Change in fruit intake between 2003 and 2009 for 11-year old boys and girls from mothers with higher (HE) and lower education (LE), grams per day (Fischer et al. In preparation)
Evidence-based promotion of fruit and vegetable consumption: the importance of socio-economic determinants

EMGO Institute for Health and Care Research
Johannes Brug, EGEA, 2010

| A: Analysis of health and quality of life |
| B: Analysis of personal and environmental risk factors |
| C: Analysis of determinants of exposure to risk factors |
| D: Intervention development |
| E: Intervention implementation |
Planned Promotion of Fruit and Vegetable intakes

A: What are the important population health issues?

B: Is fruit and vegetable intakes associated with these issues?

C: Who eats too little F&V and why?

D: Intervention development

E: Intervention implementation
Who? Differences according to socio-demographics

- Age: very young < young < adults (< older)
- Ethnicity: ....
- Sex: Men > Women; Women > Men
- Socio-economic Position: Low SES < High SES

Planned Promotion of Fruit and Vegetable intakes

A: What are the important population health issues?
B: Is fruit and vegetable intakes associated with these issues?
C: Who eats too little F&V and why?
D: Intervention development
E: Intervention implementation
A: What are the important population health issues?

B: Is fruit and vegetable intakes associated with these issues?

C: Who eats too little F&V and why?

D: Intervention development

E: Intervention implementation

Who: Socioeconomic position...

- An individual’s social and economic ranking within society
- based on access to resources (such as material and social assets, including income, wealth, and educational credentials) and prestige
- proxy indicators for SEP include education level; own or household income; and occupational status
Life expectancy according to level of education, the Netherlands

<table>
<thead>
<tr>
<th>Level of Education</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary education</td>
<td>68</td>
<td>70</td>
</tr>
<tr>
<td>Secondary education</td>
<td>70</td>
<td>72</td>
</tr>
<tr>
<td>Vocational training</td>
<td>72</td>
<td>74</td>
</tr>
<tr>
<td>College/University training</td>
<td>74</td>
<td>76</td>
</tr>
</tbody>
</table>

SES differences in lifestyle, the Netherlands

- Smoking
- Alcohol abuse
- Inactivity
- Overweight

Primary school vs. University training
Differences (g/day) in fruit and vegetable intakes according to level of education (high vs low) of main provider in household

Likelihood of daily use of vegetables (OR= Odds Ratio, low level of education as reference group) (Prättälä et al. PHN 2009)

* = not significant
systematic reviews...

- Irala-Estevez et al, EJCN, 2000; Kamphuis et al., BJN 2006 (adults)
- Van der Horst et al., HER 2006; Rasmussen et al. IJBNPA 2006 (children)

**International Journal of Behavioral Nutrition and Physical Activity**

*Review*

**Determinants of fruit and vegetable consumption among children and adolescents: a review of the literature. Part I: quantitative studies**

Mette Rasmussen*, Rikke Krogh1, Knut-Inge Klepp2, Leslie Lytle1, Johannes Brug3, Ellen Berc4 and Pernille Dicz1

Address: 1Department of Social Medicine, Institute of Public Health, University of Copenhagen, Denmark; 2Department of Nutrition, Faculty of Agricultural and Life Sciences, University of Copenhagen, Denmark; 3Department of Public Health, Minnesota University Medical Center, Minneapolis, Minnesota, USA; 4Department of Public Health, Amsterdam University Medical Center, Amsterdam, The Netherlands

*Corresponding author

Why?
Three ‘broad’ categories of determinants

- Motivation
- Ability
- Opportunity

Motivation and Free choice I:

People just do what they like...
We eat what we like...

Sweet, fatty, salty, energy-dense

..but taste preferences are modifiable...

Mere exposure, Social learning, Taste-environment Learning; may all contribute to SES differences...
Free choice II: people act sensibly

Evolution of a theory... (1): People change when you scare them?

\[
\text{THREAT} = \text{Perceived susceptibility} \times \text{Perceived severity}
\]

Preventive action

Increase In F&V

Low F&V intake puts ME at risk for heart disease (which is bad!)
Beliefs X evaluations → Attitudes → Behaviour

- There is more than risks and health...
- Beliefs are not knowledge...
- Affective rather than cognitive?

Klepp et al. IJBNPA 2007

Table 1: Proportion (%) reporting having seen TV ads during the previous month by country: The ProChildren study

<table>
<thead>
<tr>
<th></th>
<th>Austria</th>
<th>Belgium</th>
<th>Denmark</th>
<th>Iceland</th>
<th>Netherlands</th>
<th>Norway</th>
<th>Portugal</th>
<th>Spain</th>
<th>Sweden</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh fruits</td>
<td>72.8</td>
<td>54.9</td>
<td>58.1</td>
<td>63.8</td>
<td>46.6</td>
<td>68.1</td>
<td>56.7</td>
<td>51.9</td>
<td>51.6</td>
<td>59.5</td>
</tr>
<tr>
<td>Vegetables</td>
<td>52.9%</td>
<td>62.7</td>
<td>49.8</td>
<td>48.6</td>
<td>49.7</td>
<td>52.0</td>
<td>62.0</td>
<td>45.8</td>
<td>37.8</td>
<td>46.3</td>
</tr>
<tr>
<td>Fruit prices</td>
<td>76.6</td>
<td>66.3</td>
<td>64.5</td>
<td>80.3</td>
<td>70.9</td>
<td>86.2</td>
<td>80.0</td>
<td>83.5</td>
<td>44.1</td>
<td>64.2</td>
</tr>
<tr>
<td>Water</td>
<td>61.3</td>
<td>81.3</td>
<td>53.0</td>
<td>49.6</td>
<td>73.1</td>
<td>71.0</td>
<td>75.9</td>
<td>90.2</td>
<td>42.4</td>
<td>66.2</td>
</tr>
<tr>
<td>Candy/chocolate</td>
<td>77.4</td>
<td>77.9</td>
<td>74.4</td>
<td>60.5</td>
<td>81.4</td>
<td>77.2</td>
<td>65.4</td>
<td>84.3</td>
<td>66.7</td>
<td>77.3</td>
</tr>
<tr>
<td>Sodas/soft drinks</td>
<td>78.4</td>
<td>80.8</td>
<td>72.1</td>
<td>73.9</td>
<td>89.0</td>
<td>80.0</td>
<td>75.8</td>
<td>80.1</td>
<td>73.4</td>
<td>78.4</td>
</tr>
<tr>
<td>Crisps/cereals</td>
<td>79.3**</td>
<td>66.7</td>
<td>68.7</td>
<td>82.9</td>
<td>79.9</td>
<td>82.2</td>
<td>80.0</td>
<td>74.6</td>
<td>84.0</td>
<td>74.1</td>
</tr>
</tbody>
</table>

\* Items with the lowest rate in each country are underlined
\** Items with the highest rate are marked in bold
Vereecken et al., PHN 2006

• higher exposure to TV ads is associated with lower F&V intakes...
• Lower SES youth watch more TV
• and are thus exposed more...

• Klepp et al. IJBNPA, 2007: but exposure to healthy food ads may have some benefits:

![Diagram](image)

* Standardized regression coefficients, adjusted for sex, age, social class, TV viewing & TV during dinner

Figure 1
Conceptual model of the relationship between TV viewing, fruit and vegetable consumption and potential mediators: The Pro Children study
The ‘environment’

- Ecological ‘model’...
  - Making healthy choices easy choices
  - Making healthful nutrition/F&V intakes:
    - Easier
    - Better facilitated
    - More necessary
    - Unavoidable

Environmental opportunities

Physical environment

Social-cultural environment

Political environment

Economical environment

- **More evidence for the importance of social environments than for physical environments:**
  - **Social support and modelling** appears to be important for **physical activity**, in youth as well as in adulthood.
  - **Parents** have a crucial role in the health behaviour of their children. They should not only provide a good example by eating right and being physically active themselves, but also by using **parenting practices** and styles that encourage and support **healthy habits** in their offspring.

- **Availability and accessibility** of healthy and less healthy foods are important for **nutrition behaviours**; in youth and adulthood; schools and worksites offer good opportunities to improve availability of healthful foods.

- From the reviews of intervention studies it appeared that increasing **physical activity opportunities** makes a difference, and **schools** and **worksites** offer good settings to do that. Especially increasing the amount of hours of **physical education/physical activity in schools** can make a difference for youth. Improving opportunities for walking can make a difference in adults.

- **Children** and adolescents from more **deprived families** are likely to have **unhealthier diets and less physical activity**, and lower household income is associated with less healthy diets in adults.

---


**Environmental influences:**

**Accessibility and availability → affect**

- **behaviour through (perceived) barriers of behaviour change.** Include financial, geographical and temporal accessibility of facilities, and availability of products.

- **Macro:** country availability

- **Meso:** neighbourhood availability

- **Micro:** household/school availability
Likelihood of daily use of vegetables (OR, low level of education as reference group (OR=1)) (Prättälä et al. PHN 2009)

Trends in the per capita supply of vegetables 1993–2003 (kg/year) in the countries studied
### Meso availability

Table 3 The influence of area socio-economic characteristics and education on food choice behaviour and dietary intake*

<table>
<thead>
<tr>
<th></th>
<th>Unhealthy grocery food choices</th>
<th>Low fruit consumption</th>
<th>Skipping breakfast</th>
<th>High total fat intake</th>
<th>High saturated fat intake</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
</tr>
<tr>
<td>Gender (women)</td>
<td>0.75 0.59, 0.98</td>
<td>0.49 0.37, 0.65</td>
<td>0.65 0.48, 0.87</td>
<td>1.03 0.82, 1.33</td>
<td>1.45 1.12, 1.87</td>
</tr>
<tr>
<td>Age</td>
<td>1.00 0.99, 1.01</td>
<td>0.97 0.99, 1.00</td>
<td>1.00 0.96, 1.04</td>
<td>1.00 0.96, 1.04</td>
<td>1.00 0.96, 1.04</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>1.54 1.00, 2.37</td>
<td>1.38 1.20, 1.60</td>
<td>1.44 1.36, 1.59</td>
<td>1.22 0.84, 1.77</td>
<td>0.99 0.74, 1.56</td>
</tr>
<tr>
<td>Lower secondary</td>
<td>1.57 1.08, 2.28</td>
<td>1.54 1.04, 2.28</td>
<td>1.90 1.23, 2.92</td>
<td>1.22 0.73, 1.91</td>
<td>0.91 0.59, 1.01</td>
</tr>
<tr>
<td>Higher secondary</td>
<td>1.54 1.02, 2.32</td>
<td>1.35 0.80, 2.08</td>
<td>1.01 1.28, 3.16</td>
<td>1.17 0.73, 1.74</td>
<td>1.07 0.72, 1.56</td>
</tr>
<tr>
<td>Tertiary</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Area deprivation quartile</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (most deprived)</td>
<td>1.15 0.70, 1.87</td>
<td>0.60 0.39, 1.06</td>
<td>1.49 0.96, 2.34</td>
<td>0.84 0.58, 1.21</td>
<td>1.17 0.61, 1.97</td>
</tr>
<tr>
<td>2</td>
<td>1.00 0.70, 1.42</td>
<td>0.82 0.55, 1.21</td>
<td>1.43 0.93, 2.21</td>
<td>0.99 0.70, 1.41</td>
<td>1.04 0.61, 1.85</td>
</tr>
<tr>
<td>3</td>
<td>1.22 0.86, 1.74</td>
<td>0.66 0.44, 0.99</td>
<td>1.15 0.73, 1.81</td>
<td>0.76 0.53, 1.08</td>
<td>0.97 0.67, 1.41</td>
</tr>
<tr>
<td>4 (least deprived)</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Random variance</td>
<td>Var. 0.00</td>
<td>Var. 0.03</td>
<td>Var. 0.06</td>
<td>Var. 0.07</td>
<td>Var. 0.00</td>
</tr>
<tr>
<td>Between areas</td>
<td>0.00 0.00</td>
<td>0.03 0.04</td>
<td>0.07 0.00</td>
<td>0.00 0.00</td>
<td>0.00 0.00</td>
</tr>
</tbody>
</table>

*OR – odds ratio; CI – confidence interval; Var. – variance; SE – standard error.

*Multivariable logistic regression models were used for analyses. Independent variables entered in the models were gender, age, education level and area deprivation.
Reported vegetable availability outside the home

Micro availability

Abstract

Many adolescents have diets that are less than optimal, particularly adolescents of low socioeconomic position (SEP). The determinants of SEP differences in adolescent diet intake are poorly understood. This study examined home food environments of adolescents and specifically investigated whether low-SEP adolescents have less supportive home meal environments, fewer eating rules, and poorer home availability of fruits and vegetables than adolescents of high SEP. A cross-sectional self-reported survey was administered to 3,524 adolescents in years 7 and 10 from 37 secondary schools in Victoria, Australia. Adolescent perceptions of the home meal environment, eating rules and home food availability were described and compared across SEP, which was measured using maternal education. Maternal education was linked to various aspects of the home meal environment, as well as home food availability, but not to eating rules. Low-SEP adolescents were more likely to report that they were always allowed to watch television during meal times, and that their main meals were always or usually available at home. In contrast, high-SEP adolescents were more likely to report that vegetables were always served at dinner. The event meal was more often an unsupervised and shared or usually a time for family conversation, and that they always or usually had a meal at home. This study highlights aspects of the home food environment that might explain SEP variation in adolescent diets. Feasible ways of increasing home availability of healthy foods, and encouraging home meal environments to be supportive of healthy eating should be explored, particularly in households of low-SEP adolescents.
Parental educational differences in adolescents’ fruit and vegetable (FV) intake in 2002 and 2005 (Bere et al., Eur J Publ Health, 2008).
Parental educational differences in adolescents’ determinants of FV intakes in 2005 (Bere et al., Eur J Publ Health, 2008).

In the multiple mediator model:

- the mediators together explained 92% (2002) and 60% (2005) of the educational disparity,
- with perceived accessibility contributing the largest amount [45% in 2002 and 14% in 2005]
- each of the other factors contributed little to the explanation in the multiple mediator models
...why lower availability at home and/or outside the home?

- ...lack of knowledge, health values...? (e.g. Ball et al. PHN 2006; Turrell Aus J Nutr Diet 1997)
- ...lack of financial means...? (e.g. Darmon & Drewnowski Am J Clin Nutr 2008)
- ...‘food deserts’...?

...why lower availability at home and/or outside the home?

- ...lack of knowledge, health values...? (e.g. Ball et al. PHN 2006; Turrell Aus J Nutr Diet 1997)
- ...lack of financial means...? (e.g. Darmon & Drewnowski Am J Clin Nutr 2008)
- ...‘food deserts’...? Evidence for the US, but not for UK, other EU countries, Australia, Canada (e.g. Cummins & McIntyre, Urban Studies 2002.)
...where we are so far

- SES disparities in F&V most countries across Europe
- because of differences in motivation, abilities, and opportunities
  - (but evidence-base is weak, not because of evidence for no association, but because of lack of studies...)
- interventions to promote F&V among lower SES groups should target these groups of determinants


A: Analysis of health and quality of life
B: Analysis of personal and environmental risk factors
C: Analysis of determinants of exposure to risk factors
D: Intervention development
E: Intervention implementation
Pro Children: Intervention

School-based Intervention program

School
- Classroom
  - Worksheets
  - Educational Activities
  - Computer Tailoring
  - Web site
- School meals
- School environment
  - Fruit break
  - Special school Events
  - School Project committees
  - School Policy

Family
- Worksheets
- Newsletters
- School Events
- Computer tailoring
- School Health
- Mass Media
- Grocery stores

Community

Evaluation, design

- Cluster randomised controlled trial
- Norway, Spain, the Netherlands

Intervention schools
- Curriculum
- Provision of FV
- family component

Control schools

Baseline, sept 2003
FU1, may 2004
FU2, may 2005
Knowledge of recommended daily fruit intake (%)

![Chart showing the percentage of people who knew the recommended daily fruit intake.](chart1.png)

*Sign. effect at Follow-up II when adj. for baseline values & age; p<0.001*

Knowledge of recommended daily vegetable intake (%)

![Chart showing the percentage of people who knew the recommended daily vegetable intake.](chart2.png)

*Sign. effect at Follow-up II when adj. for baseline values & age; p<0.001*
Fruit availability at school (Can you get fruit at school either by buying it or getting it for free?)

(scale 0-4)

<table>
<thead>
<tr>
<th></th>
<th>Intervention</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>1.31</td>
<td>1.34</td>
</tr>
<tr>
<td>Always</td>
<td>2.5</td>
<td>1,23</td>
</tr>
</tbody>
</table>

* Sign. effect at Follow-up II when adj. for baseline values & age; p<0.001)

Vegetable availability at school (Can you get fruit at school either by buying it or getting it for free?)

<table>
<thead>
<tr>
<th></th>
<th>Intervention</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>1.06</td>
<td>1,12</td>
</tr>
<tr>
<td>Always</td>
<td>1.06</td>
<td>1,12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Follow-up II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Reported total fruit & vegetable intake at baseline (Sept. 03) and follow-up II (May 05) (24 hour recall; gram per day; n=1493)

* Sign. effect at Follow-up II when adj. for baseline values & age; p<0.001

Results: total fruit and veggies intake

Te Velde et al, BJN, 2008
Results: total fruit intake

Te Velde et al, BJN, in press

Results: total vegetable intake

Te Velde et al, BJN, in press
### Reported program implementation, parental involvement & student appreciation

<table>
<thead>
<tr>
<th></th>
<th>Norway</th>
<th>Spain</th>
<th>The Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>School curriculum implementation (0-16):</td>
<td>10.9</td>
<td>9.4</td>
<td>7.4</td>
</tr>
<tr>
<td>Parental involvement (0-7):</td>
<td>3.4</td>
<td>3.5</td>
<td>2.8</td>
</tr>
<tr>
<td>Child appreciation (0-3):</td>
<td>2.4</td>
<td>2.3</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Wind et al, Health Educ Res 2008

### Fruit and Vegetables Make the Marks (FVMM)

**Subscription vs. free school fruit – Norwegian experiences**

**Subscription program:**

*Offered to all Norwegian elementary schools*

**Cost:**

- NOK 2.50 per school day (approximately EUR 0.30)
- Subsidised by the Norwegian Government by NOK 1.00 per pupil per school day
The FVMM project

- 38 schools, 1950 6th and 7th graders

- School fruit intervention (October 01 – June 02):
  - Free school fruit: 9 schools
  - Existing subscription program: 9 schools
  - No program: 20 schools

- Data collections:
  - Baseline (September 01)
  - Follow-up (May 02)
  - Follow-up (May 05)

Free fruit: more effective than subscription program

Bere et al., Prev Med, 2005
Free fruit: Showed long term effect

No differences according to parental education

Challenges in school fruit programs

- Implementation
- Parental involvement
- Participation in subscription programs is low (Norway, 41% of the schools, 28% of children within schools)
- Paid subscription programs may increase socio-economic differences in FV intake
Conclusions

- Differences in F&V intakes according to SES/SEP are apparent
- Availability of FV at schools important
- Evidence-based intervention programs focusing on improving motivation, abilities and opportunities are promising...
  - If implemented to the fullest extend
- Free provision of F&V may be crucial to contribute to decreasing socio-economic disparities
- (...more research is certainly necessary...)
RECOMMENDATIONS

COMMISSION RECOMMENDATION

of 28 April 2010

on the research joint programming initiative ‘A healthy diet for a healthy life’

(2010/245/EU)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Article 186(2) thereof,

Whereas:

(1) Health of the citizens is essential for growth and prosperity in the Union.

(2) In the last 3 decades the levels of overweight and obesity in the population of the Union have risen dramatically, particularly among children.

(3) The trend of poor diet and low physical activity across the population of the Union is worrisome.

(4) In order to ensure the efficiency of the joint efforts of Member States in the field of food and health, Member States should develop and implement a strategic research agenda based on a common approach to prevention of diet-related diseases.

(5) Joint programming of research in the field of food and health would provide for coordination of research on the impact of dietary and diet on health, contributing significantly to completion of a fully operational European Research Area on prevention of diet-related diseases and strengthening leadership and competitiveness of the research activities in this field.

(6) With a view to ensuring effective management of the joint action to be taken, Member States should set up a common management structure with a mandate to establish common conditions, rules and procedures for cooperation and contributions and to monitor implementation of the strategic research agenda.