Risk factors of childhood obesity: Lessons from the European IDEFICS study

Wolfgang Ahrens, Iris Pigeot
on behalf of the IDEFICS Consortium
Leibniz Institute for Prevention Research and Epidemiology – BIPS

ECOG-ebook on Childhood Obesity
Objectives:

- Enhance knowledge of health effects of changing diet & altered social environment & lifestyle of children, 2-9 years, in Europe,
- Develop, implement & evaluate specific intervention approaches to reduce prevalence of diet- & lifestyle-related diseases & disorders.

Known modifiable risk factors:

- Nutrition
- Physical activity
- Stress

Specific intervention targets → Intervention study

New knowledge on aetiological mechanisms → Analytical study
Study design

- Approach through schools and kindergartens
- Longitudinal: comparison of baseline ($T_0$) with follow-up ($T_{1-2}$)
- Controlled: intervention / control communities with similar socio-demographic profile (non-randomised)

- Sample size:
  - $N=16,228$ at baseline (2-9 years)
  - $N=13,498$ at follow-up (4-11 years)

Ahrens W et al. The IDEFICS cohort: design, characteristics and participation in the baseline survey. *Int J Obes (Lond).* 2011; 35 (Suppl. 1): S3-S15.*
Baseline survey...

...addresses first strategic objective:

to enhance the knowledge of the

health effects of a changing diet

& an altered social environment &

lifestyle of children in Europe


Core variables

- Questionnaires (parent)
  - Social factors, lifestyle + PA
  - Eating behaviour + FFQ
  - Medical history

- 24-hour dietary recall + school meals
  - **SACINA:** computer-based 24-hour dietary recall

- Physical activity
  - **Accelerometer:** 3 days

Core variables & add-ons

- Physical examination
  - Anthropometry
  - Blood pressure
  - Musculoskeletal disorders (calcaneal ultrasonometry)

- Biological markers
  - Blood
  - Saliva / mouth swab
  - Urine
Additional variables assessed in subgroups

- Special examinations
  - **Food tasting** (food preference, taste sensitivity)
  - **Aerobic fitness** (using parts of the *Eurofit* test battery for children aged 6 to 10 years)
  - **Age-specific motor tests** (hand-grip strength, strength of back muscles, hip flexibility test, motor skills)
  - **Food advertising effects** (media literacy, internal & external triggers)

- (Pre-) school environment (in selected centres): GIS
  - Opportunities for physical activity
  - Food supplies
Intervention…

…addresses second strategic objective:

to develop, implement & validate specific intervention approaches in order to reduce the prevalence of diet- & lifestyle-related diseases & disorders in the EU

IDEFICS Intervention

Community-oriented

Setting-based

Intervention mapping in 5 steps

3 x 2 key messages (diet, stress, physical activity)

Programme: 10 modules at 4 levels

Participation of stakeholders

Community

Involvement of community partners

e.g. Media campaign

IDEFICS Intervention

Community-oriented

Setting-based
## Intervention: 6 key messages

<table>
<thead>
<tr>
<th>Nutrition</th>
<th>Physical activity</th>
<th>Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily water</td>
<td>Reduce TV-viewing</td>
<td>Spend more time together</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Family time</td>
</tr>
<tr>
<td>→ Less soft drinks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily fruit &amp; vegetables</td>
<td></td>
<td>Adequate sleep duration</td>
</tr>
<tr>
<td></td>
<td>→ Safe bicycle lanes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>→ Outdoor playing</td>
<td></td>
</tr>
</tbody>
</table>
Adherence to the 6 IDEFICS key messages

- 0 or 1 key message: 1%
- 2 key messages: 6%
- 3 key messages: 20%
- 4 key messages: 35%
- 5 or 6 key messages: 38%
Some results …

… with respect to the six key messages
Dietary behaviour
<table>
<thead>
<tr>
<th>Dietary pattern</th>
<th>Components</th>
<th>Explained variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snacking</td>
<td>Sandwiches (including hamburgers, hotdogs, and kebabs); butter or margarine on bread; savoury pastries; chocolate, candy bars; white bread; veg. cooked</td>
<td>10%</td>
</tr>
<tr>
<td>Sweet &amp; fat</td>
<td>Chocolate- or nut-based spreads on bread; cakes, pastries, and puddings; sweets/candy; fried meats; soft drinks (sugar added and diet); mayonnaise and similar; cured meat and sausages</td>
<td>6%</td>
</tr>
<tr>
<td>Veg. &amp; wholemeal</td>
<td>Raw vegetables; wholemeal bread; cooked vegetables; fresh fruit (no added sugar); milk (no added); breakfast cereals (no added sugar); low-fat butter or margarine on bread</td>
<td>5%</td>
</tr>
<tr>
<td>Protein &amp; water</td>
<td>Fish fresh, not fried; water; fried fish, fish-fingers; eggs, not fried; fresh meat, not fried; pasta, rice; pizza as main dish; butter or margarine on bread</td>
<td>4%</td>
</tr>
</tbody>
</table>
### Risk of becoming overweight/obese over two years of follow-up by food pattern

<table>
<thead>
<tr>
<th>Dietary pattern</th>
<th>Tertile</th>
<th>Adj. OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(reference = low)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Snacking</strong></td>
<td>middle</td>
<td>1.09</td>
<td>(0.88-1.35)</td>
</tr>
<tr>
<td></td>
<td>high</td>
<td>1.18</td>
<td>(0.91-1.52)</td>
</tr>
<tr>
<td><strong>Sweet &amp; fat</strong></td>
<td>middle</td>
<td>1.08</td>
<td>(0.88-1.33)</td>
</tr>
<tr>
<td></td>
<td>high</td>
<td>0.97</td>
<td>(0.77-1.22)</td>
</tr>
<tr>
<td><strong>Veg. &amp; wholemeal</strong></td>
<td>middle</td>
<td>0.76</td>
<td>(0.62-0.94)</td>
</tr>
<tr>
<td></td>
<td>high</td>
<td>0.69</td>
<td>(0.54-0.88)</td>
</tr>
<tr>
<td><strong>Protein &amp; water</strong></td>
<td>middle</td>
<td>1.00</td>
<td>(0.80-1.25)</td>
</tr>
<tr>
<td></td>
<td>high</td>
<td>0.95</td>
<td>(0.74-1.23)</td>
</tr>
</tbody>
</table>

Odd ratios (OR) with 95% confidence intervals from mixed effects logistic regression with country as “random effect”; adjusted for baseline BMI, sex, age, hours of physical activity/week (continuous), country specific income (low, low/medium, medium, medium/high and high).
TV viewing
Odds ratios (OR) and 95% confidence intervals (CI) adjusted for sex, age, parental education, country (all)
Physical activity and the built environment
Which characteristics of the built environment influence physical activity levels in the home environment of children?

- **Land use** (Frank et al., 2005)
- **Playgrounds, green spaces and sports facilities** (Black and Macinko, 2008)
- **Bikeways and footpaths** (Sallis et al., 2009)
- **Intersections** (Frank et al., 2005)

How can we assess these characteristics?
Development of a moveability index

- **Geostatistical measures:**
  - Availability of urban characteristics
  - Kernel density

- **Moveability index:**
  - Mean z-scores of measures of urban characteristics
  - Pilot study (317 children): positive association with PA (AVG CPM)
Duration of MVPA across Europe (60 sec interval, Evenson et al., 2008)


Sleep duration
Odds ratios for overweight by sleep duration

<table>
<thead>
<tr>
<th>Adjusted OR*</th>
<th>&gt;10h to ≤ 11h</th>
<th>&gt;9h to ≤ 10h</th>
<th>≤ 9h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-school</td>
<td>0.93 (0.63; 1.36)</td>
<td>1.08 (0.73; 1.61)</td>
<td>1.38 (0.87; 2.19)</td>
</tr>
<tr>
<td>School</td>
<td>1.46 (0.96; 2.22)</td>
<td>1.88 (1.23; 2.86)</td>
<td>3.53 (2.24; 5.54)</td>
</tr>
<tr>
<td>All</td>
<td>1.10 (0.84; 1.45)</td>
<td>1.36 (1.03; 1.80)</td>
<td>2.22 (1.64; 3.02)</td>
</tr>
</tbody>
</table>

Ref. >11 h; OR, 95% CI; *adjusted for age (continuous), ambient temperature (continuous), European region (north versus south)
What next?
Determinants of eating behaviour in European children, adolescents and their parents
Longitudinal design of I.Family and concatenation with IDEFICS

IDEFICS study

- Intervention group
- Cohort (~16,000 children)
- Baseline survey
- Intervention phase
- 2nd & 3rd survey
- Control group
- Physical activity
- Sleep
- Diet
- Evaluation of intervention effects
- Transition into adolescence

I.Family

- Environment
- School
- Peers
- Family
- Healthy diet maintained
- Unhealthy diet maintained
- Diet worsened significantly
- Diet improved significantly

Contrasting Groups (stage 2)

Longitudinal

Determinants

- Diet
- Physical activity
- Sleep
- SES
- Genes
- Biomarker
- Environ. & family
  life
- Parental quest.
- School quest.
- GIS

Assessment

- FFQ
- 24h dietary recall
- Quest.
- Accelerometers
- Quest.
- Activity
  monitor
- Quest.
- Pedigree
  analysis
- CAQDA
- Saliva
- Taste
  threshold
- GIS
- GPS
- Blood
  microRNA
  profiling
- Tween
  quest.
- Network
  analysis
- Canteen
  exp.

Outcome

- Lifestyle & nutrition related diseases and disorders
- Overweight & Obesity
- Musculoskeletal disorders
- Insulin resistance
- Anthropometry
- Ultrasonography
- Biomarkers

Assessment

- Eating behaviour, diet & food choice
- FFO
- Web-based 24h dietary recall
- Gene expression
- microRNA profiling
- fMRI

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Work programme

- To study the impact of biological, socio-behavioural, genetic and environmental factors on dietary behaviour by comparing subjects who developed in an unfavourable direction with those who maintained a healthy diet.

- To study brain activation, expression of genes related to food choice, biological and genetic basis for taste thresholds, role of sleep, sedentary time, physical activity and built environment in subgroups with contrasting dietary profiles.

- To study the prognostic value of body composition and cardio-metabolic markers by linking them to diet and interacting factors.

- To derive effective communication strategies to empower EU consumers to induce favourable behaviour changes.