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Introduction of complementary feeding before 4 months of age increases the risk of childhood overweight or obesity: a meta-analysis of prospective cohort studies

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ABSTRACT

The association between the age at introduction of complementary feeding and the risk of overweight or obesity during childhood has been hotly debated, but the result remains uncertain. This meta-analysis of prospective cohort studies attempted to evaluate this association, as well as provide evidence for infant feeding recommendations. The PubMed, Embase, and Cochrane databases were systematically searched for relevant original articles published prior to March 1, 2015 that met predefined inclusion criteria. The pooled relative risks (RRs) and corresponding 95% confidence intervals (CIs) were calculated using fix-effect or random-effect models, which were chosen based on heterogeneity among studies. Ten articles consisting of 13 studies, where 8 measured being overweight as an outcome and 5 measured being obese, were included in this meta-analysis. There were a total of 63,605 participants and 11,900 incident cases in the overweight studies, and 56,136 individuals and 3246 incident cases in the obese studies. The pooled results revealed that introducing complementary foods before 4 months of age compared to at 4 to 6 months was associated with an increased risk of being overweight (RR, 1.18; 95% CI, 1.06-1.31) or obese (RR, 1.33; 95% CI, 1.07-1.64) during childhood. No significant relationship was observed between delaying introduction of complementary foods after 6 months of age, and being overweight (RR, 1.01;

Abbreviations: RR, relative risk; CI, confidence interval; WHO, World Health Organization; BMI, body mass index; IOTF, International Obesity Task Force; SD, standard deviation; SE, standard error.

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95% CI, 0.90-1.13) or obese (RR, 1.02; 95% CI, 0.91-1.14) during childhood. The results of this study suggest that the introduction of complementary foods to infants before 4 months of age should be avoided to protect against childhood obesity.

1. Introduction

Children overweight and obesity are recognized as a major public health problem worldwide [1]. According to the World Health Organization (WHO) data covering 144 countries, the worldwide prevalence of overweight and obesity in preschool children aged 0 to 5 years old increased from 4.2% in 1990 to 6.7% in 2010 [2] and is projected to reach 9.1% (about 60 million) by 2020 [2]. An estimated 31.8% of 2- to 19-year-old Americans in 2011 to 2012 and 20% of school-aged children in the European Union in 2010 to 2011 were overweight or obese [3,4]. In China, the prevalence of general obesity (including overweight) increased significantly from 6.1% in 1993 to 13.1% in 2009 among children and adolescents aged 6 to 17 years old [5]. Being overweight and/or obese during childhood tends to be accompanied by metabolic syndromes, hypertension or dyslipidemia, and predicts the risk of diabetes mellitus, stroke, coronary artery disease and several cancers later in life [6–8]. Thus, it is important to assess the potential risk factors for being overweight and obese as a child.

In recent years, evidence has accumulated suggesting that early complementary feeding may be one risk factor for childhood overweight and obesity [9–18]. Complementary feeding is defined as giving infants food and liquid in addition to formula and/or breast milk, when breast milk and/or formula alone no longer meet the nutritional requirements of the infant [19,20]. The age recommended to start complementary feeding varies based on country, although WHO issued a global recommendation in 2001 that infants should be exclusively breastfed for the first 6 months of life and then complementary foods should be introduced at this time [21]. Several observational studies reported that early introduction of complementary feeding increased the risk of childhood overweight or obesity [9–18]. However, the association was not observed in other related studies [22–24]. Recently, 2 systematic literature reviews were published focusing on this possible association [25,26]. However, these reviews failed to find a clear association between these parameters. This was likely due to heterogeneity from the differences in study design, age when outcomes were measured, and types of outcome (body mass index [BMI], body weight, body composition, overweight or obesity) determined in the studies included in the analyses. In the present study, we hypothesize that early introduction of complementary feeding increases the risk of childhood overweight or obesity and late introduction decreases the risk. To test this hypothesis, a meta-analysis of published studies was performed using inclusion criteria that differed from the aforementioned systematic reviews and, thus, included data from prospective cohort studies that provided RRs with 95% CIs and reported the outcome as overweight or obesity based on a specified definition.

2. Methods and materials

2.1. Search strategy

A literature search was performed for prospective cohort studies published before March 1, 2015 concerning the association between the age at introduction of complementary food and the risk of becoming overweight and/or obese during childhood on the PubMed (Medline), Embase and Cochrane databases. The PubMed search terms used were "("infant" OR "baby") AND ("solid food" OR "complementary food" OR "complementary feeding") AND ("overweight" OR "body mass index" OR "BMI" OR "body weight" OR "weight" OR "obese" OR "obesity")", and similar search terms were used for the Embase and Cochrane databases. The references from relevant primary papers and review articles were searched to identify additional relevant studies. The design, implementation, analysis, and reporting of this meta-analysis were performed in accordance with the Meta-Analysis of Observational Studies in Epidemiology (MOOSE) protocol [27].

2.2. Study selection

The criteria necessary for studies to be included in this meta-analysis consisted of having a prospective study design, a focus on the age at introduction of complementary or solid food, occurrence of children aged 2 to 12 years being overweight or obese as a quantified outcome, all measurements related to outcome taken by health professionals or trained investigators rather than self-reported, and RRs for being overweight and obese calculated with 95% CIs for at least 2 quantitative ages at which solid food was introduced or provided the original data allowing calculation of these estimates. Any retrospective, cross-sectional, non-human, and/or non-primary (eg, reviews, editorials, protocols, letters and guidelines) studies were excluded. Furthermore, studies that failed to report the incidence of participants being overweight or obese as an outcome or the age at introduction of complementary feeding as an exposure, or included pre-term infants and infants with conditions that can influence growth were excluded. Fig. 1 illustrates the study selection process.

2.3. Data extraction

Data extraction was carried out independently by 2 authors (Yuanjue Wu and Rui Liu) using a standard extraction form. The following information was mined from each study that met the selection criteria: basic information (ie, the first author, year of publication, and country of the study conducted), study characteristics (number of participants, number of cases and length of follow-up), outcomes (being overweight or obese), definitions of outcome, and categories of age at introduction of complementary foods and RRs