Complementary Feeding and Childhood Adiposity in Preschool-Aged Children in a Large Chinese Cohort

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Objective To examine the association between the timing and type of complementary feeding and childhood adiposity in Mainland China.

Study design During 1999-2009, 97 424 singletons were enrolled in the Jiaxing Birth Cohort, a population-based prospective cohort study in Southeast China. Of these children, 43 848 children provided complementary diet information and other anthropometric measurements at 1, 3, and 6 months of age and were followed up until 4-5 years of age. Obesity and overweight were identified as body mass index (BMI)-for-age z-score (SD) ≥2 and between 1 and 2, respectively.

Results Among 40 510 children in the statistical analysis, 3.18% were overweight and 64.8% were fed complementary food before 3 months of age. Early introduction of complementary foods was associated with greater BMI z-score (*P*-trend < .001) and higher risk of overweight (*P*-trend = .033). Compared with introduction of complementary foods between 4-6 months of age, before 3 months of age of introduction was associated with 11% greater risk of overweight (OR 1.11, 95% CI 1.03-1.19). No significant association between timing of complementary feeding and obesity was observed. Fish liver oil was the major type of complementary food associated with adiposity. Early introduction of fish liver oil was associated with greater BMI z-score (*P* < .001) and greater risk of overweight (*P*-trend = .004).

Conclusions Early introduction of fish liver oil is associated with greater childhood BMI and risk of overweight in Chinese children at 4-5 years of age. *(J Pediatr 2015;166:326-31)*.

In China, the prevalence of overweight/obesity is 23.23% for urban boys and 13.76% for urban girls (7-18 years of age), respectively, in 2010.[1] The prevalence of overweight/obesity during 1985-1995, 1995-2000, 2000-2005, and 2005-2010 increased 0.10%, 0.30%, 0.23%, and 0.23%, respectively.[1] Accumulating evidence suggests that nutritional factors (eg, protein and energy intake, breastfeeding) and other factors (eg, early rapid weight gain, high birth weight) during infancy play roles in the development of overweight and obesity later in life.[2,3] A number of observational studies suggest that the early introduction of complementary foods is associated with a greater risk of overweight and obesity in children,[4-9] but results from other studies do not agree with this finding.[10-14] The evidence from Asian countries is limited.[9,10,12] In 1 prospective study, investigators did not find an association between early introduction of complementary foods and childhood obesity.[10]

The primary aim of the present study is to investigate the association between timing of complementary feeding and adiposity in children of 4-5 years of age in Mainland China. In addition, the influence of the types of complementary foods on the association was examined.

Methods

The study protocol was approved by the Ethics Committee of the College of Biosystem Engineering & Food Science at Zhejiang University (2013013). The Jiaxing Birth Cohort was initiated in 1993 as part of a large population-based health surveillance system in China.[15,16] The cohort enrolled pregnant women who primarily visit local clinics or Maternity and Child Health Care Hospitals in Southeast China, Jiaxing area of Zhejiang Province. Information was obtained during the period of 1999 to 2013 and follow-up information collected until 2013. During the period, 90 066 singleton children from the Jiaxing Birth Cohort provided complementary diet information and other anthropometric measurements at 1, 3, and 6 months of age. Follow-up information, including weight and height, was obtained from 43 848 of these children at 4-5 years of age (48-60 months).

BMI Body mass index

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Children were excluded if they had any missing data on weight or height at 4-5 years (n = 461) or had any missing data on any kind of complementary food introduction at 1, 3, or 6 months of age (n = 3338) or did not have information for sex (n = 17). Children with extreme values of gestational age (>44 weeks or <33 weeks; n = 165), birth weight (>5 kg or <1.5 kg; n = 51), or body mass index (BMI) at 4-5 years of age (BMI z-score >5 or <−5; n = 48) also were excluded from the study. A total of 40 510 children were included for statistical analysis.

At each visit, parents of these children were asked whether their children had been introduced to the following 10 kinds of foods (yes, no, or unclear) via an in-person interview by a trained nurse: fish liver oil, rice cereal/porridge, egg yolk, fish paste, liver paste, tofu, animal blood, bread/steamed bun/fine dried noodle, ground meat/soy product, and pureed noodle/cookies. The aforementioned complementary foods are commonly used in Southeast China.

Children were categorized into 3 groups: "complementary feeding before and at 3 months" (if they were introduced to any of the complementary foods before or at 3 months of age), "complementary feeding between 4 and 6 months" (if they were introduced to complementary foods between 4-6 months of age), and "complementary feeding after 6 months of age" if they did not receive any complementary foods before 6 months of age.

BMI and weight commonly are used in adults to determine adiposity; however, for them to be meaningful in children, they must be compared with a reference-standard that accounts for the child's age and sex. Therefore, BMI-for-age z-scores and weight-for-age z-score were calculated according to the World Health Organization Child Growth Standard.[17] Children were defined as having "obesity" if the BMI z-score ≥2 SD and "overweight" if the BMI z-score was between 1 and 2 SD.[17] Weight gain during the first 3 months was calculated as the difference between weight-for-age z-score at 3 months of age and that at birth.

Confounding factors were selected according to the biological knowledge or previous publications.[2,6,9,11] Maternal characteristics, including menarcheal age, educational status (>high school, high school, <high school), occupation (housework, routine job, temporary job, unemployed), cesarean delivery (yes or no), gestational age, and BMI (prepregnant or <18 gestational weeks), were recorded during the follow-up visits and were treated as confounding factors. Paternal socioeconomic characteristics, such as educational status and occupation, had no impact on the results, so they were not included in the statistical model. Alcohol drinking, smoking, or diabetes mellitus status were not included in the final model because of their low prevalence (<0.5%). Breastfeeding status was categorized into 2 groups: never and ever breastfeeding. Ever breastfeeding was defined when the infant was reported breastfeeding at any of the visits within the first 6 months of age.

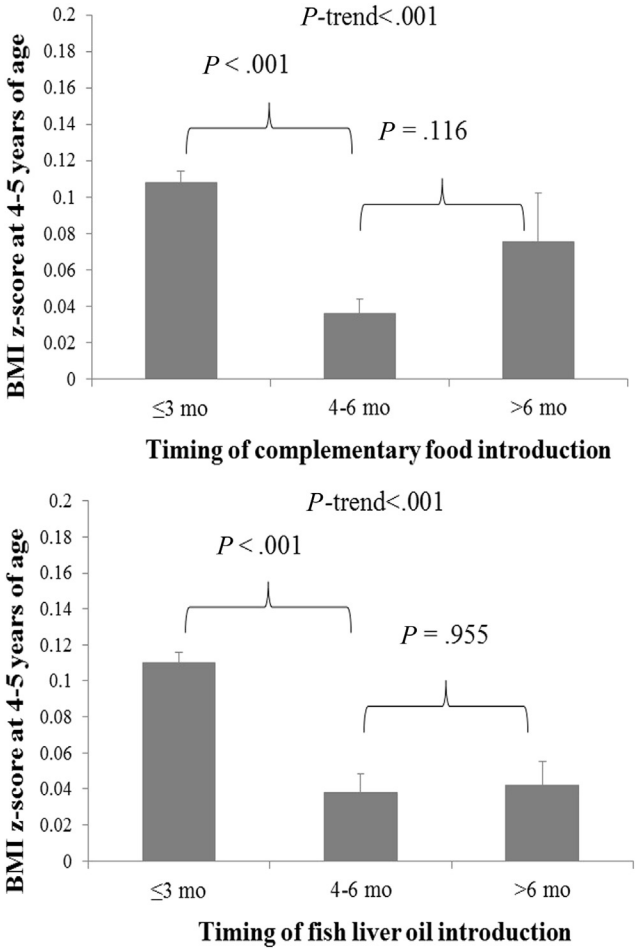

Figure 1. Timing of complementary feeding and fish liver oil introduction and BMI z-score at 4-5 years of age in the Jiaxing Birth Cohort. Linear regression model was used to obtain *P*-values, adjusting for potential confounders.

Statistical Analyses

STATA version 12 (StataCorp LP, College Station, Texas) was used to perform the statistical analyses. General maternal and child characteristics by the timing of complementary feeding were assessed by the χ^2 test. The association of complementary feeding time with risk of overweight and obesity was estimated by multinomial logistic regression models, with adjustment for potential confounding factors. Linear regression was used to assess the association between complementary feeding time and BMI z-scores with adjustment for potential confounders. The association between complementary feeding time and adiposity for any particular type of complementary foods also was examined using the logistic regression model or linear regression model. A 2-tailed $P < .05$ was considered as statistically significant.

Results

Of the 40 510 children, 64.7% of the female children and 64.9% of the male children were introduced to