Childhood overweight and obesity – identifying early risk factors

Akademisk avhandling

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This thesis is based on the following papers, referred to in the text by their Roman numerals:

I **Population-based waist circumference and waist-to-height ratio reference values in preschool children**
Josefine Roswall, Stefan Bergman, Gerd Almqvist-Tangen, Bernt Alm, Aimon Niklasson, Andreas F M Nierop, Jovanna Dahlgren
Acta Paediatr. 2009:98(10):1632-36

II **Preschool children born moderately preterm have increased waist circumference at two years of age despite low body mass index**
Josefine Roswall, Ann-Katrine Karlsson, Kerstin Allvin, Gerd Almqvist-Tangen, Stefan Bergman, Aimon Niklasson, Bernt Alm, Jovanna Dahlgren
Acta Paediatr. 2012:101(11):1175-81

III **Low levels of osteocalcin and vitamin D at birth predispose for obesity and impaired insulin sensitivity in early childhood**
Josefine Roswall, Stefan Bergman, Gerd Almqvist-Tangen, Bernt Alm, Jovanna Dahlgren
Submitted to J Clin Endocrinol Metabol

IV **Establishment of the human gut metagenome**
Fredrik Bäckhed, Josefine Roswall, Penquin Yang, Valentina Tremaroli, Petia Kovatcheva-Datchary, Qiang Feng, Stefan Bergman, Karsten Kristiansen, Jovanna Dahlgren*, Wang Jun* (*contributed equally)
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Abstract

Background: The incidence of childhood obesity is increasing. Many children become obese during preschool years and stay obese, with lifelong health consequences, such as impaired insulin sensitivity. There is growing evidence that factors during intrauterine life and infancy influence the risk of developing obesity. The aim was to describe early factors in infancy related to childhood obesity.

Research questions: Is waist circumference an auxological variable to be used in early childhood and is this variable related to early metabolic markers? Can biomarkers of bone and nutrition during infancy predict the development of childhood obesity and insulin resistance? How is the gut microbiota established during infancy and influenced by nutrition? Is any gut microbiota pattern during infancy associated with subsequent weight gain or the development of childhood obesity?

Methodology:

Paper 1: A cross-sectional population-based study comprising 4,500 children aged 0-5 years were followed at the child health clinic (CHC) in the County of Halland in 2006. Data on height, weight and waist circumference (WC) were collected from 6-60 months. Reference curves for WC were developed using the Box-Cox-power exponential (BCPE) distribution.

Paper 2: Waist circumferences and BMI were investigated in moderately preterm preschool children (n=154), a group known to have increased risk of impaired insulin sensitivity.

Paper 3 and 4: 388 healthy children were followed from birth to three years of age. Blood and stool samples were collected (cord, at 4, 12 and 36 months). Parents filled in questionnaires regarding hereditary, social factors and feeding preferences and anthropometric data was collected at the CHC. Fecal samples (n=100 at birth, 4 and 12 months) were analyzed with whole genome shotgun sequencing.

Results: Swedish reference curves for WC and waist to height ratio for preschool children were constructed and found comparable to contemporary curves from Germany. Waist to height ratio declined from birth and reached a mean less than 0.5 first at five years of age. A cohort of moderately preterm children was compared to the new reference curves and were found to have an increased WC at 2 years of age despite being lean. In healthy children, multivariate regression analysis showed that neonatal levels of osteocalcin and vitamin D were predictors of body composition at three years of age. Early feeding patterns influenced levels of bone markers and BMI development. The early development of gut microbiota in 100 of the above mentioned children was described from birth to 12 months and compared with the gut microbiome of the mother. The gut microbiota evolved from low abundance to a more adult-like microbiota at one year of age and the early establishment was influenced by feeding patterns.

Conclusion: We investigated the longitudinal development of obesity and found that early nutrition correlated to factors like gut microbiota, bone markers, insulin and leptin sensitivity as well as BMI and WC in early childhood.

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