

1 Introduction

Overweight and obesity are major global public health problems in all age groups. Worldwide, 41 million children under the age of 5 years were estimated to be overweight or obese in 2016, and it is steadily increasing¹. In Denmark, overweight and obesity are prevalent in all age groups, with 2.6% of children aged 6-8 years being obese². This percentage increase with older age groups and 16.8% of Danish adults are obese. However, Denmark is among the countries in Europe with the lowest prevalence of overweight and obesity among children aged 6-9 years³.

Infant overweight and obesity are related to both short- and long-term health problems, as adiposity in early life is consistently found to track into later childhood and adulthood^{4,5}. Early life has been widely recognised as a crucial time for prevention of later overweight and obesity^{1,6,7}. Development of childhood overweight and obesity cannot be attributed to a single factor. Thus, it is recognised as a multifactorial problem and several factors, such as maternal pre-pregnancy body mass index (BMI), maternal gestational diabetes, high infant birth weight, and rapid weight gain in infancy play a role in the development of overweight and obesity in childhood^{8,9}.

Breastfeeding promotion is part of the early preventive strategy against overweight and obesity, as breastfeeding has been suggested to modify the risk of obesity in children, adolescence and adults^{10,11}. Breastfed (BF) infants have a more healthy growth pattern during infancy than formula fed (FF) infants characterized by an overall slower growth¹². This is suggested to be part of the reason why breastfeeding is protecting against later overweight and obesity, since rapid weight gain in infancy is consistently found to be a risk factor of later overweight and obesity^{7,13}.

Even though exclusively BF (EBF) infants on average have a slower growth than FF infants, some infants have an excessive weight gain in the first 6 months of life during EBF. However, not much is known about causes and consequences of this abnormal weight gain in some infants, as the literature on this group of infants is sparse. Therefore, health personnel lack evidence on which to base advice to parents with EBF infants with excessive weight gain. A general belief among health personnel is that obese EBF infants will outgrow their adiposity

as they become toddlers. However, this may not be true for all infants with excessive weight gain when EBF.

A better understanding of human milk (HM) composition and growth trajectories in infants with excessive weight gain is important for developing early obesity prevention strategies. This PhD thesis and its three included papers explore some of these knowledge gaps within the research of excessive weight gain during exclusive breastfeeding.

1.1 Objectives

The overall aim of the thesis was to explore factors influencing the excessive weight gain observed in some special cases of BF infants and to discuss potential consequences. This aim led to a case-report of two EBF infants with excessive weight gain (Paper I) and establishment of the SKOT-III cohort, which included a group of EBF infants with excessive weight gain and a group of EBF infants with normal weight gain for comparison (Paper II-III).

Specific objectives were:

- To explore potential factors associated with excessive weight gain during exclusive breastfeeding which could have a role in development of the excessive weight gain.
- To examine how growth and body composition of EBF infants with excessive weight gain develop from birth to 18 months compared to infants with normal weight gain.
- To examine HM intake and composition, breastfeeding characteristics, serum concentration of hormones and metabolic parameters in infants with excessive weight gain compared to infants with normal weight gain.
- To investigate differences between HM oligosaccharide patterns in milk received by infants with excessive gain and infants with normal weight gain.