Infant Feeding and Long-Term Outcomes: Results From the Year 6 Follow-Up of Children in the Infant Feeding Practices Study II

AUTHORS: Laurence M. Grummer-Strawn, PhD,^{a,b} Ruowei Li, MD, PhD,^a Cria G. Perrine, PhD,^{a,b} Kelley S. Scanlon, PhD, RD,^a and Sara B. Fein, PhD^c

^a*Division of Nutrition, Physical Activity, and Obesity, National Center for Chronic Disease Prevention and Health Promotion, US Centers for Disease Control and Prevention, Atlanta, Georgia;* ^b*US Public Health Service Commissioned Corps, Atlanta, Georgia;* and ^c*McKing Consulting Corporation, Fairfax, Virginia*

ABBREVIATIONS

DOHaD—developmental origins of health and disease

IFPS II—Infant Feeding Practices Study II

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

www.pediatrics.org/cgi/doi/10.1542/peds.2014-0646B

doi:10.1542/peds.2014-0646B

Accepted for publication May 20, 2014

Address correspondence to Laurence M. Grummer-Strawn, PhD, 4770 Buford Hwy, Mail Stop F-77, Atlanta, GA 30341. E-mail: lxg8@cdc.gov

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Copyright © 2014 by the American Academy of Pediatrics

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: This study was funded by the US Food and Drug Administration, Centers for Disease Control and Prevention, Office on Women's Health, National Institutes of Health, and Maternal and Child Health Bureau in the US Department of Health and Human Services.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest relevant to this article to disclose.

In 1986, the late David Barker described a link between intrauterine growth and ischemic heart disease,¹ originating a field of medical and anthropological research known as the fetal origins of health and disease. More recently, the field has expanded to also consider the long-term effects of early postnatal nutrition on long-term health, now known as the developmental origins of health and disease (DOHaD).² Evidence on the long-term consequences of infant diet is expanding rapidly. In this *Pediatrics* supplement, we present new data available from a follow-up study of children at age 6 years who were previously included in the longitudinal Infant Feeding Practices Study II (IFPS II), sponsored by the US Food and Drug Administration and the Centers for Disease Control and Prevention.^{3,4} Not all the articles in this supplement directly address DOHaD hypotheses, but they provide additional context to understanding the longitudinal associations between early feeding and subsequent outcomes.

Because of the depth of detail they provide, the IFPS II and its year 6 follow-up present a unique opportunity to examine the association of infant feeding with later health outcomes and behaviors. By following infants almost monthly from the third trimester of pregnancy to the age of 12 months, the IFPS II provides detailed information on changes in infant feeding that cannot be accurately captured through retrospective recall. The mothers of these infants were recontacted 6 years later to provide information on diet, health, and developmental outcomes. A large number of potentially confounding factors are available in both IFPS II and year 6 follow-up to reduce the chances that the associations discovered are not merely spurious.

The first set of articles examines child health outcomes at 6 years of age. The study by Li and colleagues⁵ demonstrates that longer breastfeeding and later introduction of foods or beverages other than breast milk are associated with lower rates of ear, throat, and sinus infections in the year preceding the survey. However, they find no associations with upper or lower respiratory or urinary tract infections. Lucciolli and co-workers⁶ find no significant associations between exclusive breastfeeding duration or timing of complementary food introduction and overall food allergy at 6 years old. Pan and colleagues⁷ examine childhood obesity at 6 years of age and show that consumption of sugar-sweetened beverages by infants doubles the odds of later obesity. Lind et al⁸ describe how breastfeeding is associated with various aspects of psychosocial development. They show a protective relationship between duration of breastfeeding and emotional, conduct, and total psychosocial difficulties, but these relationships become statistically nonsignificant after other confounding factors are

controlled for. Though certainly not conclusive, these studies demonstrate that infant feeding is predictive of some later health outcomes (eg, some infectious diseases and childhood obesity) but not others (eg, food allergy and psychosocial development).

One article focuses on maternal weight retention 6 years postpartum. Sharma, Dee, and Harden⁹ find no statistically significant overall association between weight retention and exclusive breastfeeding for at least 4 months combined with continued breastfeeding for 12 months. However, they do find that among women who were already obese before the pregnancy, meeting these breastfeeding recommendations is associated with a 6.2 kg lower weight retention compared with those who never breastfed. Given that few studies have examined breastfeeding and weight retention for more than a 1-year follow-up, this study is an important contribution to understanding the long-term effects of breastfeeding on the mother.

Three articles consider the relationship between infant diet and later diet quality. Perrine and colleagues¹⁰ look at the association between breastfeeding duration and various markers of a

healthful or poor diet at 6 years of age. Breastfeeding duration was positively associated with some markers of a healthful diet, such as higher consumption of water, fruits, and vegetables, but negatively associated with some markers of a poor diet, such as higher consumption of sugar-sweetened beverages and juice. However, no association was found between breastfeeding duration and consumption of milk, sweets, or savory snacks. Park and co-workers¹¹ demonstrate that consumption of sugar-sweetened beverages during infancy doubles the odds of consuming them at age 6. Similarly, Grimm and colleagues¹² show a significant relationship between infrequent consumption of fruits and vegetables during infancy and infrequent consumption of them at age 6. It is not clear whether these associations reflect the development of taste preference during infancy or a family eating pattern that manifests at various ages, but the studies do point to the need to establish healthful eating behaviors early in life.

Finally, an article by Li and co-workers¹³ focuses on how children eat rather than what they eat. This report looks at maternal feeding style and children's

eating behaviors in relation to bottle feeding practices during infancy. They show that the more frequently a baby is fed by bottle (containing either breast milk or infant formula), the more likely the mother is to exhibit the controlling behavior of making sure the child gets enough to eat. Regularly encouraging the infant to finish off all the milk in the bottle is similarly associated with these more controlling behaviors, including the mother making sure that the 6-year-old child gets enough to eat and encouraging the child to eat all of the food on the plate.

The articles in this supplement represent only the beginning of the multiple research opportunities provided by the year 6 IFPS II follow-up. Detailed information on many other aspects of the prenatal and postpartum environment, such as maternal diet, employment, day care, and sleep arrangements, is available from the IFPS II. Similarly, the data from the year 6 follow-up go well beyond the topics examined in this supplement. The data sets from both the IFPS II and the follow-up are available from the Centers for Disease Control and Prevention (www.cdc.gov/ifps) for researchers to explore many more topics.

REFERENCES

1. Barker DJP, Osmond C. Infant mortality, childhood nutrition, and ischaemic heart disease in England and Wales. *Lancet*. 1986; 1(8489):1077–1081
2. Gluckman P, Hanson M. The developmental origins of health and disease. In: Gluckman P, Hanson M, eds. *Developmental Origins of Health and Disease*. Cambridge, England: Cambridge University Press; 2006:1–5
3. Fein SB, Labiner-Wolfe J, Shealy KR, Li R, Chen J, Grummer-Strawn LM. Infant Feeding Practices Study II: study methods. *Pediatrics*. 2008;122(suppl 2):S28–S35
4. Fein SB, Li R, Chen J, Scanlon KS, Grummer-Strawn LM. Methods for the year 6 follow-up study of children in the Infant Feeding Practices Study II. *Pediatrics*. 2014;134(suppl 1):S4–S12
5. Li R, Dee D, Li CM, Hoffman HJ, Grummer-Strawn LM. Breastfeeding is associated with reduced risk of infections at age 6 years. *Pediatrics*. 2014;134(suppl 1):S13–S20
6. Lucciolli S, Zhang Y, Verrill L, Ramos-Valle M, Kwegyir-Afful E. Infant feeding practices and reported food allergies at six years of age. *Pediatrics*. 2014;134(suppl 1):S21–S28
7. Pan L, Li R, Park S, Galuska D, Sherry B, Freedman DS. A longitudinal analysis of sugar-sweetened beverage intake during infancy and obesity at six years old. *Pediatrics*. 2014;134(suppl 1):S29–S35
8. Lind JN, Li R, Perrine CG, Schieve LA. Breastfeeding and later psychosocial development of children at 6 years of age. *Pediatrics*. 2014; 134(suppl 1):S36–S41
9. Sharma A, Dee D, Harden SM. Associations of meeting breastfeeding recommendations with maternal weight 6 years after delivery. *Pediatrics*. 2014; 134(suppl 1):S42–S49
10. Perrine CG, Galuska D, Thompson FE, Scanlon KS. Breastfeeding duration is associated with child diet at 6 years. *Pediatrics*. 2014; 134(suppl 1):S50–S55
11. Park S, Pan L, Sherry B, Li R. A longitudinal analysis of sugar-sweetened beverage and

100% juice intake during infancy with sugar-sweetened beverage intake at six years old. *Pediatrics*. 2014;134(suppl 1):S56–S62

12. Grimm KA, Kim SA, Yaroch AL, Scanlon KS. Association of fruit and vegetable intake during infancy and early childhood. *Pediatrics*. 2014;134(suppl 1):S63–S69

13. Li R, Scanlon KS, May A, Rose C, Birch L. Bottle-Feeding Practices During Early Infancy and Eating Behaviors at 6 Years of Age. *Pediatrics*. 2014;134(suppl 1):S70–S77