Effect of Nutritional Intervention on Food Choices of French Students in Middle School Cafeterias, using an Interactive Educational Software Program (Nutri-Advice)
Introduction

- Obesity in developed countries is a major health issue
- Prevalence of obesity for French children and teenagers: 19.9% in boys, 16% in girls
- Schools and cafeterias are the best places for prevention
- In France, PNNS - strategic plans targeting the general population and health professionals
- Aims at improving public health through the diffusion of documents and advertising
- Few studies assess the efficacy of multimedia interactive tools
Methods

- **Authorizations:**
  - Ethical committee for Biomedical Research
  - National Committee for Database Information Privacy

- **Criteria of eligibility**
  - Middle-schools with cafeterias
  - Meals must be cooked on-site
  - All recipes and food weights must be available
  - School staff must comply with the study protocol
Study preparation

- All recipes were collected in each school cafeteria and fed into a food database
- Next month menus were collected from school staff
- A formal consent was obtained from children’s parents
- Biometric and medical data were collected from children and put into a children database; barcode cards were issued for all children
Study design

- Comparative and controlled study
- 6 middle schools in Toulouse area, urban and suburban areas, chosen with help of educational local authorities
- 3 schools A, B, C equipped with kiosks, 3 others as control groups
- Kiosk were available from november to may (6 months)
- maximum one connection / day / child; allowed before and after lunch
- Total number of children : 580
Nutri-Advice: a demo

- The barcode card is presented first
Bonjour Emilie !

Tu as 5 points sur 7. Encore 2 points et tu pourras participer à la loterie pour une place de cinéma...

continuer...
Dishes of the day are proposed for choice

<table>
<thead>
<tr>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avocat mayonnaise</td>
</tr>
<tr>
<td>Doré de merlu</td>
</tr>
<tr>
<td>Babybel</td>
</tr>
<tr>
<td>Compote de pêche</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

annuler  valider
## Child chooses her meal

The child chooses the meals that correspond to her needs:

<table>
<thead>
<tr>
<th>Plats</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Croque monsieur</td>
<td>1/2 Doré de merlu portion</td>
</tr>
<tr>
<td>Doré de merlu</td>
<td>pas de laitage</td>
</tr>
<tr>
<td>Entre l'échelle</td>
<td>pas l'accompagnement</td>
</tr>
<tr>
<td>Babybel</td>
<td></td>
</tr>
<tr>
<td>Yaourt nature</td>
<td></td>
</tr>
<tr>
<td>Flan vanille</td>
<td></td>
</tr>
<tr>
<td>Compote de pêche</td>
<td>pas de dessert</td>
</tr>
<tr>
<td>Gâteau de semoule</td>
<td>un petit pain</td>
</tr>
<tr>
<td>Brugnon</td>
<td>deux petits pains</td>
</tr>
<tr>
<td></td>
<td>pas de pain</td>
</tr>
</tbody>
</table>

### Annuler / Valider
Her choice is then validated

Choisis les plats qui correspondent à tes besoins :

- Croque monsieur
- Doré de merlu
- Yaourt nature
- Gâteau de semoule
- 1/2 Printanière de légumes
- un petit pain

annuler  valider
The major imbalances are pointed out...

Choisis les plats qui correspondent à tes besoins :

Il manque des féculents (pain, pâtes, riz, légumes secs, pommes de terre) dans ton repas

continuer...

annuler valider
Choisis les plats qui correspondent à tes besoins :

Bravo, ton repas est bien adapté à tes besoins !
Tu as maintenant 6 points !

continuer...

annuler valider
Winning 5 points leads to a lottery game

LOTERIE

(Aujourd'hui, il y a une chance sur 8 de gagner)

NOMBRE GAGNANT: 2

TON NOMBRE: 2
How does Nutri-Advice work?

- Based on the engine of Nutri-Educ application software
- Uses Fuzzy Sets theory to deal with imprecision and uncertainty of food values and quantities
- An algorithm computes the best possible meal for the child and then evaluates her answer comparatively
Fuzzy numbers

“moins de 10g de beurre”

“je ne sais pas du tout quelle quantité j’ai bu !”

“environ 10g de beurre”

“pain au lait, 70g”

“plus de 10g de beurre”
How does Nutri-Advice work? (cont.)

- The child meal is declared ‘correct’ when its evaluation is close to the evaluation of the best possible meal.
- When the child meal is incorrect, the best solution is not displayed. Only the main nutrient or energy imbalances are pointed out, and general classes of foods are proposed.
- The idea is to let children learn new nutritional skills by themselves, instead of directly providing them with a solution without explanations.
## Results on food choices

### Table 2. Change in Children’s Food Choices and Anthropometric Measures at End of Study vs Baseline

<table>
<thead>
<tr>
<th>Children’s choices</th>
<th>Overall (n = 350)</th>
<th>School A (n = 84)</th>
<th>School B (n = 88)</th>
<th>School C (n = 178)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>End of Study</td>
<td>P</td>
<td>Baseline</td>
</tr>
<tr>
<td>Dairy products</td>
<td>70.0</td>
<td>74.2</td>
<td>.030</td>
<td>75.8</td>
</tr>
<tr>
<td>Cheese</td>
<td>22.1</td>
<td>15.9</td>
<td>.002</td>
<td>37.3</td>
</tr>
<tr>
<td>Starch</td>
<td>94.9</td>
<td>96.8</td>
<td>.030</td>
<td>93.7</td>
</tr>
<tr>
<td>Fruits and vegetables</td>
<td>92.2</td>
<td>94.4</td>
<td>.050</td>
<td>98.0</td>
</tr>
<tr>
<td>Pastry, ice cream, dessert</td>
<td>30.3</td>
<td>23.1</td>
<td>&lt;.001</td>
<td>23.8</td>
</tr>
</tbody>
</table>

### Anthropometric measures

<table>
<thead>
<tr>
<th>Body mass index (z-score)</th>
<th>Overall (n = 350)</th>
<th>School A (n = 84)</th>
<th>School B (n = 88)</th>
<th>School C (n = 178)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.50 ± 1.08</td>
<td>0.43 ± 1.03</td>
<td>&lt;.001</td>
<td>0.33 ± 0.89</td>
</tr>
<tr>
<td>Obesity (%)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12.3</td>
<td>10.3</td>
<td>.040</td>
<td>2.4</td>
</tr>
</tbody>
</table>

ns indicates not significant.

<sup>a</sup>Defined as body mass index > 97th percentile, according to French reference curves (Rolland-Cachera); P < .05 was considered significant.

Note: Baseline is the first 3 connections; the end of study is the last 3 connections. Results are expressed as percentages of children’s choices for lunch meal over 3 connections. Dairy includes yogurt and fromage blanc. Starch includes bread, rice, pasta, potatoes, beans, and lentils. Variance analysis (ANOVA) was used for matched continuous variables, and chi-square test was used for matched qualitative variables.
Figure 3. Frequency of kiosk use. For school C it exceeded 0.7, meaning that children used it on most occasions. For a given month, nb/child is the ratio between the number of actual uses and the number of possible uses of the kiosk, for all children of a school.
**Number of connection ➔ evolution of food choices**

**Table 3.** Correlation Between Total Number of Connections to Device and Evolution of Food Choices and Body Mass Index

<table>
<thead>
<tr>
<th></th>
<th>Pearson Correlation Coefficient</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy products</td>
<td>0.15</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>Cheese</td>
<td>−0.02</td>
<td>ns</td>
</tr>
<tr>
<td>Starch</td>
<td>0.11</td>
<td>&lt; .05</td>
</tr>
<tr>
<td>Fruits and vegetables</td>
<td>0.15</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>Pastry, ice cream, dessert</td>
<td>−0.14</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>z-score body mass index</td>
<td>−0.03</td>
<td>ns</td>
</tr>
</tbody>
</table>

ns indicates not significant.
Strength of the approach

- Based on actual and real time data on child profile and her meals
- Direct influence of the system on the children’s eating choices
- Make the child an actor of her eating behavior
- Allow children to assess the school meals contents
- Provides specific prevention messages, applied to the child own daily meals
- Children are incented by cinema tickets and then they apply prevention messages
Limitations of the approach

- The school staff must be involved – otherwise nothing happens
- The game as an incentive may bias motivation (children do it for cinema tickets but do not intend to apply prevention messages)
Implications of the approach

- Several actors were implicated: children, school staff, cafeteria staff, principal
- Integration of a nutrition prevention action into a middle school, outside the classrooms
- Necessitate a logistic organisation (location of kiosks, moment of use, data acquisition) – which is time-consuming but does not impede school assignment