Obesity-related disorders

- Psychosocial consequence:
  - Poor self-esteem
- Respiratory tract:
  - Sleep apnoea
  - Asthma
- Gastro-intestinal tract:
  - Gallstones
  - Fatty liver disease
- Kidney:
  - Renal insufficiency (due to diabetes)
- Musculoskeletal disorders:
  - Splay-, skew-, flatfeet
  - Knock knees, bowlegs
  - Femoral head luxation
  - Lower arm fractures
  - Arthritis
  - Back pain

- Neurological & psychiatric disorders:
  - Headache, visual impairment
  - Depression
  - Eating disorders

- Cardiovascular system:
  - Lipid metabolism, elevated cholesterol
  - Hypertension
  - Coagulation disorder, thrombosis
  - Chronic blood vessel inflammation
  - Water/ mineral imbalance

- Hormone system:
  - Type-2 diabetes
  - Early puberty
  - Ovary cysts
  - Testicular atrophy

IDEFICS Study
Design and baseline results of a European prospective intervention study in young children

Wolfgang Ahrens (coordinator)
on behalf of the IDEFICS Consortium
Bremen Institute for Prevention Research and Social Medicine (BIPS)
University of Bremen

Academy of Finland’s research programmes

Naantali 10th of May 2011

Funded by the EC, FP6, Contract No. 016691 (FOOD)
Worldwide prevalence of overweight and obesity in children & adolescents

European prevalence of overweight and obesity in children & adolescents
There is need for …

- Comparable data on overweight/obesity
- Comparable data on risk factors and morbidity
- Identification of determinants that are amenable to primary prevention
- Evidence-based prevention programmes

IDEFICS study design and methods
Identification and prevention of dietary- and lifestyle-induced health effects in children and infants

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 & timeline

Study design
- Approach through schools and kindergartens
- Longitudinal: comparison of baseline (T₀) with follow-up (T₁-₂)
- Controlled: intervention / control communities with similar socio-demographic profile (non-randomised)

Timeline of surveys and intervention activities

### Study groups/ sample size*

<table>
<thead>
<tr>
<th>Country</th>
<th>Intervention</th>
<th>Non-Intervention</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>1,179</td>
<td>887</td>
<td>2,066</td>
</tr>
<tr>
<td>Sweden</td>
<td>902</td>
<td>907</td>
<td>1,809</td>
</tr>
<tr>
<td>Estonia</td>
<td>793</td>
<td>926</td>
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<tr>
<td>Spain</td>
<td>798</td>
<td>709</td>
<td>1,507</td>
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<tr>
<td>Cyprus</td>
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<td>1,007</td>
<td>2,380</td>
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<td>Italy</td>
<td>1,155</td>
<td>1,095</td>
<td>2,250</td>
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<tr>
<td>Hungary</td>
<td>1,277</td>
<td>1,290</td>
<td>2,567</td>
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<tr>
<td>Belgium</td>
<td>976</td>
<td>950</td>
<td>1,926</td>
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<tr>
<td>TOTAL</td>
<td>8,453</td>
<td>7,771</td>
<td>16,224</td>
</tr>
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</table>

* Children with minimum set of data completed (questionnaires + anthropometry)

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### 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 (100%)
  - Eating behaviour + FFQ (94%)
  - Medical history (77%)

- 24-hour dietary recall + school meals
  - SACINA (68%): computer-based 24-hour dietary recall

- Physical activity
  - Accelerometer (46%): 3 days

Core variables & add-ons

- Physical examination
  - Anthropometry (100%)
  - Blood pressure (91%)
  - Musculoskeletal disorders (47%)
    (calcaneal ultrasonometry)

- Biological markers
  - Blood (57% venous + 20% capillary)
  - Saliva / mouth swab (86%)
  - Urine (86%)

- Add-ons, e.g.
  - Sensory taste perception
  - Physical fitness
  - Food advert effects
  - (Pre-) school environment: GIS
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**

1. **3 x 2 key messages** (diet, stress, physical activity)
2. **Programme:**
   - 10 modules at 4 levels
3. **Participation of stakeholders**
4. **Community**
5. **e.g. Media campaign**

**Involvement of community partners**

-----

**Develop intervention modules**

- … taking into account the socio-cultural and living environment
  - **Participatory**
    - Involve all actors, e.g. through focus groups
  - **Target the obesogenic environment**
    - Integrate policy level
    - Shift locus of responsibility to society
  - **Draw upon existing modules for which evidence is at least promising**
    - Standardised
    - Preparatory phase to test & culturally adapt programme
    - Easy to implement and cost-effective
    - Specific modules to reach targets at all intended levels
Develop intervention modules

- … addressing several levels
  (non-selective primary prevention & health promotion)
  - **Community**
    - environment, social & political dimensions
  - **Pre-school/ primary school**
    - education, food preparation (catering), school neighbourhood
  - **Household/ family**
    - information, education, motivation
  - **Individual**
    - behaviour

Implement intervention

- Establishment of
  - Central and local **project intervention managers**
  - Community platforms: **local intervention programme committees**
    (IPC: local actors & stakeholders)
  - **Round tables**

- Standardised community intervention programme (CIP) **starting from schools/ pre-schools**: 
  - Intervention messages & communication strategies
  - Core settings & dissemination channels
  - Core intervention tools & modules
Aims & levels of intervention

8 intervention centres in 8 European countries

- Control: intervention region in each country
- 500:500 preschoolers & 500:500 primary school children each
- Evaluation of:
  1. Development of the programme (costs, expenditure of time, practical problems & solutions)
  2. Process (participation, feasibility, acceptance, sustainability)
  3. Effect (individual, various endpoints)

Intervention: 6 key messages

- **Nutrition**
  - Daily water
  - Less soft drinks

- **Physical activity**
  - Reduce TV-viewing

- **Stress**
  - Spend more time together
  - Family time

  - Daily fruit & vegetables
  - Daily PA
  - Safe bicycle lanes
  - Outdoor playing

  - Adequate sleep duration
First results ....

...baseline survey 2007/2008:

Distribution of BMI classes (Cole)

16,188 children, all ages (≤ 9 years)

BMI (Cole) by income level
(Dataset 3rd of February 2010)
Results regarding key messages

Prevalence of fruit & vegetable consumption by country (boys & girls)
Junk food* and BMI category by income

*Junk food = popcorn, chocolate, candy bars, candies, sweetened drinks, chocolate/nut-based spread

Nocturnal sleep duration by age (24-hour recall)

Hense et al. „Factors that influence sleep duration in European children“ SLEEP 2011
Nocturnal sleep duration by country (24-hour recall)

Sleep duration and overweight

Associations between sleep duration and overweight
(Reference >11 hours; OR, 95% CI).

<table>
<thead>
<tr>
<th></th>
<th>≤ 11h and &gt;10h</th>
<th>≤ 10h and &gt;9h</th>
<th>≤ 9 h</th>
</tr>
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<tbody>
<tr>
<td>Crude OR</td>
<td></td>
<td></td>
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<tr>
<td>Pre-school</td>
<td>1.3 (1.0; 1.7)</td>
<td>1.8 (1.4; 2.4)</td>
<td>1.9 (1.4; 2.8)</td>
</tr>
<tr>
<td>School</td>
<td>1.9 (1.4; 2.5)</td>
<td>2.9 (2.1; 3.9)</td>
<td>4.9 (3.5; 6.8)</td>
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<tr>
<td>All</td>
<td>1.7 (1.4; 2.1)</td>
<td>2.6 (2.2; 3.2)</td>
<td>3.7 (3.0; 4.6)</td>
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<tr>
<td>Adjusted OR*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-school</td>
<td>1.0 (0.7; 1.3)</td>
<td>1.1 (0.8; 1.5)</td>
<td>1.2 (0.9; 1.8)</td>
</tr>
<tr>
<td>School</td>
<td>1.4 (1.1; 2.0)</td>
<td>1.7 (1.3; 2.4)</td>
<td>3.0 (2.2; 4.4)</td>
</tr>
<tr>
<td>All</td>
<td>1.1 (0.9; 1.4)</td>
<td>1.3 (1.1; 1.7)</td>
<td>1.9 (1.6; 2.5)</td>
</tr>
</tbody>
</table>

*adjusted for sex, age, parental education level, screen time, country
Moderate/vigorous physical activity by country (accelerometer data)

School children (6-9 yr)

MVPA (min./day)

N=7,454

Screentime (audiovisual media) and family lifestyle

Percentage of 6–9-year-olds watching TV/video/DVD usually for > 1 h/day

Percentage of parents reporting “quite boring weekends”
Odds ratios for selected known and suspected risk factors

OR for overweight/obesity by income level

N=13,914
OR for overweight/obesity by single parenthood & migration background

OR for overweight/obesity by parental BMI (continuous)
Sensory taste preferences

Taste is one of the most important drivers of food choice (Glanz et al. 1998) 
- Association with overweight and obesity plausible
- Contradicting results in previous studies on preference for fatty and sweet foods in relation to weight status, dietary intake

However:
- Other taste modalities than sweet and fat relatively less studied
- Taste preferences are likely to vary across food cultures
Sensory taste preference: specific aims

1. Taste preferences in children from different countries
2. Taste preferences weight status?
3. Taste preferences dietary habits?

Based on a multi-centre study in 8 European countries

Sensory taste preference: methods

Study population
- Systematic subsample of 1,833 children from the baseline survey (fall 2007-spring 2008) of the IDEFICS study.
- Schoolchildren: 6 - 9 years old

Taste preferences
- Paired forced choice tests for preference for added sugar, apple flavour in apple juice (not in Cyprus) and salt, fat, MSG in cracker

Weight status and diet
- Standardized measurement of BMI. Categories by Cole et al. (2000)
- Food frequency questions answered by parents
Taste preferences by country (i)

Preferences for crackers with added fat, monosodium glutamate or salt

Sensory taste preferences

- Vary by country
- Are positively associated with BMI
  - Fat
  - Sweet
    → particularly in girls
    → independent of country
- Fat preference is not convincingly associated with consumption of fatty food
- Sugar preference is not associated with consumption of sweet food
The built environment

Urban factors

Elements of the urban environment impact on physical activity (PA) and food choice

- Availability of play and sports grounds increase PA of children (Davison and Lawson 2006)
- Safe sidewalks and bike lanes facilitate an active way to school (Davison et al. 2008)
- Availability and pricing of food are associated with consumer behaviour and BMI (Papas et al. 2007)
Considered components of the urban environment

- **Physical activity**
  - Infrastructure (walkways, bike lanes, crossings, public transport)
  - Destinations (play and sports grounds, open spaces)
  - Urban development (population density, diversity of land use)

- **Nutrition**
  - Fast-food and convenience-food (restaurant, fast food outlet)
  - Consumer market, food stores
  - Bakeries, kiosks, etc.

---

Effect of the built environment: ADULTS

- Belgian Environmental Physical Activity Study (BEPAS)
  - (Van Dyck et al., 2009, 2010)

- Ghent, Belgium: 24 neighbourhoods

<table>
<thead>
<tr>
<th></th>
<th>SES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Walkabil</td>
<td>High</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>6</td>
</tr>
</tbody>
</table>

- Neighbourhood selection:
  - SES: median annual household income
  - Walkability: GIS: connectivity, land use mix, residential density
Methods (BEPASS)

- 1200 participants (20-65 years), 50 per neighbourhood
- 2 home visits, 1 week between visits
  - IPAQ interview
  - NEWS
  - 7 day accelerometer
  - demographic and psychosocial questionnaire
  - waist circumference

Results (BEPASS)

### Results: neighbourhood walkability - PA

<table>
<thead>
<tr>
<th></th>
<th>High walkability (mean (SD))</th>
<th>Low walkability (mean (SD))</th>
<th>β (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPAQ (min/week)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>walking transport</td>
<td>117.3 (169.2)</td>
<td>37.6 (90.1)</td>
<td>0.764 (0.157)***</td>
</tr>
<tr>
<td>cycling transport</td>
<td>82.3 (126.7)</td>
<td>43.9 (95.2)</td>
<td>0.447 (0.105)***</td>
</tr>
<tr>
<td>motor transport</td>
<td>309.2 (295.3)</td>
<td>344.8 (315.7)</td>
<td>-0.125 (0.067)*</td>
</tr>
<tr>
<td>walking recreation</td>
<td>85.3 (137.2)</td>
<td>67.6 (128.4)</td>
<td>0.334 (0.111)**</td>
</tr>
<tr>
<td>Activity monitor (min/day) MVPA</td>
<td>38.6 (23.8)</td>
<td>31.8 (23.1)</td>
<td>0.095 (0.030)***</td>
</tr>
</tbody>
</table>

* p<0.05; ** p<0.01; *** p<0.001
Effect of the built environment:
ADULTS – BEPAS *(Van Dyck et al., 2009, 2010)*

**Neighbourhood walkability**
- Walking for transport: $\alpha = 3.10$ (p<0.001)
- Cycling for transport: $\beta = -0.11$ (p<0.05)
- Walking for recreation: $\alpha = 1.75$ (p<0.001)
- Cycling for recreation: $\beta = -0.20$ (p<0.001)
- Walking for transport: $\alpha = 1.28$ (p<0.05)
- Walking for recreation: $\beta = -0.06$ (p<0.05)

BEPASS results: mediating effects of domain-specific self-reported PA behaviors

**Neighborhood walkability**
- Walking for transport: $\alpha \beta$ – coefficient walking transport = -0.13 (p<0.05)
- Cycling for transport: $\alpha \beta$ – coefficient cycling transport = -0.12 (p<0.01)
- Walking for recreation: $\alpha \beta$ – coefficient walking recreation = -0.02 (p<0.05)
Good for adults = good for children?

ADULTS
- Connectivity
- Short distance to places
- Many crossings
- Population density
- Active transport

CHILDREN
- Dead end streets
- Safety
- Quietness
- Gardens / green spaces
- Free play
IDEFICS

- Development of a moveability index for young children by German Idefics Group
  - UNIH (C. Buck, H. Pohlabeln, I. Pigeot)

- Pilot application in the German intervention region of Idefics, Delmenhorst

Density of destinations in DEL regarding physical activity
A moveability index was developed reflecting urban opportunities for physical activity in children. The moveability index includes:

- **Street connectivity**
  - Intersection density
  - Density of footpaths and bikeways
- **Destinations**
  - Playgrounds
  - Green Spaces
  - Sports facilities
- **Land use mix**
- **Residential density**

The moveability index includes:

- **Street connectivity**
  - Intersection density
  - Density of footpaths and bikeways
- **Destinations**
  - Playgrounds
  - Green Spaces
  - Sports facilities
- **Land use mix**
- **Residential density**

Combination of all intensities to quantify opportunities for physical activity.

Calculation by school area.

Standardisation of intensities over school areas (z-score).

Adjustment by urban development.
Result of pilot study

- Moveability was linked with reported physical activity of 344 school children for six school catchment areas.

- Parents living in areas that provided high moveability reported on average more outdoor physical activity of their children, adjusted for:
  - Age and household income
  - Sex
  - ISCED of the parents (International Standard Classification of Education)

- Moveability index did not explain active travel to school.
  - Distance to school was a significant predictor of active travel to school.

CONCLUSION (built environment)

- ADULTS: Established relationship between the built environment, physical activity and BMI
  - WALKability!

- ADOLESCENTS: Less clear relationships with built environment: only in low SES neighborhoods a relationship between walkability and physical activity, no relationship with BMI.

- CHILDREN: playgrounds, green spaces, sport facilities but availability may not be enough ⇒ also encouragement
  - MOVEability!
Conclusion (built environment)

- There is probably not ONE built environment that encourages physical activity and prevents obesity in all age groups.
- More research needed on characteristics of the built environment that increase physical activity in adolescents and children.

Summary

- Prevalence of overweight/obesity higher in
  - Southern vs. northern Europe (exception UK)
  - Girls
  - Low SES groups (income/education/migration/one-parent)
- Overweight/obesity associated with
  - Sleep duration (negatively)
  - Physical activity and fitness (negatively)
  - Parental BMI (positively)
  - Media consumption (positively)?
  - Migration background (positively)?
  - One-parent families (positively)?
  - Sensory taste preference for sweet and fat (positively, girls)?
- The built environment impacts on levels of physical activity.
Conclusion 1 of 2

- **Not one** built environment encouraging PA and preventing obesity in all age groups
  - **Adults**: established relationship between built environment, PA and BMI ⇒ **Walkability**
  - **Children**: playgrounds, green spaces, sport facilities, dead end streets ⇒ **Moveability**
    - More research needed in children and adolescents

Conclusion 2 of 2

- No association between taste preference for sweet / fat and the corresponding food groups
- Negative association of F+V consumption with overweight/obesity on ecological – not individual – level
  - Wish bias? ⇒ **Longitudinal data** needed to measure incidence
  - Better dietary assessment methods (24-hour dietary recall)
- Cave: first cross-sectional analysis!
  - Cross-country heterogeneity still to be considered
  - More insight by **multivariate analyses** and longitudinal data
Study outcomes

- **Prevalence estimates** on diet- & lifestyle-related diseases & their key risk factors - comparable across Europe
- **Risk factors & causal pathways** incl. biomarkers of exposure & effect as well as genetic factors
- **Internal & external triggers of food choices** in children
- **Effective culturally sensitive intervention strategies** - easy to implement on a large scale in Europe
- **Nutritional, behavioural & ethical guidelines** for scientists, policy makers, health insurances, stakeholders & channels

The IDEFICS consortium thanks for your attention

[Website links]
www.idefics.eu
www.mpib-berlin.mpg.de
I.Family

Determinants of eating behaviour in European children, adolescents and their parents

Coordinator: Wolfgang Ahrens (D)
Deputy coordinators: Alfonso Siani (I), Iris Pigeot (D)
Grant requested: 9 mill. €
Duration: 60 months
No. of partners: 14 (incl. 1 SME)
Participating countries: Cyprus, Denmark, Estonia, Germany, Finland, Hungary, Italy, Spain, Sweden, The Netherlands, United Kingdom
Aim: to make significant contribution to reduce burden of diet-related diseases

- Understand interplay between barriers and main drivers of a healthy food choice
  - Focus on individual and his/her family
  - Assess dynamic nature of causal factors over time and during transition into adolescence
  - Unique opportunity: follow-up of the IDEFICS cohort (16,000 EU children 2-10 years in 2007) + extension to family members

- Develop and disseminate strategies to induce changes towards a healthy behaviour in consumers

Provide strength of methodology, breadth of coverage and depth of investigation across the ecological model
Work programme

➢ To compare contrasting groups: healthy diet / unhealthy diet
➢ Factors to be considered:
  ➢ Biological and genetic basis for taste thresholds
  ➢ Brain activation by food stimuli
  ➢ Genes and expression of genes related to food choice
  ➢ Sleep, sedentary time, physical activity
  ➢ Built environment (GPS, GIS)
  ➢ Social environment (peers)
  ➢ Setting factors (food pricing)
➢ 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

Workflow and work packages (WPs)

WP5 Physical Activity

WP3 Dietary Behaviour

WP6 Family Environment

WP4 Genetics & Neurobehaviour

WP7 Consumer Behaviour

WP2 Epidemiologic Platform

WP1 Management

WP8 Awareness

WP9 Cascade