



Youth, Nutrition and Behaviour

Healthy nutrition is widely assumed to have a beneficial influence on educational performance and social behaviour. Yet research in developed countries about the effects of food intake on children's behaviour and school performance is limited. We propose a randomised controlled field experiment to study the effects of a school lunch programme in the Netherlands, based on an overview of studies by LEI and Food and Biobased Research, both part of Wageningen UR. With the foundation of a Knowledge Centre on Food, Nutrition and Behaviour, we want to integrate and disseminate the theoretical and practical knowledge on this topic.

Dutch setting

There is **no national policy for school meals** in the Netherlands. Ninety-eight percent of Dutch school children do not consume the recommended daily amounts of fruit and vegetables, 9% are undernourished, 12% do not eat breakfast; and there are large differences in nutritional intake between socio-economic groups. In most European countries school meal programmes have been implemented to improve food habits (UK: The Education

Regulations 2007; Germany: law on school food, 2007), but no such policy exists in the Netherlands.

A systematic intervention, aimed specifically at **how school meal supply may improve educational outcomes and social behaviour**, is therefore an important first step for policy formulation.

Practical guidelines for school food programmes

From a series of interviews and workshops (spring–summer 2011) with representatives of local initiatives, researchers and other experts, a number of practical considerations have arisen for implementing a school meal intervention. For evaluations on methodological issues and the efficacy of providing school meals, see Tapper (2007) and Greenhalgh *et al.* (2007).

- 1 Mind the budget:** For a medium-sized school 80,000 euro per year is needed, not including kitchen and personnel; contributions from parents and schools are hard to achieve
- 2 Recruit timely:** Start timely and approach schools and parents personally
- 3 Cooperate:** Involve parents, teachers, schools from the start; monitor how the actual implementation differs between schools
- 4 Find dedicated personnel:** Mix qualified personnel and volunteers; train them in hygienic standards; teachers are best involved only in informing parents and setting an example
- 5 Communicate progress:** Try personal, informal communication, next to reports and newsletters; exchange experiences between school
- 6 Consider all options:** Ready-to-eat delivery/heating up/preparing at school



- 7 Consider the physical setting:** Consider waste, noise, smell, tables; washing facilities, fridge, heating
- 8 Be flexible:** If a warm lunch proves too ambitious, try a mixture of hot and cold food on different weekdays. Don't forget allergies, seasons, sustainability, regional products
- 9 Play first, eat later:** Plan the actual lunch or snack moment at the end of the break



Food based dietary guidelines

Product groups	Source of	RDI 9-13 y
Fruit and vegetables	Vitamin C, folic acid, minerals (e.g. potassium), fibres, bioactive substances, water	150-200 gr vegetables 2 servings of fruit
Bread, potatoes, rice, spaghetti, pulses	Carbohydrates, proteins, fibres, vitamin B, minerals	290-375 gr
Fish, chicken, eggs, meat products	Proteins, minerals (e.g. potassium, iron), vitamin B, fatty acids	80-100 gr
Dairy products		600 ml
Oil and butter	Essential amino acids, vitamin A, D and E	35-40 gr
Drinks	Water	1-1 1/2 L

Source: adapted from Food Based Dietary Guidelines
RDI: Recommended Daily Intake, Voedingscentrum 2012

Low SES districts

40 websites of schools in low SES districts have been screened for their food policy.

20 schools do not mention any food policy.

11 schools mention food policies varying from "no snacks" to prohibiting vending machines, but hardly any infrastructure for communal lunch.

These schools form a complex (multi-cultural) environment for an intervention, but also offer great potential for improvement.

National projects (incidental)

Schoolfruit is a large EU programme which aims for healthy habits and a better lifestyle by delivering fruit at schools.

SchoolGruiten is a national programme prolonging Schoolfruit programme and offering additional course material.

Smaaklessen is a teaching programme about food.

JOGG (*Jongeren Op Gezond Gewicht*) helps local municipalities stimulate a healthy school lunch, cf EPODE.

Opportunities for a Dutch intervention study:

- The potential for school meal policies is highest in disadvantaged districts
- Public health is largely the responsibility of local municipalities in the Netherlands
- Many local initiatives and programmes stimulate healthy school food (snacks, lunches and/or breakfast)
- EU programmes focus mostly on stimulating fruit and vegetable intake to prevent obesity, and do not take

into account the effects on educational performance and social behaviour

- Most initiatives lack systematic evaluation of intervention effects
- The yearly individual student assessment by CITO, the Dutch PISA testing company, could serve as a standardised measure of learning performance
- Guidelines for healthy nutrition exist for specific nutrients, meals, eating patterns, and product groups



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Neighbouring countries/EU

In 2007 a **German** guideline on criteria for the introduction of school food programmes was introduced and ratified by all 16 states. By 2011, 6400 schools were starting to implement them.

In 2007 the **UK** launched comprehensive regulations for school food and nutrient intake.

In **Sweden**, schools have been obliged to serve a warm meal since 1946.

Lunch habits of Dutch children

Every day 37% of the Dutch schoolchildren aged between 6 and 12 stay at school during lunch time (Smit 2007).

That equals 500,000 children per day.

In rural areas, 17% stay at school for lunch; in cities, that figure is 87%.

9% of the Dutch children aged between 7 and 18 are undernourished (Van Buuren 2004).

Only 1-2% of children aged 7 or older have a high enough fruit and vegetable intake.

98% of children do not get the nutrition as advised by the guidelines. Children lack knowledge about food (Thijssen 2011).

There is no standard or regulation for school food in the Netherlands.

Local initiatives

There are any local initiatives that focus on health and food culture by stimulating food knowledge, experience and consciousness.

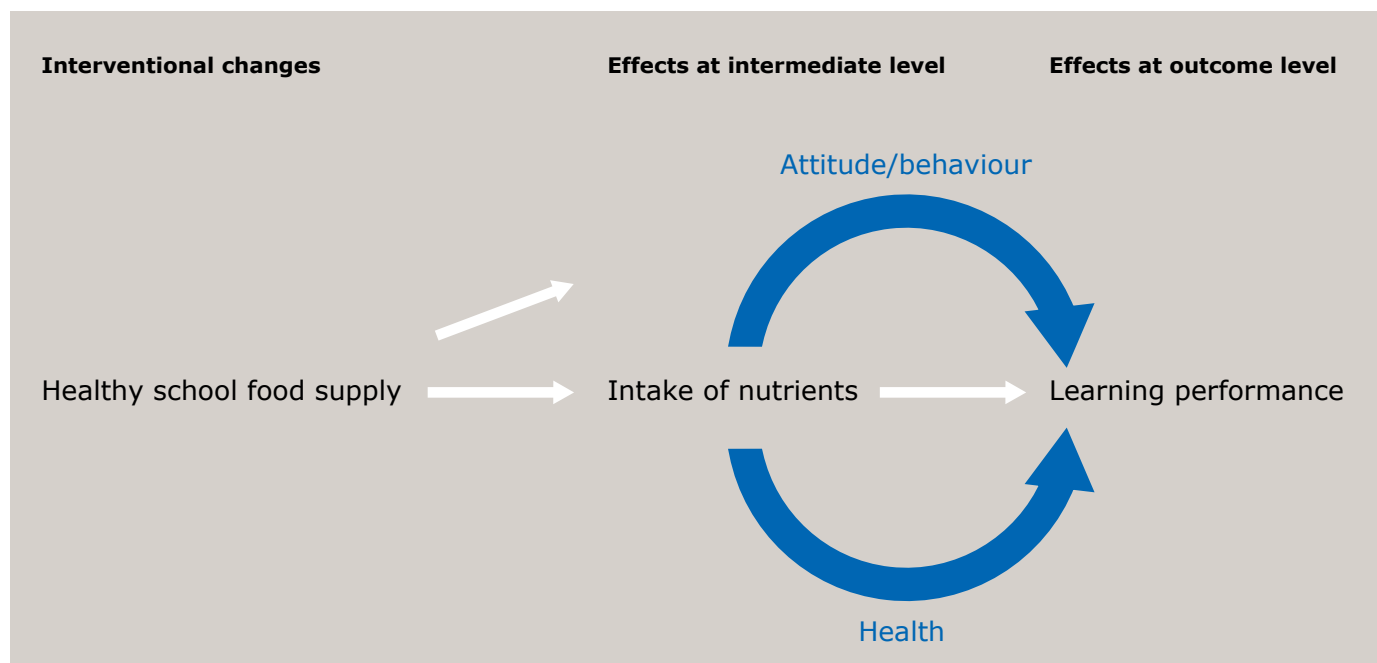
Tijd voor Eten (Time for food) is a pilot with a children's restaurant to stimulate good and healthy food.

Lunchen op School (Lunch at school) is a foundation that offers help and training for school lunches in Amsterdam.

A randomised field experiment to assess the relation between food and behaviour

An intervention to estimate the effects of nutrition on behaviour in a class setting must be carefully designed and timed. A randomised and controlled field experiment with a cross-over design would allow for a robust assessment of effects.

In such a design, the intervention would be carried out at intervention schools only during one school year, while measures would be taken from all schools. In the second year, the intervention would be carried out at all schools.



Population A focus on primary schools is advisable because of their large potential for behavioural change. Two scenarios within primary schools are feasible: targeting regular **primary schools** to maximise generalisation, and schools in **low socio-economic status areas** to maximise the potential impact of the intervention.

Eleven-to-twelve-year-olds ('group 7/8' in the Dutch primary school system) would be particularly eligible for an intervention that aims at both behavioural corrections and preventive measures; in addition, nation-wide learning tests are already conducted in these grades.

Observation and Instruments In order to optimise after-school recruitment and the allocation of the different treatments, data needs to be collected on both interventional as well as contextual aspects.

The interventional aspects include information about nutritional values, the food offered, the preparation, and the social setting. This can be monitored in part by observation, documentation, checklists; part of it will be based on surveys and interviews; and partly it will involve chemical analysis.

The latter, **the contextual aspects**, may include socio-economic status, socio-demographic situation, eating behaviour at home and parenting, the school type and social environment, social trends, etc.

Dependent and independent variables

Before, during and after the intervention, the dependent variables may include **at the individual level** nutritional intake; learning performance, behaviour at and outside school; cognitive/creative performance (CITO scores), degree of attention, concentration and memory; habit formation; preferences; anthropometrics; school attendance; and food knowledge.

At the school level, the number of incidents, teaching climate, and the class noise level may be taken into account.

Protocol A carefully documented protocol is needed for the school recruitment strategy and provision of the school lunches.

This document should contain a **manual** for training the personnel and standardise the **quality control**, the kind of food and preparation in different school settings, including timing of the food, school break policies, physical settings like the kitchen and the eating room, and the communication of the interventions with both the children and their parents.

Outcomes

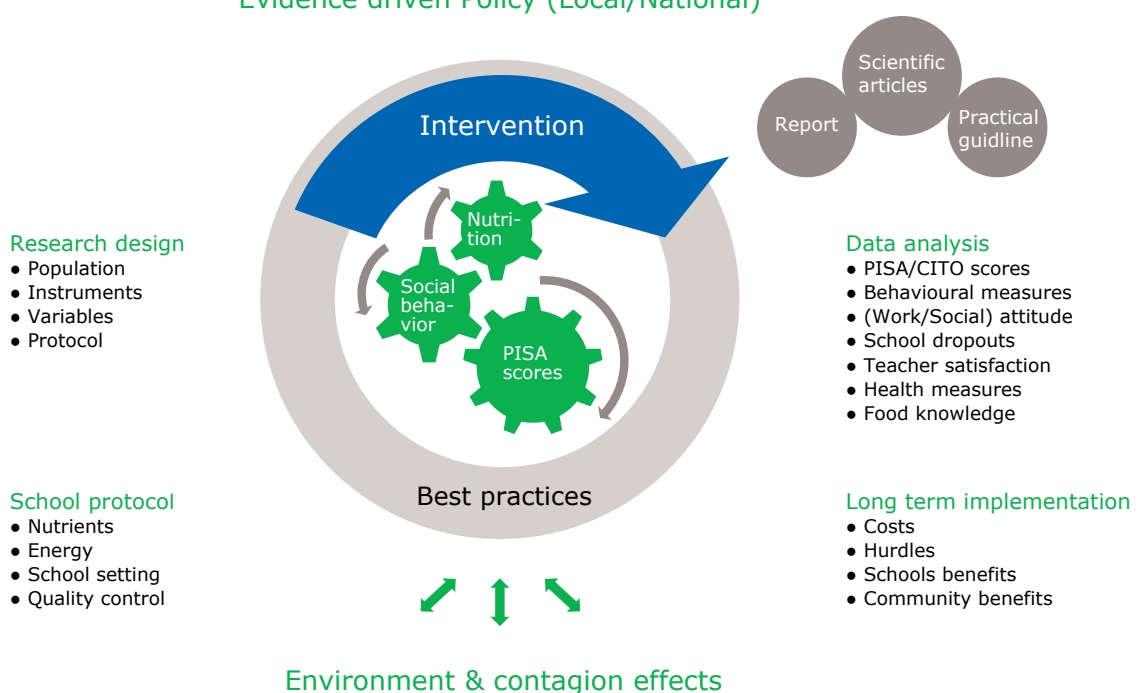
Evidence-based policy Poor nutritional intake and the development of food preferences at a young age can have life-lasting consequences. Although the relation between nutrition, health, and behaviour is complex and not fully understood, it is known that certain school food interventions can have a beneficial impact on educational outcomes and anti-social behaviour in children, including aspects such as health, attitude and habits. There is a lack of quantitative evidence on the relation between nutritional intake, learning performance and (unacceptable) social behaviour among children in developed countries. Schools in the Netherlands would be an appropriate platform for a targeted intervention at the still-developing food habits of school children and their food knowledge. By conducting a carefully designed randomised evaluation, this project could provide schools with a workable food scheme and evaluate the effects at the same time.

Reach and potential Generalisations of the results may extend to more general settings like youngsters with problem behaviour, school dropouts, and situations in closed settings other than schools, like youth prisons. Moreover, the findings could be compared to other European countries and perhaps offer an instrument to improve PISA (Programme for International Student Assessment) scores. The intervention will provide information on how school lunches fit in Dutch culture, the school system and wishes of parents, students, schools, industry, and policy makers. Finally, the multidisciplinary setup of the study ensures a knowledge exchange between different sectors and research fields. This information exchange may be facilitated by the setup of a national knowledge centre.

Deliverables include a report on effectiveness and long term effects, an evaluation of the support for the school lunches by consumers and stakeholders, and the costs and practical hurdles for schools; scientific articles on the effectiveness of the intervention; an overview of best practices from Germany and other European countries; and a practical guideline for implementing food interventions at schools. Combining and diffusing the insights obtained will be essential for establishing changes in children's social behaviour and educational performance.

Beneficiaries and spill-overs Local and national governments, communities and municipalities, schools, other youth settings, and local retailers may profit from the intervention and knowledge, among other groups. Spill-over effects include the contagion effect of best practices for school lunches, side benefits for schools and communities (e.g. schooling and job opportunities), lower health expenditures, and potential avenues for more sustainable consumption.

Evidence driven Policy (Local/National)



Literature

Despite the widespread awareness of the cognitive benefits of breakfast and lunch programmes on schools, evidence in the literature is limited. There is insufficient evidence based on high-quality studies, e.g. randomised controlled trails, to identify any causal relations between meal programmes and academic performance (Benton 2008). Only a small number of studies indicate a significant and immediate effect of diet on behaviour, concentration and cognitive ability to attend school (Sorhaindo 2006). Below we give a short overview; a more extensive literature review can be found in Voordouw *et al.* (in preparation).

Food programmes may influence children’s behaviour via a number of different pathways: through nutrients that are necessary for the development and functioning of the brain (I); through effects on children’s ability to think (II); and through nutritional effects on behaviour, energy level and mood (III). The evidence for (I) stems mostly from developing countries or is based on subjects with multiple disorders. Since most European countries have adopted a school food policy, most European studies on (II) and (III) present correlational rather than causal evidence (Ells 2008). Schools in the Netherlands would provide an opportunity to do a randomised controlled trial in a developed country.

Effects of nutrition on learning performance/ educational outcomes

Undernourishment can have severe impact on children’s learning capacities, concentration and memory. There is evidence that breakfast with a low glycaemic index improves **concentration** and **memory** (Benton 2007). Positive but small short-term effects of an intervention with tryptophan and tyrosine-rich proteins have been assessed on alertness and **sleeping behaviour** (Markus 2005). A review shows that the positive effects of having breakfast were more pronounced among children with a lower socio-economic background (Hoyland 2009; Taras 2005). One randomised controlled intervention on a

combination of school meals provision and environmental after lunch (Storey 2011); another found an increase in levels of **alertness** after lunch (Golley 2010). The Jamie Oliver ‘Feed me better’ school campaign in the UK led to a significant **decline in absences** and an **increase in English and science scores** compared to schools in comparable boroughs (Belot 2011). Dutch students observing Ramadan (an Islamic holiday in which observers fast during daylight hours) received significantly **lower final grades** than their fellow students (Oosterbeek 2011).

Effects of nutrition on anti-social behaviour or externalising problem behaviour

Examples of anti-social behaviour are verbal or physical aggressive or violent behaviour and whining. Direct provision of omega-3 fatty acids led to **fewer feelings of aggression** and to a stabilisation of aggressive incidents among young students (Hamazaki *et al.* 1996). Standardised meal provision to children was also linked to less whining and lower involvement in **violent acts** (Turagabeci 2008). Among young children with ADHD, a lack of tryptophan (an amino acid) was associated with more **aggressive reactions** to provocations (see Aan het Rot, 2006; Wallner 2009). In a double-blind placebo-controlled study, incarcerated young adults who received vitamin supplements and minerals and essential fatty acids displayed **less violent and aggressive behaviour** (Gesch 2002; Zaalberg 2010) than those who did not receive such supplements. A four month intervention with food supplements led to a significant decrease in **disciplinary measures** in young schoolchildren (Schoentaler *et al.* 2000).



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Effects of poor nutrition on behaviour

Nutrients lacking	Behavioural effects	Population
Undernourishment in general	Impulsive behaviour, fighting, stealing	Schoolchildren
Essential acids	Violence, aggression	Adults
Cholesterol	Impulsive behaviour, violence, aggression	Human and animal studies
Tryptophan	Aggression	Human and animal studies
Phyto-oestrogens	Aggression	Animal studies
Carbohydrates	Aggression	Animal studies
Glucose, vitamins and minerals	Violence, aggression	Humans

Source: adopted from Wallner and Machatschke (2009)



Other nutrition-related effects on youth

The consumption of healthy school lunches also affects physical health; more specifically, nutritional levels and weight or similar anthropometric values may improve. Another potential avenue for food effects on behaviour is suggested by the correlation between obesity and **absenteeism** (Geier 2007). In this study, overweight students were absent for an average of four days a month, whereas students with a normal weight were absent for an average of one day a month. A recent

systematic review confirms the correlation between overweight and learning performance (Caird 2011). Children with more knowledge about food and food content tend to **choose more healthy food** (Wardle 2002). Lastly, through the adoption of healthier and more social eating habits at a young age (eating together, knowledge about food, habit formation), children may develop **better habits and food preferences** over the long term. Finally, **interactions** between the abovementioned variables are likely to occur.

Suggested reading (available from first author)

Backus, G., Fresco, L.O., Kok, F., and Franse, O. (2010). Roundtable on Encouraging and Sustaining Healthy Food Choices, Amsterdam.

Heselmans, M. (2007). *Smart meals – Zorgt betere voeding ook voor betere leerprestaties?* Innovatienetwerk, Utrecht.

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www.lei.wur.nl/UK/research/Research+areas/Consumer+and+behaviour

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For more information on the Knowledge Centre for Nutrition, Learning, and Behaviour, see www.kcnlb.eu

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Current stakeholders (in formation): LEI, part of Wageningen UR, other universities, RIVM, CITO.

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Stakeholders

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