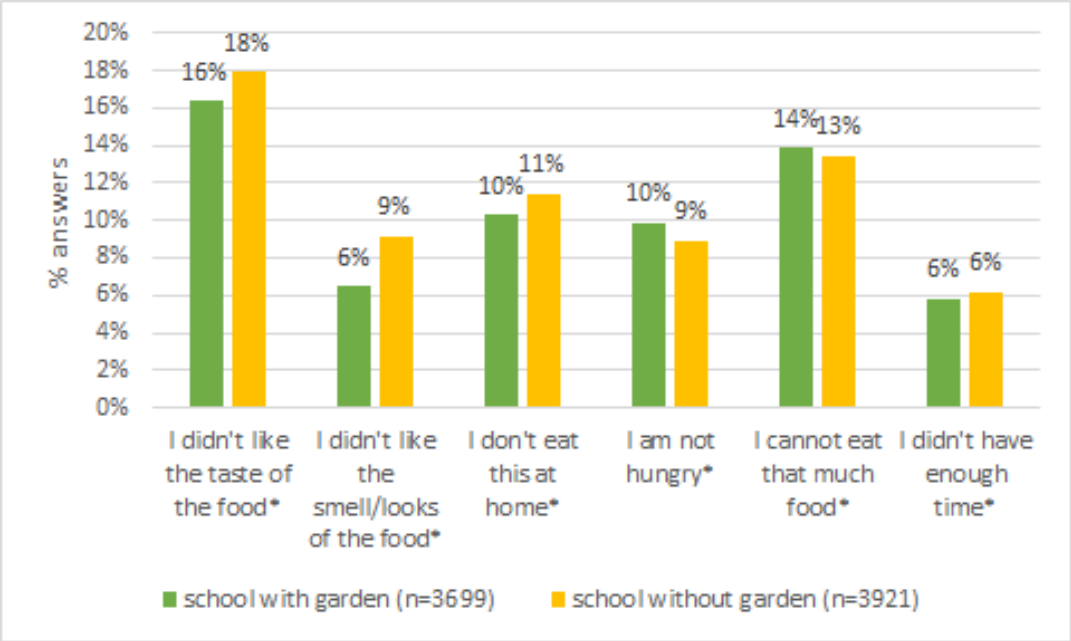
Students in schools with garden significantly ($p<0.001$) prefer vegetable dishes compared to students in schools without garden (Table 16). The same analysis couldn't be performed for fruits because the fruit was not served during the collection data days in schools without a garden, and only one type of fruit (apple) in two lunches was served in schools with garden. A general reason for this is that schools in Croatia mainly serve fruits during breakfast or snacks.

Table 26. Like score of selected dishes in students from schools with and without garden

Parameters	**Schools**	**Like score**	**P** [1]
		mean ± st. error	
Vegetables (n=7620)	**Schools with garden (n=3699)**	3.79 ± 0.03	< 0.001
	Schools without garden (n=3921)	3.56 ± 0.03	
Fruits (n=269)	**Schools with garden (n=269)**	3.97 ± 0.09	-[3]
	Schools without garden (n=0)	nm[2]	

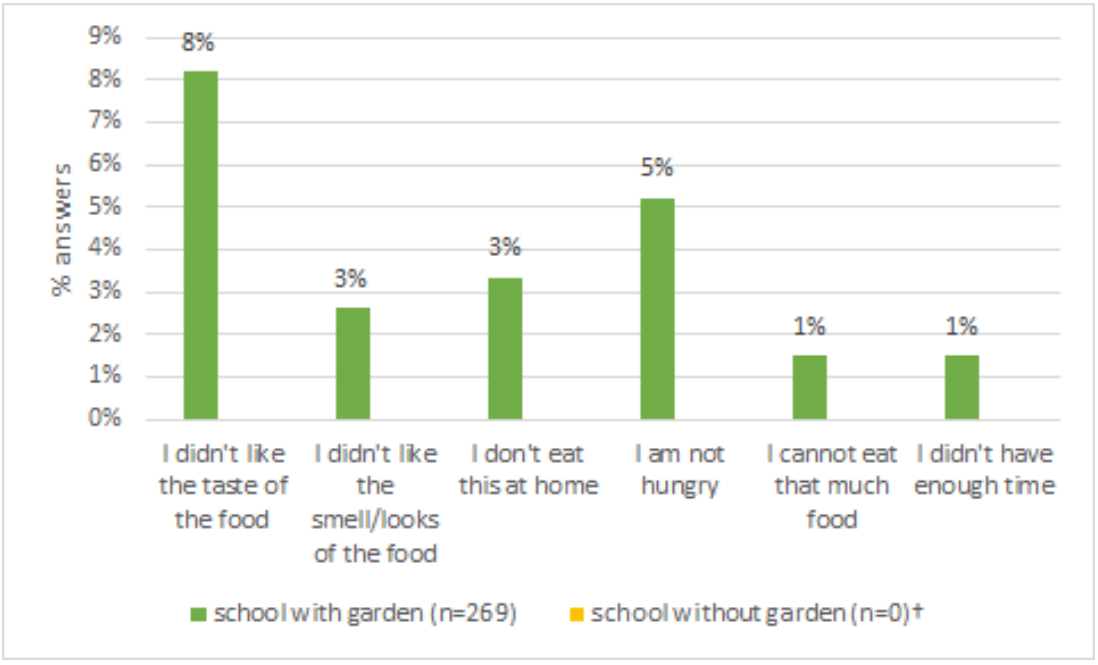
1 – Mann U Whitney test ($p<0.05$)
2 – Fruits were not served during collection data (*nm= not measured*)
3 – Statistical analysis could not be performed due to a lack of data

According to statistical analysis, the reason for not finishing the vegetable dishes differs among students ($p=0.001$), but there were no statistical differences ($p=0.248$) among the distribution of answers in students from schools with and without gardens (figure 16). The same analysis couldn't be performed for fruit dishes for the same reason stated in the preference analysis (Figure 17). From Figure 16, it can be noticed that the main reasons why students waste vegetable food are: they didn't like their taste; they couldn't eat that much food; they didn't eat that kind of dish at home. For fruit (Figure 17), students stated that they did not like the taste of apples, they were not hungry and they do not eat that at home.



Note: Two-factor ANOVA without replication (*p<0.05)

Figure 59. Reasons for not finishing the meal among students (n=7620) who did not eat whole served food from vegetable category in schools with and without garden



† fruits were not served during collection data

Figure 60. Reasons for not finishing the meal among students (n=269) who did not eat whole served food from fruit category in schools with and without garden

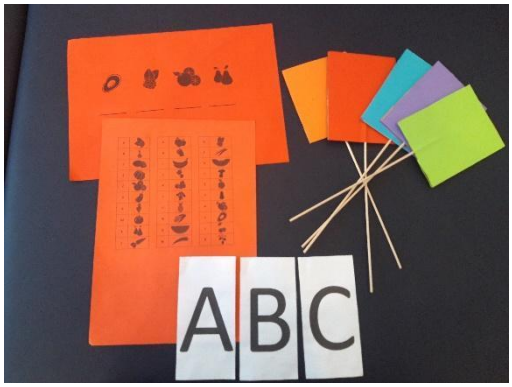
5. EDUCATIONAL INTERVENTION IN SCHOOLS WITH AND WITHOUT GARDENS

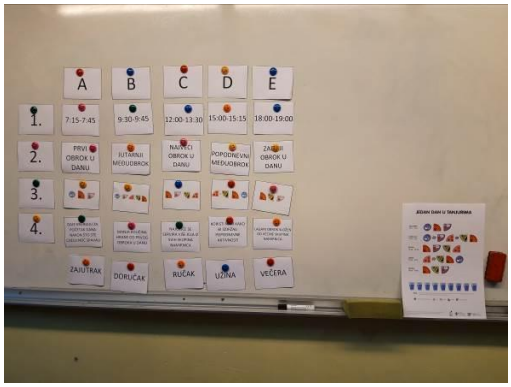
This pilot action was informed by a view of education as a multi-component intervention, designed to act at all levels of the child's bioecological system according to the Bronfenbrenner bioecological model (Bronfenbrenner and Morris, 2006; Scaglioni et al., 2018). Education is focused on postulates of a healthy diet, raising awareness of the importance of fruit and vegetable consumption, consumption of seasonal, organic and local fruits and vegetables. The latter includes educating children about nutrition, encouraging the consumption of fruits and vegetables, educating parents, arranging classrooms and school dining rooms and correcting school menus (ibid.).

In this context, activities were planned for both children and parents. For two years, we ran 23 different classroom activities of multicomponent nutrition education in the duration of 45 minutes each based on motivational, behavioural and socio-cognitive learning theory and Gardner's theory of multiple intelligences (Contento, 2007; Blanchette and Burg, 2005; Knai et al., 2006; Evans et al., 2012; Appleton et al., 2016; van Cauwenberghe et al., 2010; Delgado-Noguera et al., 2011; Diep et al., 2014). The activities were conducted by a nutritionist with additional pedagogical and psychological education. As regards parents, the official website developed for the needs of this project (https://pilots2f.wixsite.com/nutriskolica), was used to promote knowledge of the adequate nutrition of children and the application of various methods to practice the principles of adequate nutrition in a family environment. During nutritional education students participated in creating educational posters which were used to decorate classrooms for the purpose of visual stimulation because children who know the appearance of fruits and vegetables are more likely to accept its consumption. Through various homework assignments, students were encouraged to taste new foods/dishes for them, which could affect the acceptability of fruits and vegetables.

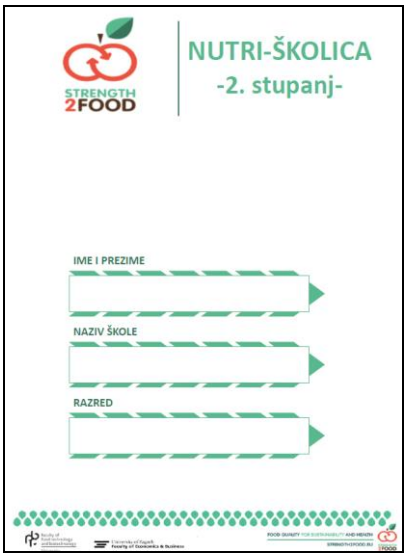
All educational materials (teaching aids, booklets, posters and presentations) were designed and prepared by the ZAG team (figure 18).

In this part of the research, all 14 selected primary schools (described in section 2.1.) were included. Within each school, the first grades classes were divided into an intervention group and a control group by random selection method. This distribution of schools and classes in each school is important to reduce the possible impact of socioeconomic status, different school fruit and vegetable availability, school projects that promote adequate nutrition and physical activity, and accompanying extracurricular activities. In total, 364 students participated in the intervention and 280 students in the control group. Different dietary tools were used before the education started and they were repeated at the end of the education in order to observe the efficacy of the nutritional education as well as changes in nutritional behaviour.





1. Teaching aids



2. Booklet

3. Posters

4. presentation

Figure 61. Examples of teaching aids

Note: Parental consents for photography were collected.

Figure 62. Insights from nutritional educations

5.1 Preferences toward fruit and vegetables after education

Preference toward fruit and vegetable was examined through the same questionnaire described in section 4.4. In total, 611 students from all 14 schools completed the questionnaire. Within this group, 286 (125 in control and 161 in the intervention group) students attended the schools with garden and 325 (130 in control and 195 in the intervention group) students attended school without garden.

Generally, students preferred fruits more than vegetables in both schools with and without garden. According to the results, there is no difference in preference for fruit and vegetables between the control and intervention groups of students in both schools with and without garden (table 17). According to mean like score, students from school with garden (table 18) in the intervention group most preferred fried potato, carrot and beans among the vegetables, while the control group most preferred fried potato, carrot and cucumbers. Students from school without garden (table 19) in the intervention group most preferred fried potato, carrot and lettuce, while students from the control group prefer fried potato, carrot and beans. Students from both intervention and control groups from both schools with and without gardens most preferred apple, strawberry and watermelon among fruits (table 18 and 19).

Table 27. Preference of fruit and vegetables of students from schools with and without garden after implementation of education

Parameters	School	Schools with garden	P[1]	Schools without garden	P[2]
Vegetables	**Control group**	2.82 ± 0.19	0.737	2.69 ± 0.18	0.350
	Intervention group	2.92 ± 0.18		2.91 ± 0.18	
Fruits	**Control group**	3.77 ± 0.15	0.522	3.67 ± 0.13	0.453
	Intervention group	3.88 ± 0.15		3.75 ± 0.16	

[1,2] Mann U Whitney test ($p<0.05$)

Table 28. Students preference scores of fruits and vegetables - schools with garden

Control group	Mean	St. error	Intervention group	Mean	St. error
Vegetables					
Fried potato	4.65	0.08	**Fried potato**	4.58	0.08
Carrot	4.32	0.09	**Carrot**	4.27	0.09
Cucumber	4.01	0.13	**Beans**	4.23	0.10
Beans	3.95	0.13	**Lettuce**	4.07	0.11
Lettuce	3.79	0.15	**Cucumber**	4.04	0.11
Peas	3.62	0.12	**Tomato**	3.75	0.12
Green beans	3.62	0.15	**Peas**	3.68	0.10

Beetroot	3.55	0.15	**Green beans**	3.53	0.12
Tomato	3.54	0.15	**Cabbage**	3.51	0.12
Cabbage	3.47	0.15	**Beetroot**	3.49	0.13
Cooked potato	3.41	0.17	**Spinach**	3.38	0.13
Spinach	3.26	0.16	**Pepper**	3.29	0.13
Broccoli	3.02	0.15	**Cooked potato**	3.28	0.14
Pepper	2.91	0.16	**Broccoli**	3.06	0.12
Kale	2.80	0.15	**Onion**	3.05	0.13
Onion	2.63	0.17	**Kale**	2.91	0.13
Leek	2.55	0.16	**Leek**	2.74	0.14
Cauliflower	2.48	0.17	**Cauliflower**	2.50	0.14
Mushrooms	2.46	0.16	**Mushrooms**	2.43	0.14
Pumpkin	2.35	0.17	**Zucchini**	2.35	0.14
Zucchini	2.21	0.16	**Celeriac**	2.23	0.14
Radish	2.02	0.17	**Radish**	2.22	0.14
Celeriac	1.91	0.16	**Pumpkin**	2.17	0.14
Eggplant	1.56	0.16	**Brussel sprouts**	1.78	0.13
Brussel sprouts	1.40	0.12	**Chickpeas**	1.50	0.14
Chickpeas	1.28	0.16	**Eggplant**	1.44	0.12
Asparagus	1.25	0.15	**Asparagus**	1.39	0.13
Kohlrabi	1.04	0.14	**Kohlrabi**	1.05	0.13
Fruits					
Apple	4.85	0.04	**Apple**	4.82	0.04
Strawberries	4.73	0.07	**Strawberries**	4.74	0.06
Watermelon	4.70	0.07	**Watermelon**	4.71	0.07
Mandarin	4.68	0.08	**Mandarin**	4.68	0.07
Banana	4.49	0.08	**Banana**	4.67	0.07
Grapes	4.36	0.11	**Pear**	4.49	0.08
Cherry	4.36	0.13	**Cherry**	4.42	0.10
Orange	4.31	0.11	**Grapes**	4.39	0.09
Pear	4.25	0.10	**Orange**	4.32	0.10
Peach	4.17	0.13	**Apricot**	4.26	0.10
Apricot	4.05	0.14	**Raspberries**	4.22	0.11
Nectarine	4.02	0.14	**Peach**	4.18	0.11
Raspberries	4.01	0.14	**Nectarine**	3.96	0.13
Lemon	3.77	0.13	**Blackberries**	3.92	0.13
Blueberries	3.67	0.17	**Sour cherry**	3.87	0.12

Blackberries	3.63	0.16	**Plum**	3.84	0.13
Pomegranate	3.61	0.17	**Blueberries**	3.75	0.14
Plum	3.58	0.15	**Kiwi**	3.75	0.13
Sour cherry	3.58	0.16	**Lemon**	3.74	0.11
Pineapple	3.51	0.16	**Pineapple**	3.68	0.13
Kiwi	3.38	0.17	**Pomegranate**	3.34	0.15
Currants	2.85	0.20	**Fig**	2.95	0.15
Apple quince	2.71	0.17	**Currants**	2.94	0.16
Fig	2.55	0.17	**Apple quince**	2.55	0.15
Grapefruit	2.33	0.19	**Grapefruit**	2.36	0.16
Mango	2.06	0.19	**Mango**	2.27	0.16

Table 29. Student preferences scores of fruits and vegetables - schools without garden

Control group	**Mean**	**St. error**	**Intervention group**	**Mean**	**St. error**
Vegetables					
Fried potato	4.66	0.08	**Fried potato**	4.81	0.05
Carrot	4.19	0.10	**Carrot**	4.27	0.09
Bean	3.83	0.13	**Lettuce**	4.21	0.11
Lettuce	3.74	0.15	**Cucumber**	3.90	0.13
Cooked potato	3.63	0.15	**Bean**	3.82	0.12
Cucumber	3.52	0.15	**Spinach**	3.78	0.13
Spinach	3.50	0.15	**Beetroot**	3.59	0.14
Beetroot	3.38	0.17	**Green beans**	3.59	0.13
Cabbage	3.30	0.14	**Cabbage**	3.58	0.13
Peas	3.29	0.13	**Tomato**	3.46	0.14
Tomato	3.28	0.16	**Peas**	3.45	0.12
Green beans	3.06	0.16	**Cooked potato**	3.31	0.16
Pepper	2.89	0.17	**Pepper**	3.14	0.15
Broccoli	2.74	0.16	**Broccoli**	3.02	0.13
Onion	2.58	0.16	**Onion**	2.76	0.14
Kale	2.45	0.15	**Kale**	2.71	0.15
Leek	2.33	0.16	**Mushrooms**	2.65	0.15
Cauliflower	2.22	0.16	**Cauliflower**	2.57	0.15
Zucchini	2.18	0.16	**Leek**	2.45	0.16
Pumpkin	2.17	0.16	**Radish**	2.36	0.17
Radish	2.03	0.18	**Zucchini**	2.29	0.14
Mushrooms	2.02	0.16	**Pumpkin**	2.29	0.15

Celeriac	1.73	0.15	**Celeriac**	1.76	0.13
Chickpeas	1.62	0.18	**Chickpeas**	1.71	0.16
Brussel sprouts	1.43	0.14	**Asparagus**	1.67	0.15
Eggplants	1.38	0.14	**Brussel sprouts**	1.57	0.13
Asparagus	1.35	0.16	**Eggplants**	1.53	0.14
Kohlrabi	0.86	0.14	**Kohlrabi**	1.12	0.14
Fruits					
Watermelon	4.58	0.10	**Apple**	4.77	0.06
Strawberries	4.58	0.10	**Watermelon**	4.66	0.07
Apple	4.56	0.10	**Strawberries**	4.64	0.08
Cherry	4.35	0.12	**Mandarin**	4.60	0.08
Pears	4.33	0.10	**Banana**	4.53	0.08
Mandarin	4.18	0.13	**Cherry**	4.43	0.10
Banana	4.10	0.14	**Grapes**	4.35	0.11
Peach	4.07	0.15	**Pears**	4.28	0.10
Blueberries	4.02	0.15	**Orange**	4.27	0.10
Grapes	3.98	0.14	**Raspberries**	4.12	0.13
Apricot	3.97	0.15	**Peach**	4.10	0.13
Orange	3.92	0.14	**Apricot**	4.04	0.13
Nectarine	3.87	0.16	**Nectarine**	3.97	0.14
Plum	3.80	0.15	**Blueberries**	3.83	0.14
Raspberries	3.74	0.16	**Blackberries**	3.77	0.15
Lemon	3.59	0.15	**Lemon**	3.77	0.13
Sour Cherries	3.57	0.17	**Plum**	3.75	0.14
Blackberries	3.52	0.17	**Kiwi**	3.58	0.16
Kiwi	3.44	0.18	**Pineapple**	3.52	0.15
Pomegranate	3.42	0.17	**Sour cherry**	3.50	0.15
Pineapple	3.37	0.17	**Pomegranate**	3.15	0.17
Fig	2.85	0.17	**Fig**	2.73	0.17
Currents	2.65	0.19	**Apple quince**	2.64	0.16
Apple quince	2.61	0.18	**Currants**	2.52	0.18
Grapefruit	2.38	0.19	**Mango**	2.04	0.17
Mango	2.13	0.19	**Grapefruit**	2.03	0.17

5.2. Student preference for new fruit and vegetable dishes after education

This section presents the results of the assessments of student preferences for new fruit and vegetable dishes (described in section 6). The assessments were carried using a five-point 'faces' scale (scores 1 to 5; 5 being the most preferable) for newly designed dishes which included fruits or vegetables (Birch and Sullivan, 1991).

Student preferences for fruit and vegetable dishes were collected after implementation of education in all 14 elementary schools from students who were recruited into the intervention as an educational and control group. For two weeks the poster with five-point 'faces' scale (scores 1 to 5; 5 being the most preferable) and names of selected dishes were hung in their classrooms. After the meal (breakfast, lunch and snack) students needed to rate the dish which included fruit or vegetables they ate in the dining room. In total, 3553 rates were collected, of which is 1376 (936 vegetable dishes and 440 fruit dishes) from schools with garden and 2177 (973 vegetables dishes and 1204 fruit dishes) from schools without garden.

From table 20 it can be noticed that students prefer fruits more than vegetable dishes. No significant difference in preference for fruit and vegetable dishes was observed between control and intervention groups neither in school with nor without garden. However, preference toward fruit and vegetable dishes increased in both groups control and intervention compared with baseline results (table 16 *vs.* table 20). This could be as a result of changes in menus, however, preference analysis was not tasted for the same fruit and vegetable dishes, therefore, further analysis is needed.

Table 30. Preference scores of students from schools with and without garden after the implementation of education, based on selected dishes

Parameters	School	Schools with garden	P[1]	Schools without garden	P[2]
Vegetables	**Control group**	4.14 ± 0.06	0.362	4.06 ± 0.8	0.753
	Intervention group	4.05 ± 0.06		4.08 ± 0.5	
Fruits	**Control group**	4.62 ± 0.06	0.292	4.64 ± 0.04	0.241
	Intervention group	4.48 ± 0.07		4.52 ± 0.04	

[1,2] Mann U Whitney test ($p<0.05$)

5.3. Quantity and frequency of fruit and vegetable consumption after education

The data on the quantity and frequency of consumed fruits and vegetables were collected with a food frequency questionnaire. The questionnaire was completed online by parents and students together. The frequency of food and beverage consumption was specially designed for this purpose. The questionnaire consisted of a total of 22 questions articulated in three parts: (1) general data on the student - 4 questions, (2) data on fruit consumption - 5 questions and (3)

data on vegetable consumption - 13 questions. The data about the consumption of fresh, cooked and canned fruit were included and the consumption of fruit juice and nuts were excluded. Also, the data on the consumption of fresh, canned and thermally processed vegetables were included except for potatoes, beans and vegetable juices.

In total 346 students completed the questionnaire, of which 157 students attended the schools with garden (55 in the control group and 117 in the intervention group) and 197 students attended school without garden (77 in the control group and 117 in the intervention group).

Generally, students eat more than 300 g of fruits and vegetables every day, consuming more fruits than vegetables in both schools with and without garden. There are no differences in the amount of fruit and vegetable consumption in students after the implementation of education in both school with and without garden (table 21).

Table 31. Quantity of consumed fruits and vegetables among the students from schools with and without a garden

Parameters	School	Schools with garden	P[1]	Schools without garden	P[2]
Vegetables	**Control group**	144.70 ± 11.50	0.295	140.39 ± 9.07	0.976
	Intervention group	133.86 ± 6.80		149.38 ± 7.13	
Fruits	**Control group**	191.81 ± 19.03	0.551	185.59 ± 14.05	0.618
	Intervention group	189.58 ± 12.79		212.24 ± 15.69	
Total	**Control group**	336.51 ± 24.73	0.431	325.98 ± 19.03	0.833
	Intervention group	323.44 ± 16.34		361.63 ± 19.37	

[1,2] Mann U Whitney test ($p<0.05$)

Students most frequently (table 22) consumed fresh fruit which is more than 30 times per month, than dried fruit and canned fruit in both schools with and without gardens. Students most frequently consumed vegetables by eating vegetable soups, cooked/grilled/baked vegetables, green leafy vegetables and fresh vegetables in both schools with and without gardens. In schools with garden there are no differences in the frequency of fruit and vegetable consumption, while in schools without garden intervention group more frequently consumed canned fruit ($p=0.004$) than the control group, but the control group more frequently ($p=0.045$) consumed green leafy vegetables.

Table 32. Frequency of consumed fruits and vegetables among the students from schools with and without garden

Parameters	School	Schools with garden	P[1]	Schools without garden	P[2]
Fresh fruit	**Control group**	36.29 ± 3.29	0.886	33.87 ± 2.95	0.402
	Intervention group	35.97 ± 2.28		41.10 ± 3.36	
Dried fruit	**Control group**	4.46 ± 0.87	0.073	4.62 ± 0.92	0.580
	Intervention group	3.08 ± 0.50		3.57 ± 0.65	
Canned fruit	**Control group**	2.57 ± 1.19	0.304	1.07 ± 0.46	0.004
	Intervention group	1.17 ± 0.331		1.36 ± 0.22	
Vegetable soup	**Control group**	14.54 ± 1.51	0.707	16.17 ± 1.56	0.085
	Intervention group	15.16 ± 1.69		13.92 ± 1.29	
Vegetable stew	**Control group**	12.05 ± 1.20	0.441	10.15 ± 1.21	0.084
	Intervention group	11.03 ± 0.75		10.98 ± 0.78	
Vegetable from legume stew	**Control group**	4.83 ± 0.50	0.321	5.07 ± 0.60	0.764
	Intervention group	4.74 ± 0.68		5.42 ± 0.98	
Cooked, baked or grill vegetable	**Control group**	10.98 ± 1.72	0.753	10.18 ± 1.30	0.801
	Intervention group	8.62 ± 0.85		9.07 ± 0.73	
Vegetable and potato dishes	**Control group**	5.57 ± 0.71	0.428	6.39 ± 0.67	0.888
	Intervention group	5.69 ± 0.51		6.69 ± 0.57	
Leafy green vegetables	**Control group**	10.48 ± 1.52	0.255	8.96 ± 1.02	0.045
	Intervention group	11.15 ± 0.86		13.79 ± 1.83	
Fresh vegetables	**Control group**	11.29 ± 1.79	0.876	10.68 ± 1.71	0.829
	Intervention group	10.61 ± 1.17		10.43 ± 1.64	
Canned vegetables	**Control group**	4.15 ± 0.73	0.441	3.63 ± 0.57	0.237
	Intervention group	4.16 ± 0.48		5.21 ± 0.87	
	Control group	3.54 ± 0.44	0.132	3.61 ± 0.37	0.117

Vegetables from risotto	**Intervention group**	4.28 ± 0.32		5.94 ± 1.41	
Vegetables from souce for pasta	**Control group**	3.85 ± 0.50	0.866	3.77 ± 0.46	0.316
	Intervention group	3.57 ± 0.30		5.16 0.57	

[1,2] Mann U Whitney test ($p<0.05$)

6. PRACTICAL IMPLICATIONS

According to the obtained result, a large proportion of daily menus did not meet National recommendations, therefore we decided that changes in menus are necessary. This change cannot happen overnight. Firstly, we were able to increase the amount of vegetables and fruit in certain dishes. The variety of the food could not be changed because it is strongly tied up to procurement. However, food preparation could easily be changed; therefore we tested acceptance of one vegetable dish (kale meal) prepared in four different ways.

6.1. Taste of traditional kale meals

A small pilot study “Taste and rate” was conducted with four 4 different meals (2 traditional dishes and 2 new dishes, all made of kale - figure 20) and rated each dish by modified taste and rate methodology.

The aim of this pilot study was to evaluate the acceptance rates of two unconventional (chips and smoothie) and 2 classic (stew and fritters) dishes made of kale in school-age children (1st-4th grade), and determine whether age, gender and nutritional status have any effect on acceptance of these dishes. The study included 63 children (51% boys and 49% girls). Acceptability of dishes was examined using a hedonic scale with 5 degrees (1-"I like it a lot" to 5 "I do not like it at all").

For this study, kale was selected from all vegetables, because previous studies found that almost all children have the lowest preferences for kale dishes. Four kale dishes were prepared for the research: stew, chips, smoothies and fritters. Recipes and dishes for testing were made by a professional chef. All meals were prepared and stored in accordance with the safety systems for the preparation of food for children. The proportion of kale in each of the prepared dishes was higher than 50%.

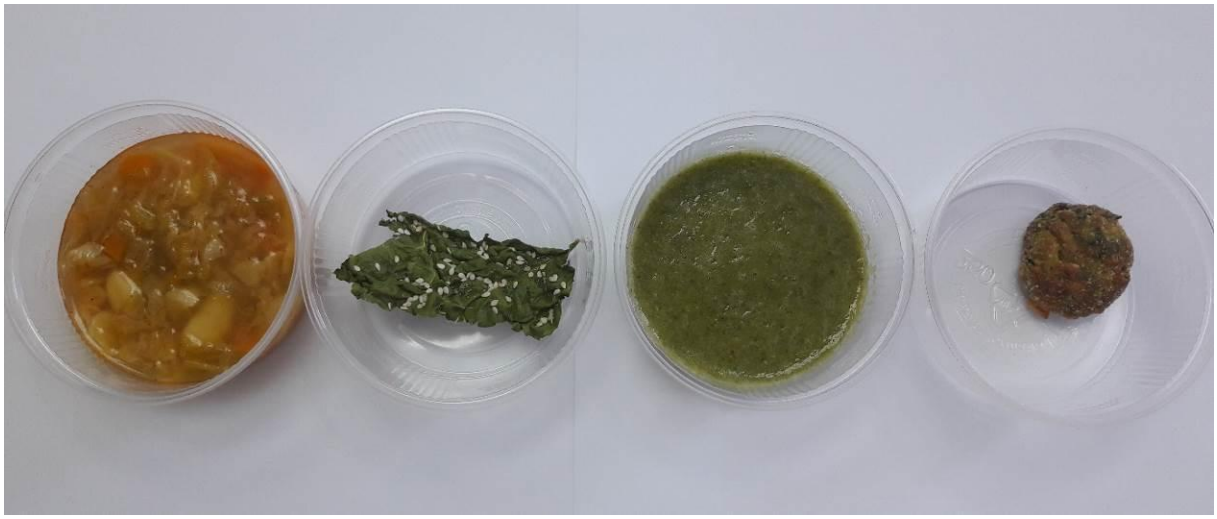
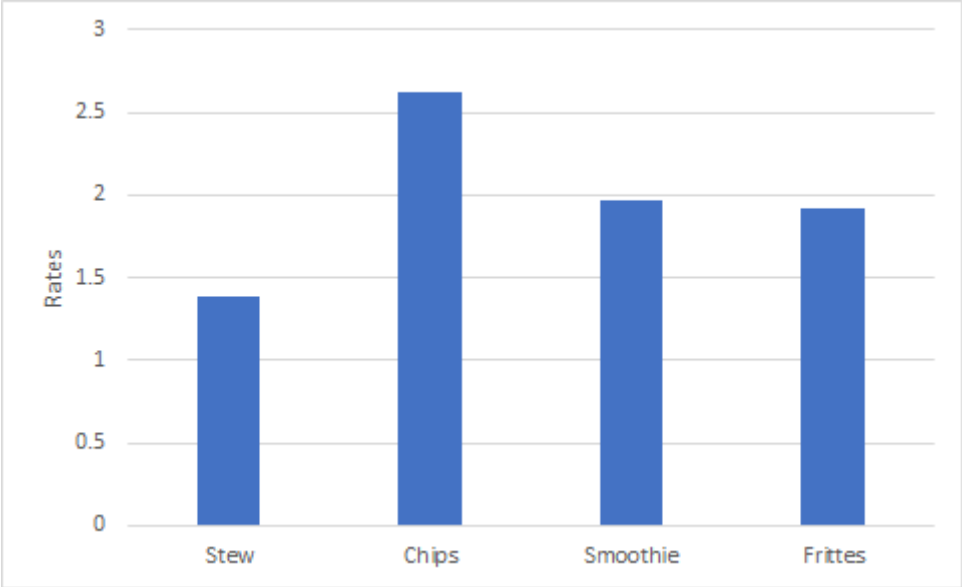


Figure 63. Four different meals made of kale (stew, chips, smoothie, fritter)

Figure 64. Study in progress

The given results show that children accept (points 1-3) every of 4 dishes served, with the best acceptance for stew (97% children), and the worst for chips (76% children). Acceptability of food increases with age (figure 22).



Note: 1-"I like it a lot" to 5 "I do not like it at all"

Figure 65. Acceptance of kale dishes by age (n=63)

To reach significant conclusions regarding the acceptability of kale dishes and nutritional status, it is necessary to examine a larger number of children. It seems that children like the traditional meal (stew) the most. The reason for that could be that they are exposed to stew more often. Research suggests that offering a disliked food continuously (at least 15 times), will lead to familiarity which will lead to acceptance (Wardel et. al, 2003; Patrick and Nicklas, 2005). From the given results it follows that all 4 dishes can be introduced into the diet of children included in this research, with the aim of increasing the consumption of vegetables.

6.2 Implementation of new dishes

In addition to the kale pilot, new dishes were designed and improved by adding more vegetables or fruits with higher nutrient quality. We proposed 40 new dishes, but implementation was very challenging. Due to the huge difference in school kitchens (infrastructure, number of staff etc.) it was not possible to propose the same meals for all kitchens. Based on previous research, the implementation of new strategies could entail many challenges. According to the study by Raine et al (2018) of healthy food procurement policies in Canada, challenges hindering implementation include limited knowledge of potential positive impacts, logistical barriers (e.g. lack of cooks or kitchens in schools), financial issues (pressures to create revenue streams from food service and/or franchising), and inconsistent nutrition standards and policies.

Significant, swift and not gradual changes in food procurement and school meals could also lead to dissatisfied children and parents (based on our own experience with the changes in kindergartens nutrition - observations not published previously). Therefore, this modification toward more nutritious and healthier food dishes should be implemented very slowly. We have proposed one or two new breakfasts and lunches per month for all 14 schools, individually adjusted. However, due to Covid-19 pandemic, it was impossible to execute our plan to the full. Before March 2019, we implemented several different breakfasts (one example is shown in

figure 23) and lunches. After 19th of March schools in Croatian were closed therefore kitchens were unable to prepare new meals.

Figure 66. Muffin with polenta and vegetables

7. CONCLUSIONS

The aim of this study was to analyse the benefits of school gardens on school meal nutrition and children's awareness and acceptance of healthy eating habits. Specifically, our goal was to establish an effective strategy to support school food procurement policy to improve children's uptake and long-term acceptance of nutritious school meals.

Firstly, we explored whether there is a difference between schools with and without gardens. In this process, 14 schools were targeted (7 with gardens and 7 without gardens). We compared those 2 types of schools regarding:

1) School meal nutrition: (a) school menus evaluation analysis and (b) fruit and vegetable availability in school menus) and

2) Children eating habits: (a) plate waste and (b)fruit and vegetable preference.

Regarding the first point (1a), this research revealed that a large proportion of daily menus from both types of schools are not nutritious according to national recommendations. The biggest problem is that ***half of the school menus in both types of schools (with and without garden) offer meals with a lower energy value than the one recommended by National guidelines, worryingly low content of fibres and excessive saturated fat content***.

Regarding the availability of fruit and vegetables (1b)***, results of this research were alarming in terms of fruit and vegetable quantity in school meals (school menus offered only 55% to 69 % of the recommended amount of fruit and vegetable in schools with garden and without garden respectively)***. In order to resolve this problem, we contacted the City of Zagreb office.

Since they showed understanding and support for school menus analysis, the recommendation based on WP 6.2 was to organize a working forum. Therefore, a School Menus Committee was established with 15 members including a nutritionist, medical doctors, an economist, as well as professionals from the Institute of public health and schools' representatives. The main tasks of this Committee are: to create and implement new menus adapted to each kitchen infrastructure; coordination of activities related to the education of staff in charge of food preparation in primary schools in the City of Zagreb; and monitoring, control and evaluation of the application of new menus. Zagreb Council is willing to be part of that process despite kitchen infrastructure barriers (being the major challenge for the implementation of new menus). Those new menus will be provided for all City of Zagreb schools. The goal to improve the nutritional qualities of school meals should be achieved in the future.

Furthermore, the analysis of children's eating habits produced further insights. Results of research on ***plate waste were alarming*** (2a) in terms of plate waste levels within the children in this sample. Surprisingly, our analysis indicates that schools with gardens have a higher plate waste level than schools without gardens (25% vs. 18%). On the other hand, research on preference toward vegetable dishes revealed some small differences between those two types of schools (2b). ***Children in schools with garden preferred vegetable dishes more than children in schools without garden***, while no differences were observed for fruit dishes. Children in schools without a garden significantly disliked the taste of prepared vegetable dishes and they stated that they do not eat those dishes at home. Finally, ***regarding fruit and vegetable preference in general, no differences were observed between the two types of school***. We believe that these findings were not only a consequence of the gardens' existence. It may be that the presence of a school garden, attached to a school, is insufficient and that more active and regular engagement is required to elicit attitudinal change (Davis et al., 2015; Lineberger and Zajicek, 2000). However, it may be that school gardens, regardless of the level of use, are unable to stimulate attitudinal change single-handed, especially when competing against the other extracurricular school activities (sport, other engagements). We believe that additional factors such as the school kitchen environment, engagement of teachers and cooks during the meal, and presentation of food are worth investigating.

The second aim of this study was to improve the nutritional awareness and eating habits of children. For this purpose, a nutritional intervention was introduced in both types of schools. The nutritional intervention included; a) education and b) nutritional improvement of school menus. Education was delivered through workshops, games and many online resources. Our results revealed that eating habits are not easy to change. The experiment with kale supported this conclusion. Kale is a vegetable that children report not to like, but when they have to choose between kale-based traditional and novel meals, they tend to prefer options that are more traditional. Despite this, we found that children are willing to try new dishes. Although the intervention with kale was based on a small sample, it is better to be realistic and to be encouraged to not 'confuse small change with no change' (Holden et al, 2020). Future interventions should incorporate regular taste exposure to maximize increases in fruit and vegetable intake in children. After all, in this study we realised that Nutritional Education was warmly welcomed among children, parents and teachers. Nutrition education seems to be a promising tool for increasing healthy eating. Unfortunately, it is very challenging to measure the impact of such education. Our recommendation is to consider this issue in the long term and to take a wider perspective (such as poverty rate of family, eating habits of mothers, TV viewing habits, etc.).

We propose more interventions for increasing children's awareness and acceptance of healthy eating habits. We recommend more engagement of health officials, policy makers and school

management levels to support school food procurement and the development of interventions to stimulate a healthy eating environment. If children do not reach adequate energy and nutrients through school meals (due to inadequately planed school menus as seen in this pilot) they will probably compensate it with food that has higher energy value but lower nutrient content. Even small effects can contribute to the desired results in much the same way as a surfeit or deficit of just 50–100 kcal per day in an individual's energy balance will, if sustained over time, create weight change (Hill et al, 2011). Heading in the right direction requires balanced school meals which should be strongly linked to school procurement policies.

8. POLICY RECOMMENDATIONS

Several policy recommendations can be drawn from this study.

First, school food policy procurement needs to be improved and in line with that healthier options meals should be offered in school kitchens (e.g. fresh fruit instead of donuts for a snack meal). Food policy procurement could be improved by connecting school management with small (local and/or family) producers of fruits and vegetables. In order to realise that, Croatian procurement law should be adjusted and school management should be educated about healthy eating problems with children. The Government should establish some mechanism to support each individual school and local producers to establish more connections. Furthermore, it is highly recommended that professional staff (like nutritionist profile person) is involved in the planning of school menus. The School Menus Committee should be responsible for the creation and implementation of new menus. In order to do that, school kitchen infrastructure needs to be adapted. Finally, activities related to the education of staff in charge of food preparation in primary schools should be coordinated. Implementation of new school meals should be monitored, controlled and evaluated.

Second, nutrition education or promoting healthy food choices, are necessary to support long-term acceptance of nutritious school meals. Different target groups (children, parents, cooks, and teachers) should be more educated about the importance of healthy eating. We recommend that parents should be provided with information and guidance on how, as well as what, to feed their children, particularly aimed at parents who are concerned about their child's weight. Practical support may also be necessary in some cases. At the very least, parents should be made aware of the likely consequences of inappropriate child feeding behaviours, in order that they do not inadvertently promote excess weight gain. We propose that the next step is to find ways of communicating messages about child-feeding behaviours to parents. This could be achieved by providing information and education resources (tools (on the web-page - for example - https://pilots2f.wixsite.com/nutriskolica).

More focus on the children's role in food negotiations could be promoted through the school systems, through the earlier introduction of cooking classes, and nutritional teaching. These might strengthen the insight and motivation of children to avoid (or ask for less) unhealthy food (Gram, 2015). We acknowledge that child-feeding behaviours, like nutrition knowledge and obesity, may be associated with socioeconomic status and ethnicity (Spruijt-Metz et al., 2006). Furthermore, it is very important to engage school kitchen staff in the preparation and presentation of healthy meals.

Changing fruit and vegetable consumption in children is complex and our findings lend support to school-based vegetable gardens as a promising tool to improve knowledge and preferences

embedded within a school culture promoting health and community frameworks. However, a holistic approach and collaboration are needed so that schools that do have gardens should better use those gardens for improving children's eating habits. The recommendation is to increase the popularity of school gardens and to grow familiar food (cherry tomatoes, strawberries, salad, blueberries…). This could improve children's knowledge and overcome neophobia towards fruit and vegetables.

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The Strength2Food project in a nutshell

Strength2Food is a five-year, €6.9 million project to improve the effectiveness of EU food quality schemes (FQS), public sector food procurement (PSFP) and to stimulate Short Food Supply Chains (SFSC) through research, innovation and demonstration activities. The 30-partner consortium representing 11 EU and four non-EU countries combines academic, communication, SMEs and stakeholder organisations to ensure a multi-actor approach. It will undertake case study-based quantitative research to measure economic, environmental and social impacts of FQS, PSFP and SFSC. The impact of PSFP policies on nutrition in school meals will also be assessed. Primary research will be complemented by econometric analysis of existing datasets to determine impacts of FQS and SFSC participation on farm performance, as well as understand price transmission and trade patterns. Consumer knowledge, confidence in, valuation and use of FQS labels and products will be assessed via survey, ethnographic and virtual supermarket-based research. Lessons from the research will be applied and verified in 6 pilot initiatives which bring together academic and non-academic partners. Impact will be maximised through a knowledge exchange platform, hybrid forums, educational resources and a Massive Open Online Course.

www.strength2food.eu