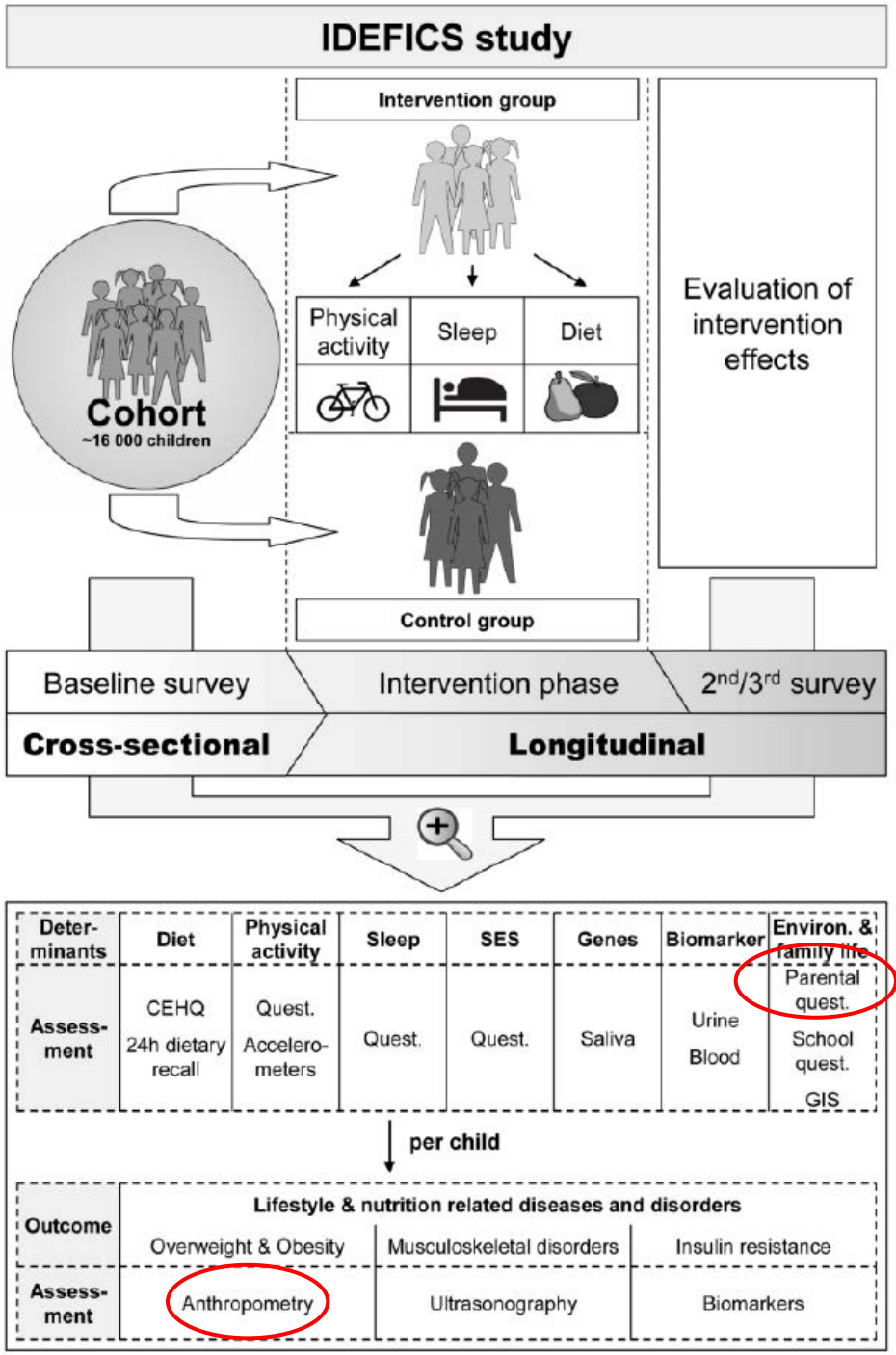
Symposium
I.Family: Health and development of small children
Observations from the IDEFICS-I.Family Cohort

Pre- and perinatal influences on the weight status of primary school children

Wolfgang Ahrens (Bremen, Germany), Alfonso Siani (Avellino, Italy)

- on behalf of the I.Family consortium -

Funded by the EC, FP 7, Project No. 266044 – Building on idefics study



idefics study
Learning healthy living

Identification and prevention of Dietary- and lifestyle-induced health EFfects In Children and infantS

A European epidemiological study to understand & prevent childhood obesity & related disorders

EU 6th Framework Programme

Thematic Priority 5: Food Quality and Safety (3rd Thematic Call; July 2004)

Area 2: Epidemiology of food-related diseases and allergies Topic 5.4.2.1: Influence of diet and lifestyle on children's health (Integrated Project)

Sept. 1st 2006-Feb. 28th 2012

Sixth Framework Programme

Participating countries

Ghent, Belgium
Strovolos, Cyprus
Copenhagen, Denmark
Tallin, Estonia
Grenoble, France
Bremen, Germany
Bremerhaven, Germany
Dortmund, Germany
Wuppertal, Germany
Pécs, Hungary
Avellino, Italy
Campobasso, Italy
Milan, Italy
Naples, Italy
Zaragoza, Spain
Palma de Mallorca, Spain
Gothenburg, Sweden
Bristol, United Kingdom
Glasgow, United Kingdom
Lancaster, United Kingdom

Study groups/ sample size*

Country	Intervention	Non-Intervention	Total
Germany	1,179	887	**2,066**
Sweden	902	907	**1,809**
Estonia	793	926	**1,719**
Spain	798	709	**1,507**
Cyprus	1,373	1,007	**2,380**
Italy	1,155	1,095	**2,250**
Hungary	1,277	1,290	**2,567**
Belgium	976	950	**1,926**
TOTAL	8,453	7,771	**16,224**

Age at baseline:

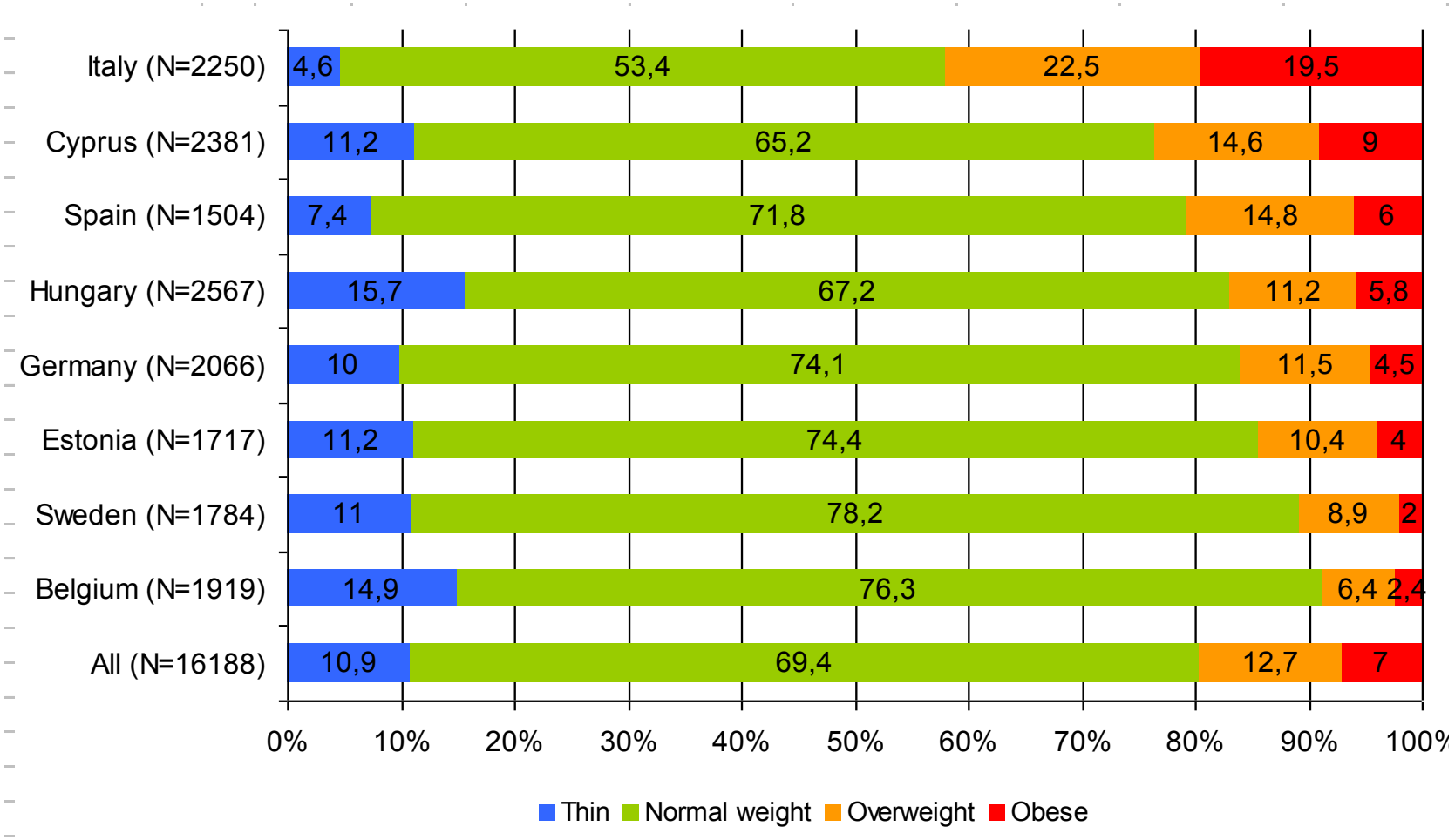
2-5 years (pre-school)

6-9 years (school)

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

Distribution of BMI classes (Cole)

16,188 children, all ages (2-<10 years)



The IDEFICS parental questionnaire

Data on prenatal, perinatal and early postnatal factors were collected by means of standardized parental questionnaires.

- birth weight (g)
- maternal gestational weight gain (kg)
- age of the mother during pregnancy (years)
- smoking (number of cigarettes/day) of the mother during pregnancy
- alcohol intake (number of alcohol servings/day) of the mother during pregnancy
- maternal obesity (categorical: yes/no)
- age of onset of maternal obesity (years)
- education level of the mother
- education level of the father
- time of delivery
- Caesarian section
- presence of gestational diabetes
- presence of gestational hypertension

Focus on risk factors:

<u>Prenatal</u>

- Smoking during pregnancy
- Gestational weight gain
- Gestational diabetes

<u>Perinatal</u>

- Birth weight
- Caesarian section

<u>Postnatal</u>

- Breastfeeding (initiation and duration)
- Early introduction of solid foods

Funded by the EC, FP 7, Project No. 266044 – Building on idefics study

• Gestational weight gain

Dello Russo M, Ahrens W, De Vriendt T, Marild S, Molnar D, Moreno LA, Reeske A, Veidebaum T, Kourides YA, Barba G, Siani A; IDEFICS Consortium.
Gestational weight gain and adiposity, fat distribution, metabolic profile, and blood pressure in offspring: the IDEFICS project.
Int J Obes (Lond). **2013** Jul;37(7):914-9.

OBJECTIVE: To investigate the association between gestational weight gain (GWG) and total adiposity, body fat distribution, blood pressure (BP), and metabolic profile in offspring.
DESIGN: Cross-sectional study.
METHODS: Body mass index (BMI), waist, subscapular and tricipital skinfolds, and BP were measured and blood samples drawn in **12,775** children (aged 2–9 years) from the IDEFICS cohort. Overweight/obesity was defined by IOTF criteria. Parents filled in a questionnaire investigating child and familiar medical history and lifestyle. A section was dedicated to pregnancy history (including GWG).

	GWG tertiles		
	I (n=5330)	II (n=3440)	III (n=4005)
Mother GWG (Kg)	10 (8-11)	14 (13-15)	20 (18-24)

ifamily
Funded by the EC, FP 7, Project No. 266044 – Building on ideficsstudy
SEVENTH FRAMEWORK PROGRAMME

RESULTS: Anthropometric indices linearly and significantly increased across GWG tertiles (BMI z-score: tertile I=0.08, 0.03–0.13; tertile II=0.16, 0.12–0.21; tertile III=0.34, 0.28–0.40, P<0.01, mean, 95% CI) by analysis of covariance (ANCOVA), adjusted by child sex, age and practice of sport, birth weight, current maternal BMI, parental education, gestational age, age at delivery, alcohol and smoking during pregnancy, maternal diabetes mellitus, gestational hypertension, and breastfeeding duration. The adjusted risk of overweight/obesity significantly increased by 14% and 22% in tertiles II and III respectively, in comparison with tertile I by logistic regression analysis controlling for covariates.

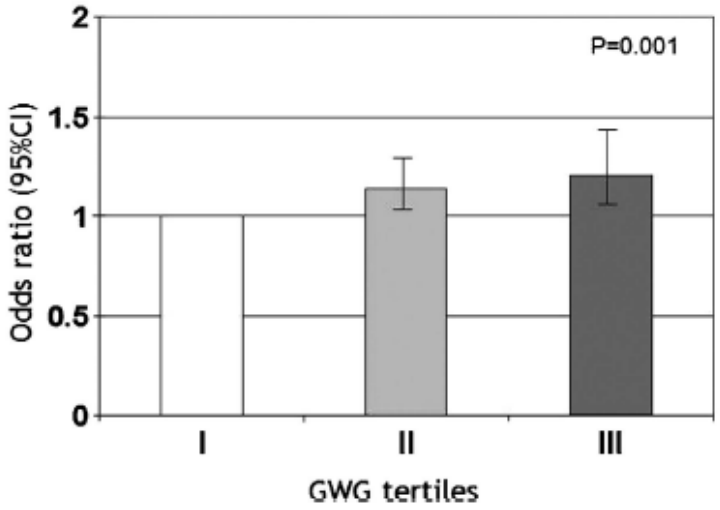


Figure 1. Odds ratio of overweight/obesity in offspring by tertiles of maternal gestational weight gain. Adjusted for: child age, sex, physical activity and birth weight, mother's BMI, parental educational level, gestational age, mother's age at delivery, alcohol and smoking during pregnancy, gHPT, gDM, breastfeeding duration.

CONCLUSION: **Maternal GWG is an independent predictor of total adiposity** and body fat distribution in offspring during infancy. Exposure to perinatal factors should be taken into account for early prevention of overweight and obesity.

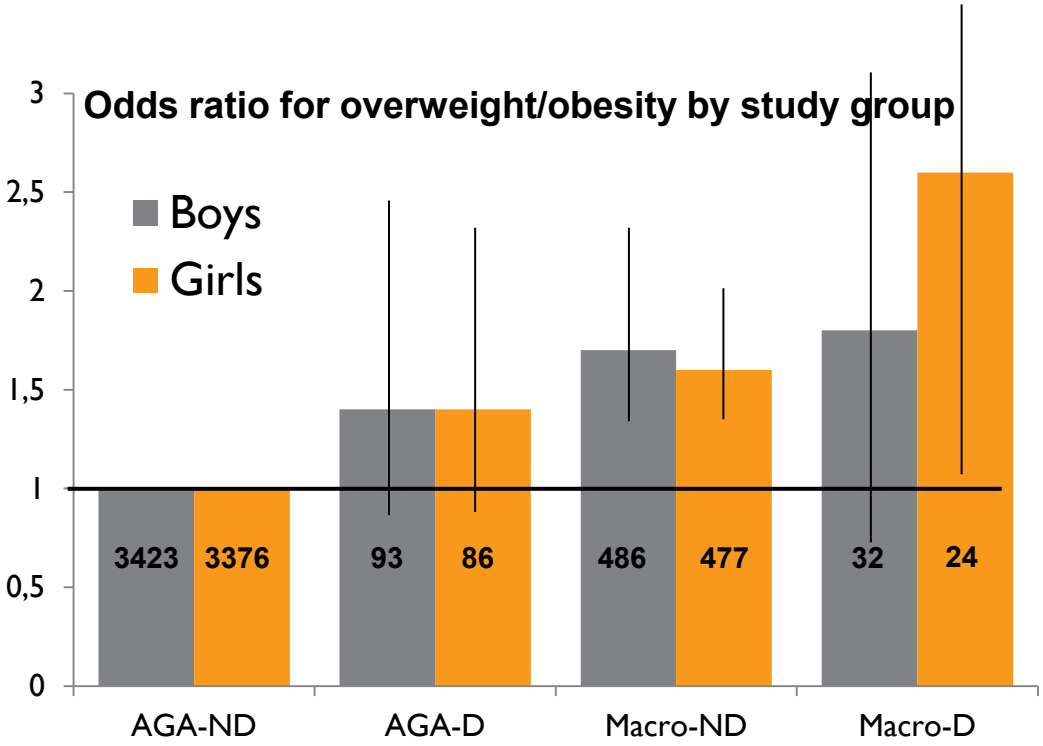
ifamily
Funded by the EC, FP 7, Project No. 266044 – Building on ideficsstudy
SEVENTH FRAMEWORK PROGRAMME

- Birth weight
- Gestational diabetes

Sparano S, Ahrens W, De Henauw S, Marild S, Molnar D, Moreno LA, Suling M, Tornaritis M, Veidebaum T, Siani A, Russo P.
Being macrosomic at birth is an independent predictor of overweight in children: results from the IDEFICS study.
Matern Child Health J. **2013** Oct;17(8):1373-81.

OBJECTIVE: Fetal macrosomia is a risk factor for the development of obesity late in childhood. We retrospectively evaluated the relationship between maternal conditions associated with fetal macrosomia and actual overweight/obesity in the children participating in the IDEFICS study.
METHODS: Anthropometric variables, blood pressure and plasma lipids and glucose were measured. Socio-demographic data, medical history and perinatal factors, familiar and gestational history, maternal and/or gestational diabetes were assessed by a questionnaire. Variables of interest were reported for **10,468** children (M/F=5,294/5,174; age 6.0±1.8 yrs, M±SD). The sample was divided in four groups according to child birth weight (BW) and maternal diabetes: (1) adequate for gestational age offspring (BW between the 10th and 90th percentiles for gestational age) of mothers without diabetes (**AGA-ND**); (2) adequate for gestational age offspring of mothers with diabetes (**AGA-D**); (3) macrosomic offspring (BW>90th percentile for gestational age) of mothers without diabetes (**Macro-ND**); (4) macrosomic offspring of mothers with diabetes (**Macro-D**).

RESULTS: Children macrosomic at birth showed significantly higher actual values of body mass index, waist circumference, and sum of skinfold thickness. In both boys and girls, Macro-ND was an independent determinant of overweight/obesity, after the adjustment for confounders [Boys: OR = 1.7 95 % CI (1.3;2.2); Girls: OR = 1.6 95 % CI (1.3;2.0)], while Macro-D showed a significant association only in girls [OR = 2.6 95 % CI (1.1;6.4)].



CONCLUSIONS:
Fetal macrosomia, also in the absence of maternal/gestational diabetes, **is independently associated with the development of overweight/obesity during childhood**.

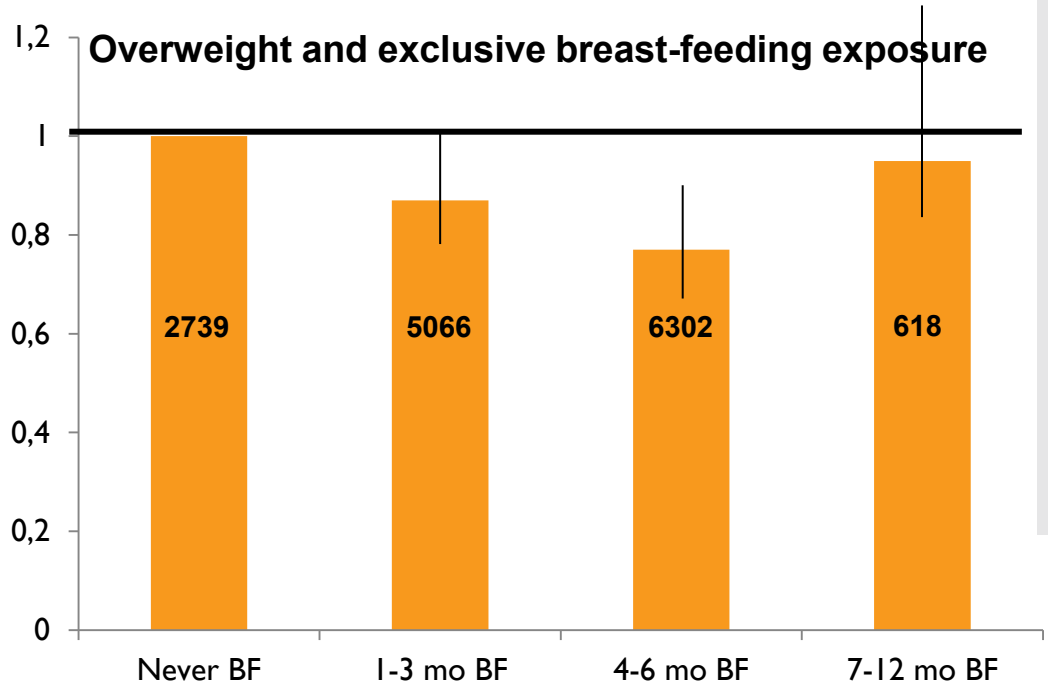
Funded by the EC, FP 7, Project No. 266044 – Building on idefics study

• Breastfeeding (initiation and duration)

Hunsberger M, Lanfer A, Reeske A, Veidebaum T, Russo P, Hadjigeorgiou C, Moreno LA, Molnar D, De Henauw S, Lissner L, Eiben G.
Infant feeding practices and prevalence of obesity in eight European countries - the IDEFICS study.
Public Health Nutr. **2013** Feb;16(2):219-27

OBJECTIVE: To assess the association between exclusive breast-feeding and childhood overweight.
DESIGN: Cross-sectional data are from the baseline survey of the longitudinal cohort study IDEFICS. Exclusive rather than partial breast-feeding is the focus of the study due to the theoretical relationship between exclusive breast-feeding and development of dietary self-regulation. Children's measured heights and weights were used to calculate weight status.
SETTING: Examination centres in eight European countries (Italy, Estonia, Cyprus, Belgium, Sweden, Hungary, Germany and Spain).
SUBJECTS: The analysis included **14 726** children aged 2–9 years for whom early feeding practices were reported by parents in standardized questionnaires.

RESULTS: After controlling for education, income and other potential confounders, breast-feeding exclusively for 4–6 months was protective of overweight (including obesity) when compared with children never exclusively breast-fed (OR=0.73; 95% CI 0.63, 0.85) across all measures of overweight. Exclusively breast-feeding for 6 months offered slightly more protection than for 4 and 5 months combined (OR=0.71; 95% CI 0.58, 0.85). The associations could not be explained by socio-economic characteristics or maternal overweight.



CONCLUSIONS: This multi-country investigation indicated that **exclusive breastfeeding for 4–6 months may confer protection against overweight** in addition to other known benefits. There was no demonstrated benefit of exclusive breastfeeding for more than 6 months or combination feeding for any duration across all measures of overweight examined.

Funded by the EC, FP 7, Project No. 266044 – Building on idefics study

• Breastfeeding (molecular bases)

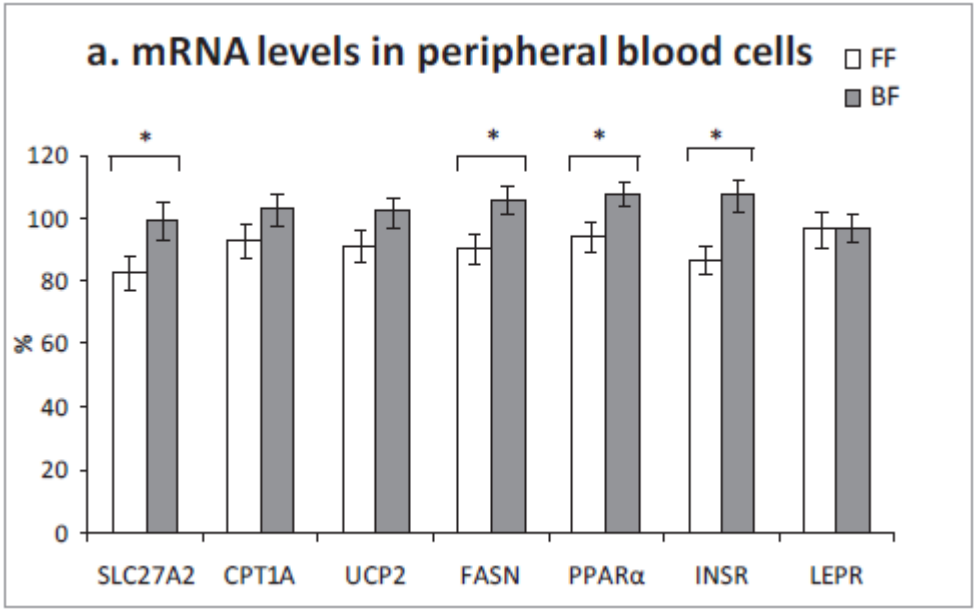
Priego T, Sánchez J, Picó C, Ahrens W, Bammann K, De Henauw S, Fraterman A, Iacoviello L, Lissner L, Molnár D, Moreno LA, Siani A, Tornaritis M, Veidebaum T, Palou A; IDEFICS Consortium.
Influence of breastfeeding on blood-cell transcript-based biomarkers of health in children. Pediatr Obes. **2013** Nov 26.

BACKGROUND: Blood-cell transcripts have showed to be good biomarkers of metabolic alterations and their use in early detection and prevention of future disorders is promising.
OBJECTIVE: This study aimed to examine the relation between previously proposed transcriptional biomarkers of metabolic health (***SLC27A2***, ***CPT1A***, ***FASN***, ***PPARα***, ***INSR***, ***LEPR***) in peripheral blood cells and type of infant feeding in a subset of children from the IDEFICS cohort.
SUBJECTS: A total of **237** children aged 2–9 years from eight European countries were studied.

	Formula-fed children ($n = 110$)		Ever breastfed children ($n = 127$)	
	n	%	*n*	%
Male	56	50.9	59	46.5
Female	54	49.1	68	53.5

ifamily
Funded by the EC, FP 7, Project No. 266044 – Building on ideficsstudy
SEVENTH FRAMEWORK PROGRAMME

RESULTS: Breastfed children showed higher expression levels of *SLC27A2*, *FASN*, *PPARα* and *INSR*, and lower risk of being overweight and of having high plasma triglyceride levels vs. formula-fed children. Besides, overweight formula-fed children presented higher HOMA-index than overweight breastfed children (1.90 vs.1.62); however, this negative effect was absent in formula-fed children with high expression of *SLC27A2*. Moreover, formula-fed children with low expression of *SLC27A2*, *FASN*, *PPARα* and *INSR* presented higher triglyceride levels than subjects with high expression of these genes (77.7 mg/dL vs. 44.8 mg/ dL). This difference was absent in breastfed children.



CONCLUSIONS: **Protective effects of breastfeeding are reflected in higher expression levels of *SLC27A2*, *FASN*, *PPARα* and *INSR* in blood cells**.

What this study adds

- Children who had been breastfed showed higher expression levels of SLC27A2, FASN, PPARα and INSR in PBCs compared with formula-fed subjects.
- The relationship of the PBC transcript levels of SLC27A2, INSR, FASN and PPARα with insulin resistance and dyslipidaemia may be dependent on the type of infant feeding (breast vs. formula).
- The transcript levels of the mentioned biomarkers could be useful to distinguish the formula-fed children who are at higher risk of metabolic alterations.

ifamily
Funded by the EC, FP 7, Project No. 266044 – Building on idefics study
SEVENTH FRAMEWORK PROGRAMME

• Pre-, peri- and postnatal risk factors

Bammann K, Peplies J, De Henauw S, Hunsberger M, Molnar D, Moreno LA, Tornaritis M, Veidebaum T, Ahrens W, Siani A; IDEFICS consortium.
Early Life Course Risk Factors for Childhood Obesity: The IDEFICS Case-Control Study. PLoS One. **2014** Feb 13;9(2):e86914

BACKGROUND: The early life course is assumed to be a critical phase for childhood obesity; however the significance of single factors and their interplay is not well studied in childhood populations.
OBJECTIVES: The investigation of pre-, peri- and postpartum risk factors on the risk of obesity.
METHODS: A case-control study with **1,024** 1:1-matched case-control pairs was nested in the baseline survey (09/2007–05/2008) of the IDEFICS study, a population-based intervention study on childhood obesity carried out in 8 European countries in pre- and primary school settings. Conditional logistic regression was used for identification of risk factors.

	Case-control pairs	
	N	**%**
Sex		
Girls	515	50.3
Boys	509	49.7
Age		
4–6 years	494	48.2
7–8 years	530	51.8
Total	**1,024**	**100**

RESULTS: For many of the investigated risk factors, we found a raw effect in our study. In multivariate models, we could establish an effect for gestational weight gain, smoking during pregnancy, Caesarian section, and breastfeeding 4 to 11 months. After additional adjustment for parental BMI and parental educational status, only gestational weight gain remained statistically significant. Both, maternal as well as paternal BMI were the strongest risk factors in our study, and they confounded several of the investigated associations.

Table 4. Multivariate models for pre-, peri- and postpartum risk factors on IOTF obesity risk.

	Model I			Model II		
	OR[ab]	95% CI	Wald	OR[ab]	95% CI	Wald
Gestational weight gain in kg	**1.02**	1.00–1.04	3. 827	**1.04**	1.01–1.07	8.717
Smoking during pregnancy	**1.48**	1.08–2.01	6.102	1.43	0.94–2.16	2.771
Caesarian section	**1.38**	1.10–1.74	7.558	1.17	0.87–1.57	1.015
Breastfeeding 4 to 11 months	**0.77**	0.62–0.96	5.415	0.83	0.62–1.11	1.552
Early introduction of solid foods	1.12	0.75–1.68	0.315	1.23	0.71–2.12	0.528
Maternal BMI				**1.16**	1.11–1.20	56.858
Paternal BMI				**1.11**	1.07–1.16	27.017
Parental educational level				0.92	0.81–1.04	1.686

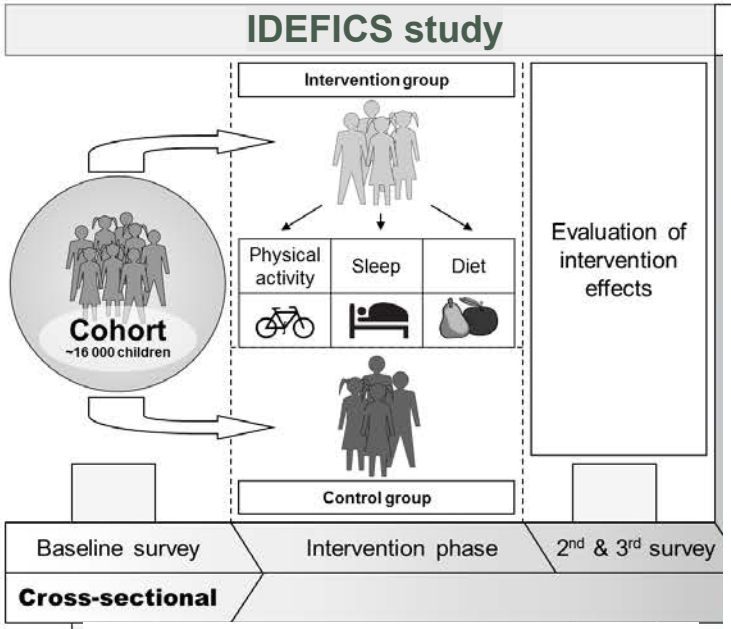
CONCLUSIONS: **Key risk factors of childhood obesity in our study are parental BMI and gestational weight gain**; consequently prevention approaches should target not only children but also adults. The monitoring of gestational weight seems to be of particular importance for early prevention of childhood obesity.

ifamily

Funded by the EC, FP 7, Project No. 266044 – Building on ideficsstudy

SEVENTH FRAMEWORK PROGRAMME

Longitudinal design of I.Family and concatenation with IDEFICS



www.idefics.eu

www.ifamilystudy.eu

Deter-minants	Diet	Physical activity	Sleep	SES	Genes	Biomarker	Environ. & family life
Assess-ment	FFQ 24h dietary recall	Quest. Accelero-meters	Quest.	Quest.	Saliva	Urine Blood	Parental quest. School quest. GIS

per child

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

Funded by the EC, FP 7, Project No. 266044 – Building on idefics study

In **IDEFICS**, we gratefully acknowledge the financial support of the European Community within the Sixth RTD Framework Programme, Contract No. 016181 (FOOD) - http://www.idefics.eu

In **I.Family**, we gratefully acknowledge the financial support of the European Community within the Seventh RTD Framework Programme Contract No. 266044 - http://www.ifamilystudy.eu