Food choice patterns of primary school children from automatically collected data

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In the UK, one in five children (10-11 years old) lives with obesity [1]. Obesity impacts both physical and mental health and in adulthood can lead to non-communicable diseases such as diabetes, cardiovascular diseases and some cancers[2]. Although obesity depends on several factors: our genes, our physiological and psychological state, our environment, the main factor is the imbalance between energy intakes and energy expenditures [2]. Changing dietary habits is important in tackling obesity, and therefore understanding how children select foods to eat is relevant. This is especially so in school, where children spend 190 days per year and consume foods that provide them one third of their daily energy [3].

Aims

(1) to examine patterns of food choice and food choice profiles from individual level data
(2) to investigate clustering methods, resultant clusters and their characteristics

Method

Data preparation: Identifying and resolving data quality issues, creating derived variables, sampling

Descriptive Analysis: Composition of sample and food selection

Cluster Analysis: (1) Determination of the optimal number of clusters (Elbow and silhouette scores methods), (2) clustering methods: K-mean with and without standardization and Principal Component Analysis, (3) visualization of clusters (heatmap), (4) checking qualities of clusters (Harabasz-Calinski score)

Multiple Linear Regression models

- Dependent variable:

% food options (Dish of the day, Vegetarian dish of the day, Sandwich/jacket potato) [a]

- Independent variables:

% orders chosen at home [b]; Year group; FSM eligibility (Key Stage 2 only) [c]

[a] Food items were matched with the 3 daily food options on the 3-week cycle menu, i.e. (1) a dish of the day, (2) a vegetarian dish of the day and (3) sandwiches/jacket potatoes.

[b] Children selected options at home remotely or at school

[c] All children in Key Stage 1 (KS1; Reception-Year 2) receive a Free School Meal (FSM). The eligibility for FSM in Key Stage 2 (KS2; Year 3- Year 6) depends on family income.

Sample

Data subjects: Children from one primary school

Raw data: 262 people (children + staff members)

Inclusion criteria: Pupils (Reception - Year 6) who selected at least 15 food options between 5 Sept 2017 - 9 Feb 2018, i.e. 97 school days

Final sample: 157 pupils (64 KS1 (Reception-Year 2), 93 KS2 (Year 3-Year 6))

82% eligible for free school meals

70% eligible for free school meals

Few children in Reception (n = 2) and in Year 6 (n = 14)

Food selection

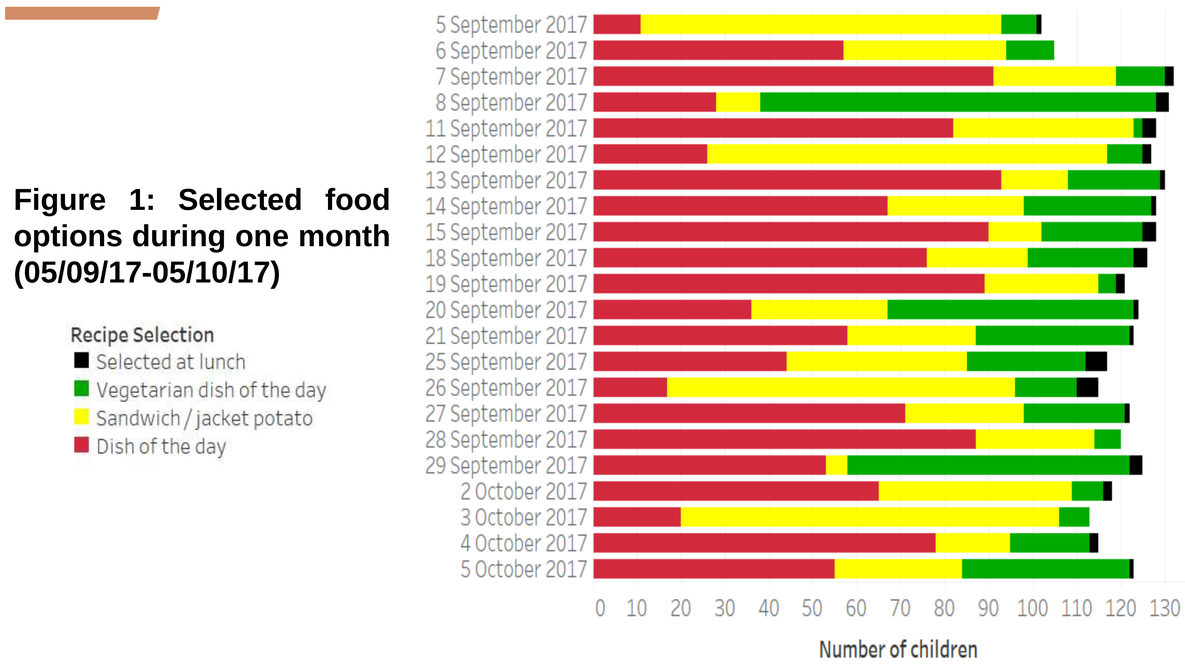


Figure 1: Selected food options during one month (05/09/17-05/10/17)

For the period of 96 days, 58 food options were on the menu and 13 484 school lunches were selected: 53.0% dishes of the day, 25.4% vegetarian dishes of the day and 21.6% sandwiches/jacket potatoes.

Out of the 10 most selected items, 7 were dishes of the day and 3 were sandwiches/jacket potatoes.

Out of the 10 least selected items, 6 were vegetarian dishes of the day and 4 were sandwiches/jacket potatoes.

There were significant ($p < 0.05$) but weak associations between the food selection and: (1) Key Stage (Cramer's V = 0.04), (2) Year group (Cramer's V = 0.08), (3) Order mode (Cramer's V = 0.12), (4) FSM (Cramer's V = 0.05).

Multiple Linear Regression models

Key Stage 1:

As age increased, dishes of the day were less frequently selected.

When choices made at home, dishes of the day were more frequently selected.

When choices made at home, vegetarian dishes were less frequently selected.

Key Stage 2:

Children eligible for FSM selected dishes of the day less frequently, and sandwiches/jacket potatoes more frequently.

Food choice profile

Optimal number of clusters: 4

Methods the most performant: K-mean without standardization and Principal Component Analysis

Cluster 1 (n = 48, 77.08% FSM) preference for dishes of the day

Cluster 2 (n = 41, 80.89% FSM) strong preference for non-vegetarian dish of the day

Cluster 3 (n = 41, 85.37% FSM) avoid vegetarian dishes of the day

Cluster 4 (n = 27, 85.19% FSM) diverse choices

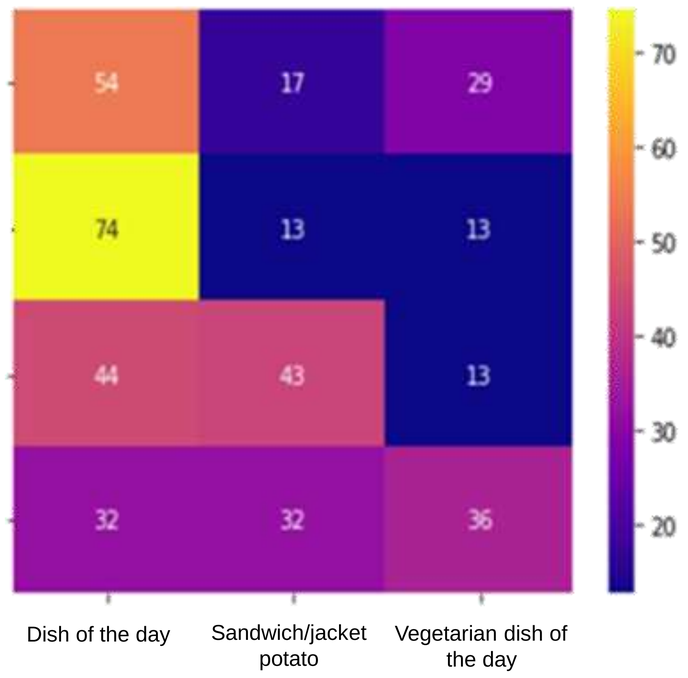
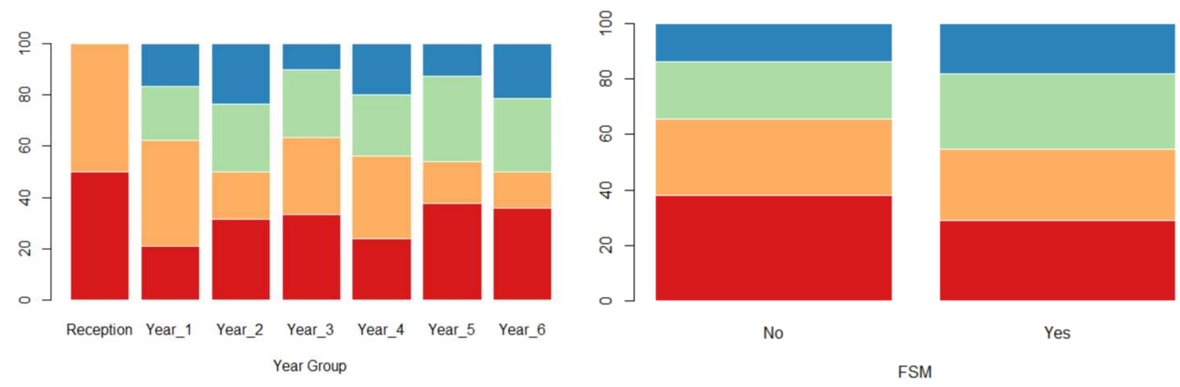


Figure 2: Heatmap representing average percentage of selection for each food option for each cluster



red: Cluster 1, orange: Cluster 2, green: Cluster 3, blue: Cluster 4

Figure 3: Characteristics of clusters

Limitations and further research

Patterns of children's food choices were investigated at a large scale (≈14 000 transactions) with a high temporal resolution (20 weeks). Analysis did not consider gender, food preferences, peer influences. Data related to food choice, rather than consumption and food waste was not assessed..

Further studies could investigate the temporal evolution of children's food choices in primary school and similarities and differences with other schools in the UK thanks to a time-series approach. Observation of children's food choice in schools and a complementary survey could be conducted to complement data analysis using these data, and improve study quality.

Conclusion

Data collected on children's selection of meals allowed valuable examination of food choices. This included cluster analysis which revealed four clusters of children with differing preferences for food options on offer. Regression analysis examined the relevance of FSM and year group, as well as choices made remotely at home vs at school. The relevance of the specific food items on offer (rather than the types of food options) may have a greater role to play in what children choose for their school lunch.

References

[1] NHS.(2019). Obesity. https://www.nhs.uk/conditions/obesity/

[2] WHO.(2021). Obesity: Overview, Complications, Prevention and Control https://www.who.int/health-topics/obesity

[3] Ruxton, C. H. S., Kirk, T. R., & Belton, N. R. (1996). The contribution of specific dietary patterns to energy and nutrient intakes in 7–8-year-old Scottish schoolchildren. II. Weekday lunches. Journal of Human Nutrition and Dietetics, 9(1), 15-22.