L’obesità non è tutta nei geni
Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults

NCD Risk Factor Collaboration (NCD-RisC)
Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults

NCD Risk Factor Collaboration (NCD-RisC)
Indagine Okkio alla Salute
Prevalenza obesità bambini 8-9 anni
persistence of obesity from childhood into adulthood

Total sample (%)

<table>
<thead>
<tr>
<th>Weight Status</th>
<th>Measurement in Adulthood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal weight</td>
<td>25</td>
</tr>
<tr>
<td>Over weight</td>
<td>35</td>
</tr>
<tr>
<td>Obese</td>
<td>40</td>
</tr>
</tbody>
</table>

Relative BMI at baseline (%)

- $r = -0.52$, $P < 0.01$

Maffeis C et al. J Clin Endocrinol Metab 2002;87:71-76
Body-Mass Index in 2.3 Million Adolescents and Cardiovascular Death in Adulthood


![Graph showing cumulative mortality from cardiovascular disease over years of follow-up, with BMI percentiles ranging from <5th to ≥95th.]

### No. at Risk

<table>
<thead>
<tr>
<th>Category</th>
<th>Participants at Risk</th>
<th>Cumulative person-yr</th>
<th>Cumulative cardiovascular deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants at risk</td>
<td>1,712,018</td>
<td>17,201,301</td>
<td>185</td>
</tr>
<tr>
<td>Cumulative person-yr</td>
<td>1,042,018</td>
<td>30,718,320</td>
<td>609</td>
</tr>
<tr>
<td>Cumulative cardiovascular deaths</td>
<td>540,636</td>
<td>38,472,521</td>
<td>1,577</td>
</tr>
<tr>
<td></td>
<td>160,145</td>
<td>41,926,636</td>
<td>2,676</td>
</tr>
</tbody>
</table>
Two-year Follow-up in 21,784 Overweight Children and Adolescents With Lifestyle Intervention

129 treatment centers

5 centers with the highest success rate

Reinehr T, et al Obesity 2009
Diagnosis, treatment and prevention of pediatric obesity: consensus position statement of the Italian Society for Pediatric Endocrinology and Diabetology and the Italian Society of Pediatrics

Consensus Conference su Diagnosi, Trattamento e Prevenzione dell’Obesità del Bambino e dell’Adolescente

- Diagnosi
- Comorbilità
- Terapia
- Prevenzione
Odds ratio to have the metabolic syndrome in subjects with a W/Hr >0.5 within normal-weight, overweight, and obese BMI categories

Childhood Obesity Group of the Italian Society of Pediatric Endocrinology & Diabetology

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>No</th>
<th>Yes</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal weight with W/Hr &lt;0.5</td>
<td>938</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>Normal weight with W/Hr &gt;0.5</td>
<td>13</td>
<td>1</td>
<td>4.01 (0.49-32.97)</td>
</tr>
<tr>
<td>Over weight with W/Hr &lt;0.5</td>
<td>132</td>
<td>10</td>
<td>3.34 (1.52-7.37) *</td>
</tr>
<tr>
<td>Over weight with W/Hr &gt;0.5</td>
<td>72</td>
<td>16</td>
<td>8.16 (3.87-17.23) **</td>
</tr>
<tr>
<td>Obese with W/Hr &gt;0.5</td>
<td>208</td>
<td>67</td>
<td>12.11 (7.08-20.71) **</td>
</tr>
</tbody>
</table>

W/Hr = waist/height ratio  * P < .05. ** P < .001.

Indicazioni operative

Misurate peso e statura e calcolare BMI

Confrontare il BMI con le tabelle di riferimento del BMI (WHO) per diagnosi di:
- Sottopeso
- Sovrappeso
- Obesità

Misurare la circonferenza della vita e calcolare il rapporto circonferenza/statura.
Se il rapporto è > 0,5 = rischio metabolico
Consensus Conference su Diagnosi, Trattamento e Prevenzione dell’Obesità del Bambino e dell’Adolescente

- Diagnosi
- Comorbilità
- Terapia
- Prevenzione
Complications of Childhood Obesity

Psychosocial
- Poor self esteem
- Depression
- Quality of life

Neurological
- Pseudotumor cerebri
- Risk for stroke

Cardiovascular
- Dyslipidemia
- Hypertension
- Left ventricular hypertrophy
- Chronic inflammation
- Endothelial dysfunction
- Risk of coronary disease

Pulmonary
- Asthma
- Sleep apnea
- Exercise intolerance

Renal
- Glomerulosclerosis
- Proteinuria

Gastrointestinal
- Pancreatitis
- Steatohepatitis
- Liver fibrosis
- Gallstones
- Risk for cirrhosis
- Risk for colon cancer

Musculoskeletal
- Forearm fracture
- Blount’s disease
- Slipped capital femoral epiphysis
- Flat feet
- Risk for degenerative joint disease

Endocrine
- Type 2 diabetes
- Precocious puberty
- Polycystic ovary syndrome (girls)
- Hypogonadism (boys)

Hernia

DVT/PE

Stress incontinence

Risk of GYN malignancy
Adolescent BMI Trajectory and Risk of Diabetes versus Coronary Disease

Incidence Trends of Type 1 and Type 2 Diabetes among Youths, 2002–2012

Impact of Severe Obesity on Cardiovascular Risk Factors in Youth

Predictors of the presence of CVRFC on follow-up

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR</td>
</tr>
<tr>
<td>Age</td>
<td>1.09</td>
</tr>
<tr>
<td>Baseline BMI category</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td></td>
</tr>
<tr>
<td>Class I</td>
<td></td>
</tr>
<tr>
<td>Class II</td>
<td></td>
</tr>
<tr>
<td>Class III</td>
<td>1</td>
</tr>
<tr>
<td>Class IV</td>
<td>1.03</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>1</td>
</tr>
<tr>
<td>African American</td>
<td>0.69</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.38</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.58</td>
</tr>
<tr>
<td>CVRFC at baseline</td>
<td>3.68</td>
</tr>
<tr>
<td>Time of follow-up</td>
<td>0.99</td>
</tr>
<tr>
<td>BMI percent change from baseline</td>
<td>1.03</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.23</td>
</tr>
</tbody>
</table>

Youth Overweight and Metabolic Disturbances in Predicting Carotid Intima-Media Thickness, Type 2 Diabetes, and Metabolic Syndrome in Adulthood: The Cardiovascular Risk in Young Finns Study

Gr. I: NW, no metab. dist.;
Gr II: NW, 1+ metab. dist.;
Gr. III: OW/Ob, no metab. dist.;
Gr. IV: OW/Ob, 1+ metab. dist.
BMI increase through puberty and adolescence is associated with risk of adult stroke

Gothenburg, Sweden
37,669 men born in 1945–61
BMI at age 8
BMI change through puberty and adolescence (BMI at age 20–BMI at age 8)
End follow-up December 2013

Change in Overweight from Childhood to Early Adulthood and Risk of Type 2 Diabetes

Fasting Plasma Glucose Levels Within the Normoglycemic Range In Childhood as a Predictor of Prediabetes and Type 2 Diabetes in Adulthood

The Bogalusa Heart Study

Maffeis C, et al.
Obesity. 2010;18:1437-42

Morandi A, et al.
Pediatr Obes. 2014;9:17-25

Di Bonito P, et al.
Risk factors for cardiovascular disease and type 2 diabetes retained from childhood to adulthood predict adult outcomes: the Princeton LRC Follow-up Study

John A Morrison¹, Charles J Glueck², Jessica G Woo¹ and Pino Wang²

Figure 1 Changes in TG status groups from childhood to adulthood by adult CVD status.

TG predicts CVD
The hyperbolic curves for NGT, IGM, and diabetes, assuming a slope of 1, are plotted for \( I_0 - 30/G_0 - 30 \) versus 1/fasting insulin.

Utzschneider KM et al Diab Care 32:335–341, 2009
The Shape of the Glucose Response Curve During an Oral Glucose Tolerance Test Heralds Biomarkers of Type 2 Diabetes Risk in Obese Youth

“IGT 1 -like” status in normoglucone tolerant obese children and adolescents: the additive role of glucose profile morphology and 2-hours glucose concentration during the oral glucose tolerance test
Indicazioni operative

Esami biochimici a digiuno
Glicemia > 100 mg/dL = alterata glicemia; > 125 mg/dL = diabete
Se 86-100 mg/dL predittore di diabete tipo 2 nel lungo termine

Trigliceridi > 100 mg/dL se <10 aa, poi > 130 mg/dL
HDL colestrolo < 40 mg/dL
LDL colesterolo > 130 mg/dL

Pressione arteriosa
>90° percentile (per sesso, età e altezza) = elevata
95° percentile (per sesso, età e altezza) = ipertensione

Steatosi epatica
Ecografia addome superiore
Consensus Conference su Diagnosi, Trattamento e Prevenzione dell’Obesità del Bambino e dell’Adolescente

- Diagnosi
- Comorbilità
- Terapia
- Prevenzione
NEUROENDOCRINE SYSTEM

GENE

ENVIRONMENT

BEHAVIOUR

NUTRIENT BALANCE

BODY COMPOSITION

Maffeis C, 2006
Loci associated with BMI, body fat percentage, waist-hip-ratio adjusted for BMI, VAT, SAT, and their ratio (VAT/SAT), and extremes of body mass index and waist-hip-ratio. *

Genes implicated in monogenic obesity are underlined.

Genetic and epigenetic variation influences gene expression.

the pathways by which gut hormones regulate energy homeostasis

Murphy KG & Bloom SR Nature 2006
Childhood and Adolescence Obesity: Principles of Treatment

Main Target → Change of behavior → Diet Exercise

drugs (?) surgery (?)

Open questions:
Motivation
Adherence
Efficacy
Maintenance
Primary Prevention of Cardiovascular Disease with a Mediterranean Diet Supplemented with Extra-Virgin Olive Oil or Nuts

Acute myocardial infarction, stroke, or death from cardiovascular causes

Foods related to the metabolic syndrome in two plant-based diets

↑ = increases the risk of MetS; ↓ = decreases the risk of MetS;  ? = uncertain relation to MetS

Sabaté J & Wien M. Br J Nutr 2015;113:S136-S143
Multivariable Odds Ratios (Ors) for significant youth predictors of adult metabolic syndrome (MetS).

<table>
<thead>
<tr>
<th>Predictor</th>
<th>OR (95% CI)</th>
<th>P value</th>
<th>$R^2$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI (kg/m$^2$)</td>
<td>1.61 (1.38–1.88)</td>
<td>&lt;0.0001</td>
<td>9.4</td>
</tr>
<tr>
<td>HDL cholesterol (mmol/L)</td>
<td>0.69 (0.60–0.80)</td>
<td>&lt;0.0001</td>
<td>4.0</td>
</tr>
<tr>
<td>Male sex (%)</td>
<td>1.77 (1.39–2.25)</td>
<td>&lt;0.0001</td>
<td>1.3</td>
</tr>
<tr>
<td>Triglycerides (mmol/L)</td>
<td>1.25 (1.11–1.40)</td>
<td>0.0002</td>
<td>1.1</td>
</tr>
<tr>
<td>Family history of hypertension (%)</td>
<td>1.60 (1.20–2.11)</td>
<td>0.001</td>
<td>0.8</td>
</tr>
<tr>
<td>Insulin (mU/L)</td>
<td>1.25 (1.10–1.42)</td>
<td>0.0008</td>
<td>0.7</td>
</tr>
<tr>
<td>Family history of diabetes (%)</td>
<td>1.87 (1.16–3.02)</td>
<td>0.01</td>
<td>0.5</td>
</tr>
<tr>
<td>Vegetable consumption (times/week)</td>
<td>0.86 (0.77–0.97)</td>
<td>0.02</td>
<td>0.3</td>
</tr>
<tr>
<td>Age in 1980 (years)</td>
<td>0.84 (0.72–0.98)</td>
<td>0.03</td>
<td>0.3</td>
</tr>
</tbody>
</table>
Microbiota-accessible carbohydrate fermentors produce SCFAs that can have multiple interactions with host tissues.

### Dietary intake and prospective changes in cardiometabolic risk factors in children and youth

**Association of dietary intake with prospective changes in cardiometabolic outcome among students participating in the Healthy Hearts Study.**

<table>
<thead>
<tr>
<th>Dietary intake at baseline</th>
<th>Multivariable model[^a]</th>
<th>Multivariable model[^a]</th>
<th>Univariate model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SBP z score, n = 310</td>
<td>DBP z score, n = 310</td>
<td></td>
</tr>
<tr>
<td>Dietary fat, per 10 g/d</td>
<td>0.03 (0.00004, 0.06)*</td>
<td>0.03 (0.003, 0.05)*</td>
<td></td>
</tr>
<tr>
<td>Vegetables and fruit, serving/d</td>
<td>-0.007 (-0.02, 0.008)</td>
<td>-0.002 (-0.01, 0.008)</td>
<td></td>
</tr>
<tr>
<td>Fibre, per 10 g/d</td>
<td>-0.03 (-0.12, 0.04)</td>
<td>0.02 (-0.04, 0.07)</td>
<td></td>
</tr>
<tr>
<td>Milk, serving/d</td>
<td>-0.009 (-0.04, 0.02)</td>
<td>0.003 (-0.02, 0.02)</td>
<td></td>
</tr>
<tr>
<td>Sodium, g/d</td>
<td>0.008 (-0.03, 0.05)</td>
<td>0.04 (0.006, 0.07)*</td>
<td></td>
</tr>
<tr>
<td>Added sugar, per 10 g/d</td>
<td>-0.001 (-0.01, 0.01)</td>
<td>0.002 (-0.007, 0.01)</td>
<td></td>
</tr>
<tr>
<td>BMI z score, n = 330</td>
<td>0.009 (-0.006, 0.02)</td>
<td>0.31 (0.08, 0.58)*</td>
<td></td>
</tr>
<tr>
<td>WC, n = 310</td>
<td>-0.002 (-0.008, 0.005)</td>
<td>-0.04 (-0.17, 0.08)</td>
<td></td>
</tr>
<tr>
<td>ISS[^b], n = 232</td>
<td>0.02 (-0.02, 0.05)</td>
<td>-0.25 (-0.93, 0.44)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.004 (-0.01, 0.02)</td>
<td>0.15 (-0.14, 0.43)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.003 (-0.02, 0.02)</td>
<td>-0.03 (-0.45, 0.38)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.002 (-0.004, 0.007)</td>
<td>-0.08 (-0.20, 0.03)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.07 (-0.02, 0.17)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Values are β (95% confidence interval). BMI, body mass index; DBP, diastolic blood pressure; ISS, Insulin Sensitivity Score; SBP, systolic blood pressure; WC, waist circumference. *, P < 0.05; **, P < 0.01.

[^a]: Multivariable mixed effect analysis of each dietary component with SBP, DBP, BMI, and WC. Model with SBP and DBP as outcome variables were controlled for baseline values of BMI z score, physical activity, and SBP or DBP. Model with SBP as outcome variable was also adjusted for the year of participation in the study. The model with WC as outcome was adjusted for age, sex, and baseline values for BMI z score, WC, and physical activity whereas the model with BMI as outcome was adjusted for baseline values of BMI z score and physical activity.

[^b]: ISS was measured noninvasively using the 13C glucose breath test.

---

Fat mass (%) vs lipid intake (% of energy intake)

- Fat mass increases with lipid intake.
- Correlation coefficient: $r = 0.28$, $P < 0.01$

Key:
- Fatty food: more palatable, high energy density, less satiating

References:
- Klesges RC et al. AJCN ‘94
- Gazzaniga JM, et al. AJCN ‘93
Postprandial triacylglycerol profile after two isocaloric, isoproteic meals with different fat and carbohydrate content in obese children

Maffeis C, et al. Obesity 2010
POSTPRANDIAL PRO-ATEROGENIC PROFILE:
change of oxidized lipoprotein concentration in obese children after two isocaloric, isoproteic meals with a different fat and carbohydrate content

Relation between increasing intakes of trans, saturated, unsaturated, monounsaturated, and polyunsaturated fatty acid (compared isocalorically with carbohydrate) in relation to total mortality.

Data are based on 126,233 men and women followed for up to 32 years, with assessments every 4 years (Wang et al. JAMA 2016;176:1134-45). The strong inverse association with polyunsaturated fatty acids was primarily due to N-6 polyunsaturated fatty acids; associations with N-3 polyunsaturated fatty acids were weaker.

Joint classification of whole- and refined-grain intake on visceral adipose tissue (VAT) volume

Dietary carbohydrate intake and mortality: a prospective cohort study and meta-analysis

U-shaped association between percentage of energy from carbohydrate and all-cause mortality in the ARIC and PURE cohort studies

46.3%
Mean values of cardiovascular risk score through the groups of adherence to a MedDiet (Low adherence vs. High adherence), cardiorespiratory fitness (Low CRF vs. High CRF), and muscular fitness (Low MF vs. High CRF).

Bars represent adjusted means and 95% confidence intervals, for age, sex, pubertal stage and country, as confounders.

Efficacy of a 12 Weeks Exercise Program without Diet in Reducing Obesity in Men

Exercise: brisk walking/light jogging, 80% max HR, 700 kcal/day.

Body weight (kg)
Waist circumference (cm)
Body fat (kg)
Subcutaneous abdominal fat (kg)
Visceral abdominal fat (kg)
VO\(^2\)max (L/min)

Age-Specific Exercise Capacity Capacity Threshold for Mortality Risk Assessment in Male Veterans

*adjusted for: age, blood pressure, race, site, beta-blockers, calcium channel blockers, ACE inhibitors angiotensin receptor blockers, Aspirin, diuretics, lipid-lowering agents, history of smoking, history of CVD, T2DM, muscle-wasting disease, alcohol/drug abuse, dyslipidemia, hypertension, and year of entry in the study.

Leisure-Time Running Reduces All-Cause and Cardiovascular Mortality Risk In a 15-year follow-up

Leisure-Time Running Reduces All-Cause and Cardiovascular Mortality Risk In a 15-year follow-up

Running, even 5 to 10 min/day and at slow speeds <6 miles/h, is associated with markedly reduced risks of death from all causes and cardiovascular disease

## Fitness vs. Fatness on All-Cause Mortality: A Meta-Analysis

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Hazard Ratio (HR)</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal weight unfit vs Normal weight fit individuals</td>
<td>2.42</td>
<td>1.96-2.99</td>
</tr>
<tr>
<td>Overweight unfit vs Normal weight fit individuals</td>
<td>2.14</td>
<td>1.77-2.58</td>
</tr>
<tr>
<td>Overweight fit vs Normal weight fit individuals</td>
<td>1.13</td>
<td>1.00-1.27</td>
</tr>
<tr>
<td>Obese unfit vs Normal weight fit individuals</td>
<td>2.46</td>
<td>1.92-3.14</td>
</tr>
<tr>
<td>Obese fit vs Normal weight fit individuals</td>
<td>1.21</td>
<td>0.95-1.52</td>
</tr>
<tr>
<td><strong>Moderate-intensity Physical Activity</strong> (Approximately 3-6 METs)</td>
<td><strong>Vigorous-intensity Physical Activity</strong> (Approximately &gt;6 METs)</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
<td>---------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Requires a moderate amount of effort and noticeably accelerates the heart rate.</td>
<td>Requires a large amount of effort and causes rapid breathing and a substantial increase in heart rate.</td>
<td></td>
</tr>
<tr>
<td><strong>Examples of moderate-intensity exercise include:</strong></td>
<td><strong>Examples of vigorous-intensity exercise include:</strong></td>
<td></td>
</tr>
<tr>
<td>• Brisk walking</td>
<td>• Running</td>
<td></td>
</tr>
<tr>
<td>• Dancing</td>
<td>• Walking / climbing briskly up a hill</td>
<td></td>
</tr>
<tr>
<td>• Gardening</td>
<td>• Fast cycling</td>
<td></td>
</tr>
<tr>
<td>• Housework and domestic chores</td>
<td>• Aerobics</td>
<td></td>
</tr>
<tr>
<td>• Traditional hunting and gathering</td>
<td>• Fast swimming</td>
<td></td>
</tr>
<tr>
<td>• Active involvement in games and sports with children / walking domestic animals</td>
<td>• Competitive sports and games (e.g. Traditional Games, Football, Volleyball, Hockey, Basketball)</td>
<td></td>
</tr>
<tr>
<td>• General building tasks (e.g. roofing, thatching, painting)</td>
<td>• Heavy shovelling or digging ditches</td>
<td></td>
</tr>
<tr>
<td>• Carrying / moving moderate loads (&lt;20kg)</td>
<td>• Carrying / moving heavy loads (&gt;20kg)</td>
<td></td>
</tr>
</tbody>
</table>

WHO, 2015
Indicazioni operative

Allattamento al seno
Colazione
Pasti consumati in famiglia (vs Fast Food)
Alimentazione bilanciata in nutrienti (RDA)
Frutta e vegetali, Fibra
Densità energetica dei cibi e dei pasti
Porzioni
Bevande zuccherate
Video-esposizione
Attività fisica (>60 min/giorno di attività moderata/intensa)
PDTA Obesità Pediatrica

Modello di rete: Hub & Spoke

I livello: Pediatra di Famiglia / Medico di Medicina Generale
II livello: Equipe multidisciplinare
III livello: Centro Specializzato Obesità Pediatrica
PDTA - Percorsi Diagnostici-Terapeutici Assistenziali

PDTA OBESITA' PEDIATRICA: approvato dal Comitato Direttivo SIEDP in data 26/02/2018
Consensus Conference su Diagnosi, Trattamento e Prevenzione dell’Obesità del Bambino e dell’Adolescente

- Diagnosi
- Comorbilità
- Terapia
- Prevenzione
fetal & perinatal programming

healthy mother
optimal maternal nutrition
good placental function
other maternal abnormalities
alcohol, smoking
Maternal undernutrition, obesity, diabetes, ...
poor placental function

adequate fetal nutrition
inadequate fetal nutrition

optimal fetal growth

domestic energy expenditure

PREGNANCY

LACTATION

low plane of post-natal nutrition

thin adult
obese adult

Programming:
Appetite
Growth
Hormonal milieu
Energy expend.

high birth weight
low birth weight
post-natal overnutrition

Maternal undernutrition, obesity, diabetes, ...

parental and perinatal factors associated with childhood obesity in north-east Italy

“... When parental and perinatal variables were included as independent variables in a multiple logistic regression model controlling for the effect of age, parental body mass index and children's birth-weight remained independently associated with childhood obesity. “

Fattori di rischio di obesità

Peso alla nascita

Peso a termine (kg)

2.5

4.5
Velocità di crescita primo anno

Lunghezza (cm)

Peso (kg)
Prevention of Obesity in Toddlers (PROBIT): a Randomised Clinical Trial of Responsive Feeding Promotion from Birth to 24 Months


Scaligera Local Health and Social Care Service, Verona (I)
Polesana Local Health and Social Care Service, Rovigo (I)
Dolomiti Local Health and Social Care Service, Belluno (I)
Euganea Local Health and Social Care Service, Padua (I)
Berica Local Health and Social Care Service, Vicenza (I)
Pediatric Diabetes and Metabolic Disorders Unit, University of Verona, (I)

International Journal Obesity 2019 (in press)
Prevention of Obesity in Toddlers (PROBIT): a Randomised Clinical Trial of Responsive Feeding Promotion from Birth to 24 Months

22 Paediatricians recruited

Randomization and allocation

11 to the control arm

270 newborns assessed for eligibility

267 newborns enrolled

251 infants underwent the 1st year well visit

216 toddlers underwent the 2nd year well visit at the appropriate age

16 moved to other towns

35 underwent the 2nd year well visit before 21 months of age

252 toddlers underwent the 2nd year well visit at the appropriate age

11 to the intervention arm

299 newborns assessed for eligibility

295 newborns enrolled

278 infants underwent the 1st year well visit

17 moved to other towns

26 underwent the 2nd year well visit before 21 months of age

11 to the control arm

270 newborns assessed for eligibility

267 newborns enrolled

251 infants underwent the 1st year well visit

216 toddlers underwent the 2nd year well visit at the appropriate age

16 moved to other towns

35 underwent the 2nd year well visit before 21 months of age

252 toddlers underwent the 2nd year well visit at the appropriate age

4 excluded for chronic disease

3 excluded for chronic disease

299 newborns assessed for eligibility

295 newborns enrolled

278 infants underwent the 1st year well visit

17 moved to other towns

26 underwent the 2nd year well visit before 21 months of age

252 toddlers underwent the 2nd year well visit at the appropriate age

11 to the control arm
Exclusive breastfeeding, what the baby needs in the first months!

Dear Parents,

Exclusive breastfeeding is what your baby needs to grow well in the first few months of life and it means to introduce only milk without adding any other solid or liquid food. Mother’s milk is the best food but, failing that, you can choose baby formula milk, that is prepared specifically to resemble breast milk. There's a wide range of different formula brands and types. If your child is not breastfed, ask your Pediatrician for advice on which formula might be appropriate for your child.

Both breastfeeding and formula feeding should follow the "requests" of the child and should not take place at fixed times and with fixed amounts. Thus it is important to understand when the child is hungry and when he is satisfied with the feed (breast or bottle), without ever forcing her/him. For example, if she/he’s fed with formula, do not try to force her/him to finish the bottle you have prepared. If you are afraid that your baby will not eat enough, ask your Pediatrician for advice. If the child grows well, she/he will reassure you.

Try to interpret your baby’s crying. Not all crying means that she/he is hungry! Especially if she/he has eaten less than three hours ago, it is possible that she/he cries because she/he’s bored or scared or disturbed by something. Before deciding to feed her/him, try to console her/him like this:

- change the diaper (if dirty)
- swaddle her/him in a wrap can help her/him to feel "warm" and "secure"
- lull your baby
- make her/him listen sounds that could calm her/him

Avoid drinks such as teas, fennel tea, etc...

Do not give her/him anything solid at least until the fourth month and start weaning when your Pediatrician recommends it.
Complementary feeding: a wonderful adventure!!

Dear Parent,

The complementary feeding is the introduction of foods other than milk, that however continues to be an important part of your child’s diet. It provides the energy, protein, iron, zinc and vitamins amounts needed for a healthy growth, when the milk is not enough anymore. The introduction of complementary feeding is also a magic moment for the sensorineural and psychological development of your child! It requires time and patience because it must be slow and gradual.

Here is a sort of “decalogue” of the complementary feeding, before moving to “how it should be done”:

- do not make your child feel any tension, favor a pleasant and calm atmosphere, offer new foods as something good, not as something to eat by force;
- don’t be surprised if your child split a new food, is expected. Don’t be discouraged and go on offering new foods without getting angry. Don’t show any disappointment;
- introduce new foods one by one;
- always use baby cutlery and baby plate sets;
- do not force your child if she/he does not clean the plate and do not reward her/him for finishing the dish: if your child grows up correctly according to the paediatrician despite she/he always leaves something in the plate, it means she/he needs a little less food than you expect. The good reaction is to prepare a little smaller portions;
- always keep the television off during the meals, and try to avoid television completely during the first two years of life!
- don’t give your child soda drinks or juices or tisanes or anything different from water. Water is the only thing she/he needs for her/his thirst!
- Don’t add salt to foods;
- Don’t add sugar too!
- Between meals stimulate you child to move, playing with you and exploring all around! Don’t let your child spend more than one hour without moving, except during sleep.

How to do the complementary feeding? ...

- Start when your pediatrician suggest you to start;
- Before the very first soup, you can make her/him taste fruits! Use commercial homogenized fruits for children without added sugar or vanilla, or chop completely an apple or a pear and give her/him 3-4 tea spoons when you prefer, for example in the afternoon ... this way she/he begins to get familiar with the spoon!
- When the moment of the first broth arrives, at the beginning prepare it with carrot, potato and courgette, boiled for 40 minutes in 1 liter of water. You can replace this by a commercial sachet of 8 grams of lyophilized vegetables to put in warm water (check the soup temperature before giving it to your child!). Add 1 teaspoon of olive oil and 3 spoons of rice or cereals cream to a about 180-200 ml of vegetable broth. The remaining vegetable broth can be kept in the fridge for 24 hours (figure on page 3). It should be better not to add any parmesan, but if you want you can add a very little spoon.
- After about one week, you can add the sources of proteins, either mixed to the broth + cereals or separately: 3 teaspoons of chopped meat or fish or ½ pot of homogenized meat or fish or 1-2 spoons of cream of beans or peas or peeled lentils or 20-30 grams of fresh cheese or baby cheese or 1 small cube or 1 spoon of parmesan or ½ egg yolk. Slowly and gradually you can add to the broth + cereals the shaled vegetables (those used for the broth or any commercial baby vegetable soup) (figures on pages 4-6).
- As far as she/he takes only one solid meal per day, go on breast feeding on demand or give her/him the formula milk on demand. However, for formula fed babies, remind that if the child takes one solid meal per day she/he needs about 750 ml of milk per day, but less could be enough. Thus, if your formula fed baby takes less than 750 ml per day of milk and grows up well, do not worry or ask your pediatrician for reassurance!
- Also the above-mentioned amounts of soup and protein containing foods could be too much for your child. Thus, if she/he doesn’t clean the plate and grows up well, do not worry or ask your pediatrician for reassurance ...
- Do not give your child cow milk but only breast milk or formula milk and, if she/he uses the bottle, never add anything to the milk (for example biscuits).
- Go to page 7 for the following “episodes”...
Prevention of Obesity in Toddlers (PROBIT): a Randomised Clinical Trial of Responsive Feeding Promotion from Birth to 24 Months

Adapted from “Atlante fotografico delle porzioni degli alimenti. Milano: Istituto Scotti Bassani, 2005.”

### Prevention of Obesity in Toddlers (PROBIT): a Randomised Clinical Trial of Responsive Feeding Promotion from Birth to 24 Months

#### Comparisons between the Two PROBIT Arms from 3 to 12 Months of Age

<table>
<thead>
<tr>
<th></th>
<th>Control Arm</th>
<th>Intervention Arm</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight-3 (grams)</td>
<td>5,860(738)</td>
<td>5,925(738)</td>
<td>0.37</td>
</tr>
<tr>
<td>Length-3 (cm)</td>
<td>60.0(2.5)</td>
<td>60.7(2.5)</td>
<td>0.002</td>
</tr>
<tr>
<td>W/L-3 (ratio)</td>
<td>97.9(13)</td>
<td>97.9(13)</td>
<td>0.98</td>
</tr>
<tr>
<td><strong>Breastfeeding-3 (yes/total)</strong></td>
<td>189/264 (71.5%)</td>
<td>226/286 (79.0%)</td>
<td>0.043*</td>
</tr>
<tr>
<td><strong>Exclusive-BF-3 (yes/total)</strong></td>
<td>138/264 (52.2%)</td>
<td>174/286 (60.8%)</td>
<td>0.043*</td>
</tr>
<tr>
<td><strong>Feeding-on-demand-3 (yes/total)</strong></td>
<td>213/264 (80%)</td>
<td>267/287 (93%)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Weight-6 (grams)</td>
<td>7,698(885)</td>
<td>7,867(4,562)</td>
<td>0.55</td>
</tr>
<tr>
<td>Length-6 (cm)</td>
<td>67.7(2.4)</td>
<td>67.8(2.5)</td>
<td>0.85</td>
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<tr>
<td>W/L-6 (ratio)</td>
<td>115.7(14.5)</td>
<td>116.1(18.0)</td>
<td>0.92</td>
</tr>
<tr>
<td><strong>Breastfeeding-6 (yes/total)</strong></td>
<td>144/262 (54.9%)</td>
<td>178/286 (62.2%)</td>
<td>0.08</td>
</tr>
<tr>
<td>Age of solids introduction (months)</td>
<td>5.2 (0.5)</td>
<td>5.4 (0.7)</td>
<td>0.55</td>
</tr>
<tr>
<td>Weight-12 (grams)</td>
<td>9,881(1,092)</td>
<td>9,830(1,177)</td>
<td>0.60</td>
</tr>
<tr>
<td>Length-12 (cm)</td>
<td>76.7(2.7)</td>
<td>76.5(2.7)</td>
<td>0.35</td>
</tr>
<tr>
<td>W/L-12 (ratio)</td>
<td>128.6(11.7)</td>
<td>128.2(13.0)</td>
<td>0.72</td>
</tr>
<tr>
<td>Cow Milk-12 (yes/total)</td>
<td>31/251 (12.3%)</td>
<td>44/278 (15.8%)</td>
<td>0.26</td>
</tr>
<tr>
<td>Overweight (yes/total)</td>
<td>52/251 (20.7%)</td>
<td>60/278 (21.5%)</td>
<td>0.89</td>
</tr>
</tbody>
</table>

comparisons between the two PROBIT arms at 2 years of age

Prevalence of obesity (%)

<table>
<thead>
<tr>
<th>Intervention Group (n=252)</th>
<th>Control Group (n=216)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P=0.10</td>
<td></td>
</tr>
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</table>

Conclusions

The PROBIT trial was not effective in significantly decreasing the general population prevalence of overweight/obesity at two years of age.

However, it did demonstrate that an educational programme entirely based on the routine pediatric follow-up visits provided by a public healthcare system is well accepted by families and effective in increasing the adoption of protective feeding behaviours during the first year of life.
L’obesità è la malattia metabolica più comune nel bambino come nell’adulto.

La prevenzione dell’obesità deve iniziare il prima possibile (vita fetale, primi 1000 giorni di vita) e proseguire per tutta l’età evolutiva.

La diagnosi di sovrappeso è già sufficiente per la prescrizione del trattamento.

Nutrizione e attività fisica sono gli strumenti principali della terapia.

La rete per l’obesità pediatrica, organizzata su tre livelli (PDTA), è il setting di cura ideale per un assistenza adeguata che vede nell’equipe multidisciplinare l’elemento irrinunciabile alla sua realizzazione.
GRAZIE