Prevalence and Reasons for Introducing Infants Early to Solid Foods: Variations by Milk Feeding Type

WHAT'S KNOWN ON THIS SUBJECT: Adherence to infant feeding recommendations in the United States is low. The prevalence of early introduction of solid foods (<4 months of age) in the United States has been estimated to range from 19% to 29%.

WHAT THIS STUDY ADDS: Mothers' most commonly cited reasons for early solid food introduction include perception of readiness, hunger, wanting to feed something in addition to breast milk or formula, perception of interest in solids, advice from a clinician, and to improve infant's sleep.

abstract

OBJECTIVE: To examine the prevalence of, and mothers' self-reported reasons for, introducing solid foods to infants earlier than recommended (aged <4 months) and the variation in reasons for early introduction by milk feeding type.

METHODS: The study included 1334 mothers who participated in the national longitudinal Infant Feeding Practices Study II (2005–2007). Monthly 7-day food-frequency questions throughout infancy were used to determine infant age at solid food introduction and to classify infant's milk feeding at introduction as breast milk only, formula only, or mixed. Reasons for introducing solid foods at age <4 months were assessed through maternal responses to a list of 12 potential reasons. Analyses included descriptive statistics and multivariable logistic regression.

RESULTS: Overall, 40.4% of mothers introduced solid foods before age 4 months. Prevalence varied by milk feeding type (24.3%, 52.7%, and 50.2% for breastfed, formula-fed, and mixed-fed infants, respectively). The most commonly cited reasons for early introduction of solid food were as follows: "My baby was old enough," "My baby seemed hungry," "I wanted to feed my baby something in addition to breast milk or formula," "My baby wanted the food I ate," "A doctor or other health care professional said my baby should begin eating solid food," and "It would help my baby sleep longer at night." Four of these reasons varied by milk feeding type.

CONCLUSIONS: Our findings highlight the high prevalence of early introduction of solids and provide details on why mothers introduced solid foods early. *Pediatrics* 2013;131:e1108–e1114

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KEY WORDS

nutrition, infant, breastfeeding

ABBREVIATIONS

AAP—American Academy of Pediatrics

aOR—adjusted odds ratio

CI—confidence interval

IFPS II—Infant Feeding Practices Study II

WIC—Women, Infants, and Children

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The American Academy of Pediatrics (AAP), the American College of Obstetrics and Gynecology, and the American Academy of Family Physicians recommend that infants not be introduced to solid foods before ~6 months of age.^{1–3} The early introduction of solid foods is of concern because, developmentally, younger infants (particularly those <4 months of age) are not prepared for solid foods.⁴ In addition, researchers have suggested that early introduction of solids may increase the risk of some chronic diseases, such as diabetes, obesity, eczema, and celiac disease.^{5–8} The early introduction of solids also ends exclusive breastfeeding and has been associated with reduced duration of any breastfeeding.⁹ Given the important health benefits of breast milk for infants (reduced risk of respiratory and ear infections, diarrhea, diabetes, obesity, and sudden infant death syndrome), any interference with breastfeeding is of concern.^{10,11}

Despite the AAP recommendation, in national studies we have seen that many parents are not adhering to infant feeding guidelines on solid food introduction.^{5,9,12} To address this issue, several studies have been launched to identify the predictors of early solid food introduction. Predictors that have been identified include low maternal education, low maternal age, smoking status, formula feeding, and participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC).^{5,13–15}

Although there have been studies on infant feeding, little is known about reasons for early introduction. We found no study that has examined systematically whether reasons for early introduction to solids vary by milk feeding type (ie, breast milk only, formula only, or mixed). There may be variation in reasons for introducing solids by milk feeding type, because women who choose or transition from

1 feeding method over another may be very different from each other. As such, this study seeks to address the deficits in the literature by examining the prevalence and reasons for introducing solid food early to infants and the variation of these behaviors by infant milk feeding type.

METHODS

Sample

The sample for this investigation consisted of participants of the Infant Feeding Practices Study II (IFPS II), a longitudinal mail-based survey of mothers of infants, drawn from a consumer-opinion panel of ~500 000 households distributed throughout the United States. Participants of the panel were asked if household members were currently pregnant. Those households that were identified with a pregnant household member were invited to participate in the IFPS II by completing a prenatal questionnaire mailed to households during the third trimester and 10 follow-up questionnaires mailed almost monthly after birth throughout the first year of life. Information on the specific design and response rates for the IFPS II has been described elsewhere in detail.¹⁶

We enrolled 3033 women in the IFPS II, and they returned a neonatal questionnaire at ~1 month. Of these, 1925 women returned all of the questionnaires at 2, 3, and 4 months; these were required to calculate the age at early introduction to solid foods. The sample was additionally restricted to women who had complete data for age at introduction to solid foods, as well as reasons for introducing solid foods ($n = 1439$). We excluded 27 mothers who reported a reason for introducing solid foods before solid foods were actually introduced. After restricting the sample to mothers who had complete data for sociodemographic

characteristics, the final analytic sample comprised 1334 mothers.

Key Variables Studied

A food-frequency table was included on each postnatal questionnaire, in which mothers were asked to report any liquids or solid foods consumed by the infant during the 7 days before the survey. Twelve categories of solid foods were included on each monthly food-frequency table, with the exception of the neonatal questionnaire in which infant cereal was the only solid food surveyed. We defined the introduction of solid foods as the first report of introducing at least 1 of the following categories of foods: dairy foods other than milk (eg, yogurt); soy foods other than soy milk (eg, tofu); infant cereal; other cereals and starches; fruit; vegetables; French fries; meat, chicken, or combination dinners; fish or shellfish; peanut butter, other peanut foods or nuts; eggs; or sweet foods.

The age at introduction to solid foods was calculated by determining the midpoint between the age of the infant when solid foods were first reported and the age of the infant on the previous questionnaire in which the mother did not indicate that her infant was receiving solid foods. We defined early introduction to solid foods as <4 months (<17 weeks) of age in accordance with the AAP Committee on Nutrition recommendation for solid food introduction that was in place during the time of data collection.¹⁷

At 5 months, the women were asked to rate the importance of 12 potential reasons for why they gave solid foods to their infant for the first time. The 4-point Likert scale responses for mother's self-reported reasons for introducing solid foods were collapsed for analyses, with "not important" representing "not at all important" and "not very important" and "important" representing

“somewhat important” and “very important.”

To explore differences in the prevalence and reasons for early introduction of solid foods by milk feeding type, the food-frequency data from the questionnaire in the month before the introduction to solid foods were used to classify the milk feeding type as breast milk only, formula only, or mixed breast milk and formula. For those infants introduced to solid foods in the neonatal period, milk feeding type was determined by mother's self-reported feeding type at hospital discharge after birth.

Statistical Analysis

The prevalence of early introduction of solids was estimated among breastfed, formula-fed, and mixed-fed infants. The percentage of mothers who considered each reason to be important for solid food introduction was estimated only among those who introduced solids before 4 months of age ($n = 539$), and the χ^2 test was used to compare differences by milk feeding type. For 3 of 12 reasons, the sample size varied due to data that were inapplicable to a specific feeding type. For example, the reason “My baby was nursing too much” was not applicable among mothers who reported formula use only. Among mothers who had introduced solid food, multivariable logistic regression was applied to assess the association between each of the 6 most common reasons (reported by ~50% or more of respondents) for solid food introduction and milk feeding type. Each of these reasons was assessed separately in a model as the dependent variable, with milk feeding type as the main exposure variable, adjusting for maternal age (18–24, 25–29, 30–34, and ≥ 35 years), marital status (unmarried or married), parity (primiparous or multiparous), maternal education (high school or less,

some college, or college graduate), income measured as the percentage of the Federal Poverty Level ($<185\%$, $185\%–349\%$, or $\geq 350\%$), and postpartum participation in WIC (yes or no). The Variance Inflation Factor of covariates for each of the models was examined to assess multicollinearity. By using a Variance Inflation Factor of 10 to suggest multicollinearity, no threats were detected.

The IFPS II study was approved by the ethical review committee of the US Food and Drug Administration. All analyses were conducted by using SAS 9.2 (SAS Institute Inc, Cary, NC).

RESULTS

Overall, 40.4% of mothers introduced solid foods before their infants achieved 4 months of age (Table 1). Mothers who introduced solid foods early were more likely to be younger, unmarried, have a lower level of educational attainment and lower income, and to be

participating in the WIC program. Among mothers who introduced solid foods earlier than 4 months ($n = 539$), the mean age at introduction was 11.8 weeks (SD: 4.3 weeks), and 9.1% of mothers introduced solids before 4 weeks of age. Among women who fed formula to their infants when solids were introduced, 52.7% reported starting solids before 4 months of age, compared with 50.2% among mixed-fed and 24.3% among breastfed infants (Table 2). Solid food introduction in the first month of life was most common among infants fed formula at the time of introduction (11.2%), compared with mixed feeding (8.3%) and breast milk only (4.5%). The proportions of infants introduced to solid foods at or older than 4, 5, and 6 months of age were highest among infants receiving only breast milk, compared with formula- and mixed-fed infants.

Reasons cited by mothers for introducing solid foods before 4 months of age ranged from “My baby had a

TABLE 1 Characteristics of Total Study Sample and Mothers Who Introduced Solid Foods to Infants Before Age 4 Months (Early Introducers)

Characteristic	Total Sample ($N = 1334$), %	Early Introducers ($n = 539$), %
Total	100	40.4
Age ^a		
18–24 years	15.0	22.5
25–29 years	32.8	31.4
30–34 years	32.5	28.2
≥ 35 years	19.7	18.0
Marital status ^a		
Unmarried	15.2	21.9
Married	84.8	78.1
Parity		
Primiparous	27.4	29.1
Multiparous	72.6	70.9
Education ^a		
High school or less	18.9	26.9
Some college	34.0	38.6
College graduate	47.1	34.5
Income as a percentage of Federal Poverty Level (PIR) ^a		
$<185\%$	36.4	41.4
$185\%–349\%$	36.2	36.2
$\geq 350\%$	27.4	22.5
Postpartum WIC participation ^a		
No	68.2	59.4
Yes	31.8	40.6

PIR, poverty to income ratio.

^a $P < .05$ (χ^2 test).

TABLE 2 Percentage of Infants First Introduced to Solid Food by Age and Milk Feeding at Time of Introduction

	Age						Mean Age at Introduction, wk (SD)
	0–6 Weeks (1 Month)	7–11 Weeks (2 Months)	12–16 Weeks (3 Months)	17–20 Weeks (4 Months)	21–25 Weeks (5 Months)	≥26 Weeks (6 Months)	
<i>n</i>	104	120	315	457	243	95	1334
Total	7.8	9.0	23.6	34.3	18.2	7.1	17.7 (6.3)
Milk feeding type at time of solid food introduction							
Breast milk	4.5	2.7	17.1	36.1	27.8	11.8	19.9 (5.8)
Formula	11.2	13.5	28.0	34.0	9.3	3.9	15.8 (6.2) ^a
Mixed	8.3	13.3	28.6	31.2	15.0	3.7	16.6 (5.9) ^a

^a $P < .05$ for association between type of milk feeding and mean age at solid food introduction (compared with breast milk).

medical condition that might be helped by eating solid food” (8.5%) to “My baby was old enough to begin eating solid food” (88.9%) (Table 3). Other common reasons included “My baby seemed hungry a lot of the time” (71.4%), “My baby wanted the food I ate or in other ways showed an interest in solid food” (66.8%), “I wanted to feed my baby something in addition to breast milk or formula” (64.8%), “A doctor or other health care professional said my baby should begin eating solid food” (55.5%), and “It would help my baby sleep longer at night” (46.4%).

The top 6 reasons for early introduction of solid foods were examined in separate logistic regression models to examine the association with milk feeding type, adjusted for all potential covariates. Of the 6 reasons examined, 4 reasons varied significantly by milk feeding type (Table 4). Among mothers who reported formula feeding, the odds of selecting the reason “I wanted to feed my baby something in addition to breast milk or formula” were 0.62 times lower than the odds among mothers who reported only breast milk feeding at the time of introduction of solid foods (adjusted odds ratio [aOR] = 0.62; 95% confidence interval [CI]: 0.39, 0.99). The odds of selecting the reason “A doctor or other health care professional said my baby should begin eating solid food” were 1.79 times

greater for mothers who reported formula feeding compared with mothers who reported only breast milk feeding (aOR = 1.79; 95% CI: 1.15, 2.80). Compared with mothers who breastfed, mothers who reported mixed feeding had 1.74 times greater odds of citing “My baby seemed hungry a lot of the time” and a 1.69 times greater odds of citing “It would help my baby sleep longer at night” as reasons for introducing solid foods early (aOR = 1.74 [95% CI: 1.03, 2.94] and aOR = 1.69 [95% CI: 1.05, 2.72], respectively).

DISCUSSION

More than one-third of mothers in our study reported introducing solid foods before their infant was 4 months old, which is higher than previously published findings that revealed ~19% to 29% of US mothers introduce solid foods early.^{5,12} The AAP recommendation in place at the time of IFPS II data collection was that solid foods were to be introduced no earlier than 4 months of age. Notably, with the 2012 revision of this recommendation by the AAP, the recommended age for introduction of solid foods was increased from 4 to 6 months, which would result in 92.9% of our analytic sample being classified as “early introducers.” Given the adverse health outcomes associated with early introduction of solid foods, it is of significant public health importance to

understand why mothers do not adhere to infant feeding recommendations.

The most common reason mothers cited for early solid food introduction was “My baby was old enough to begin eating solid foods,” which was reported by ~90% of mothers. Similarly, “My baby wanted the food I ate or in other ways showed an interest in solid food” and “I wanted to feed my baby something in addition to breast milk or formula” were cited by approximately two-thirds of mothers. A woman's decision to introduce solid foods is likely a result of several influences, as well as life circumstances. With multiple sources of information on infant feeding and care from health care providers, family, friends, and media, specific information on the timing of solid food introduction may be conflicting and not necessarily sensitive to the needs of mothers.^{18–20}

Health care providers have a crucial role in improving the adherence of mothers to infant feeding guidelines. We observed that 55% of mothers who introduced solid foods before age 4 months cited that a physician or other health care professional had told them to do so. Qualitative research focused on health care professionals' knowledge, attitudes, and practices toward infant feeding has indicated that health care providers may have some confusion regarding guidelines on breastfeeding and complementary feeding, and some may rely on their own infant feeding experiences rather than evidence-based guidelines when counseling women.^{21,22} Studies have also suggested that many health care professionals feel that they are inadequately prepared to provide information and support for appropriate infant feeding practices. For example, Power et al²³ found that 40% of US obstetricians rated their training on infant feeding practices as inadequate. Practicing pediatricians and pediatric residents

TABLE 3 Percentage of Mothers Who Indicated Each Reason as Important in Their Decision to Introduce Solid Foods Among Those Who Reported Early Introduction (<4 Months) By Milk Feeding Type at the Time of Solid Food Introduction

Reasons cited as important	Total (N = 539), %	Milk Feeding Type at Time of Solid Food Introduction		
		Breast Milk Only (n = 134), %	Formula Only (n = 254), %	Mixed (n = 151), %
My baby was nursing too much (n = 285)	22.5	26.1	—	19.2
I did not have enough milk ^a (n = 285)	21.1	15.7	—	25.8
My baby was drinking too much formula ^a (n = 405)	32.8	—	37.4	25.2
My baby had a medical condition that might be helped by eating solid food ^a	8.5	2.2	10.6	10.6
My baby was not gaining enough weight	10.2	6.0	13.4	8.6
Friends or relatives said my baby should begin eating solid foods ^a	18.9	12.7	22.8	17.9
It would help my baby sleep longer at night	46.4	41.0	44.5	54.3
A doctor or other health care professional said my baby should begin eating solid food ^a	55.5	50.8	61.4	49.7
I wanted to feed my baby something in addition to breast milk or formula	64.8	70.9	62.6	62.9
My baby wanted the food I ate or in other ways showed an interest in solid food	66.8	70.9	64.6	66.9
My baby seemed hungry a lot of the time	71.4	64.9	72.1	76.2
My baby was old enough to begin to eat solid food	88.9	88.1	89.8	88.1

— indicates that the reason was not applicable for that feeding type.

^a $P < .05$ (for association between specified reason and type of milk feeding).

have also rated their preparation for advising mothers on optimal infant feeding practices as inadequate.^{24–27} To improve the capacity of pediatricians to provide appropriate guidance and support for exclusive breastfeeding, curriculum interventions have been designed and tested over the past several years.^{26,27} In a prospective controlled trial, an AAP-developed curriculum to improve breastfeeding knowledge, practice patterns, and overall confidence of pediatric residents was shown to increase the

likelihood that infants were exclusively breastfed for 6 months.²⁷

Given the dearth of evidence for reasons for solid food introduction by milk feeding type, it is not well understood why mothers of formula-fed infants were more likely than mothers of breastfed infants to cite a health care professional's advice as a reason for introducing solid foods earlier than recommended by the AAP. The difference in mothers' perceptions of clinicians' advice for early solid introduction by milk feeding may additionally imply

variation in clinicians' training, opinion, or counseling strategies on infant feeding, particularly with regard to formula-fed infants. It is possible that clinicians recommend earlier solid food introduction for formula-fed infants simply because they think that the solid food recommendation is specifically for breastfed infants, because much of the attention on infant feeding is focused on the goal of exclusive breastfeeding.

Mothers who fed their infants with both breast milk and formula were more likely than mothers who only breastfed to cite “My baby seemed hungry a lot of the time” and “It would help my baby sleep longer at night” as reasons for introducing solid foods early. Early solid food introduction among this group of mothers for the reasons cited may represent a progression of efforts to respond to perceived hunger and to improve the duration of their infant's sleep, which are also common reasons for augmenting breast milk with formula.^{28,29} In an earlier analysis of this study population, breastfeeding mothers responded that they stopped breastfeeding because they believed they were not producing enough milk or that their infant was hungry.²⁸ More than 70% of mothers in our study indicated that they introduced solid foods early because their “baby seemed hungry a lot of the time.” Recognizing signs of hunger may be difficult for mothers, particularly within

TABLE 4 Odds of Citing a Reason for Solid Food Introduction as “Important” by Milk Feeding Type at Time of Introduction Among Women Who Introduced Their Infant to Solids Early (<4 Months of Age)

Milk Feeding Type at Time of Solids Introduction	Reason						
	My Baby Was Old Enough to Begin Eating Solid Food	My Baby Wanted the Food I Ate or on Other Ways Showed an Interest in Solid Food	I Wanted to Feed My Baby Something in Addition to Breast Milk or Formula	A Doctor or Other Health Care Professional Said My Baby Should Begin Eating Solid Food	My Baby Seemed Hungry A Lot of the Time	It Would Help My Baby Sleep Longer at Night	
Breast milk	Referent	Referent	Referent	Referent	Referent	Referent	
Formula	1.23 (0.62, 2.44)	0.75 (0.47, 1.21)	0.62 (0.39, 0.99) ^a	1.79 (1.15, 2.80) ^a	1.32 (0.83, 2.11)	1.08 (0.70, 1.68)	
Mixed	0.95 (0.45, 1.98)	0.83 (0.50, 1.38)	0.67 (0.40, 1.11)	0.96 (0.60, 1.55)	1.74 (1.03, 2.94) ^a	1.69 (1.05, 2.72) ^a	

Data are aORs (95% CI); n = 539. All of the models were adjusted for maternal age, marital status, parity, education, poverty to income ratio, and WIC participation.

^a $P < .05$.

the first few months of infancy when a mother is adapting to a new infant and learning to understand the infant's cues regarding specific needs. In a study of a Latina population receiving WIC benefits in New York City, 72% of mothers indicated that crying must be a sign of hunger.²⁹ Although crying may be 1 signal of hunger, infants also cry when they are cold, tired, need their diaper changed, want to be held, and when they are experiencing pain or other discomforts. Almost half of the mothers in our study population (46.4%) indicated that they introduced solid foods because it would help their infant sleep. This reason may also relate to infant hunger, because infants require frequent feedings: approximately every 2 to 3 hours for breastfed infants and every 2 to 4 hours for infants receiving formula.³⁰ This frequency of feeding is very challenging, and as a result, mothers might introduce solid foods earlier in an attempt to lengthen not only the amount of time that their infant sleeps but also to improve their own sleep schedule. It is possible that mothers who breast-feed may have different (or more realistic) expectations for their sleep

schedule than mothers who formula feed.

There are several strengths of our study. First, this was the largest prospective study on infant feeding behaviors in the United States, and we surveyed a broad range of reasons why mothers introduce solid foods. Second, from the third trimester through the first year after delivery, mothers responded to almost monthly questionnaires, which greatly reduced the potential recall bias when determining the infant age at first introduction of solid foods and the milk feeding type at introduction. This reduction of recall bias may also explain why we observed a higher rate of early solid food introduction than other studies in US populations (40.4% vs 19% to 29%).^{5,12}

There are a few limitations to our study. One limitation is that the IFPS II sample is not nationally representative; participants are predominantly white, have a moderate income, and are English literate. In addition, estimation of the age at solid food introduction and reasons for introducing solids limited the sample for this study to mothers who completed the survey questionnaires before the month 5 or month 9 questionnaire when reasons for solid

food introduction were assessed. To better understand the potential implication of this sample restriction, we compared our analytic sample with the IFPS II population and observed that our analytic sample was more likely to be older, married, have a high level of educational attainment, higher income, and less likely to participate in WIC (data not shown). Because mothers of lower socioeconomic status are at a higher risk of early solid food introduction,^{4,13–15} it is reasonable to think that our sample may underestimate the prevalence of early solid food introduction.

CONCLUSIONS

Our results reveal that early solid food introduction is prevalent, even more so among formula-fed infants. Our study provides key information on why mothers introduced solid food earlier than recommended and how the commonly cited reasons varied by milk feeding type. This information can be used by health professionals to develop targeted interventions to improve adherence with infant feeding recommendations, with the goal of reducing any morbidity associated with early introduction to solid foods.

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