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*Pediatrics* 2004;113:440-447

DOI: 10.1542/peds.113.5.e440

**This information is current as of May 10, 2005**

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located on the World Wide Web at:

<http://www.pediatrics.org/cgi/content/full/113/5/e440>

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# Failure to Thrive and Cognitive Development in Toddlers With Infantile Anorexia

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**ABSTRACT.** *Objective.* The goal of this study was to examine the relative contributions of growth deficiency and psychosocial factors to cognitive development in toddlers with infantile anorexia.

*Methods.* Eighty-eight toddlers, ranging in age from 12 to 33 months, were enrolled in this study. Toddlers were evaluated by 2 child psychiatrists and placed into 1 of 3 groups: infantile anorexia, picky eater, and healthy eater. All 3 groups were matched for age, race, gender, and socioeconomic status (SES). Toddlers underwent nutritional evaluations and cognitive assessments with the Bayley Scales of Infant Development. Toddlers and their mothers were also videotaped during feeding and play interactions, which later were rated independently by 2 observers.

*Results.* On average, toddlers with infantile anorexia performed within the normal range of cognitive development. However, the Mental Developmental Index (MDI) scores of the healthy eater group (MDI = 110) were significantly higher than those of the infantile anorexia (MDI = 99) and picky eater (MDI = 96) groups. Within the infantile anorexia group, correlations between MDI scores and the toddlers' percentage of ideal body weight approached statistical significance ( $r = .32$ ). Across all groups, the toddlers' MDI scores were associated with the quality of mother-child interactions, SES level, and maternal education level. Collectively, these variables explained 22% of the variance in MDI scores.

*Conclusions.* This study demonstrated that psychosocial factors, such as mother-toddler interactions, maternal education level, and SES level, are related to the cognitive development of toddlers with feeding problems and explain more unique variance in MDI scores than nutritional status. *Pediatrics* 2004;113:e440-e447. URL: <http://www.pediatrics.org/cgi/content/full/113/5/e440>; failure to thrive, feeding disorder, infantile anorexia, cognitive development, growth deficiency, mother-toddler interactions.

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ABBREVIATIONS. FTT, failure to thrive; SES, socioeconomic status; MDI, Mental Developmental Index; BSID, Bayley Scales of Infant Development.

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Received for publication Aug 3, 2003; accepted Dec 1, 2003.  
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Failure to thrive (FTT) describes children who exhibit growth deficiency, as indexed by faltering or stunted growth. Several studies suggest that FTT is associated with poorer cognitive development, learning disabilities, and long-term behavioral problems.<sup>1-3</sup> More recently, Corbett et al<sup>4</sup> detected a significant association between the severity of growth deficiency and IQ, whereas Raynor and Rudolf<sup>5</sup> found that 55% of the infants who were failing to thrive exhibited developmental delay. In addition, a study by Reif et al<sup>6</sup> reported that children with a history of FTT were found to have more learning difficulties and evidenced developmental delay at follow-up 5 years after the initial presentation.

These findings from the pediatric literature have led many to believe that FTT alone is sufficient to cause developmental delays. However, a critical problem with many previous studies is that FTT is frequently confounded with psychosocial risk factors (including low socioeconomic status [SES], maternal education levels, and maternal deprivation) that are independently related to lower Mental Developmental Index (MDI) scores.<sup>1,4</sup> As a result, psychosocial factors may contribute to the apparent association between FTT and cognitive delay. Consequently, the conclusion that FTT is sufficient to cause significant cognitive delay requires additional exploration.

The tendency to confound FTT and psychosocial risk factors grew from early studies that used non-organic FTT and maternal deprivation as synonymous terms.<sup>7,8</sup> Whereas several authors have proposed that FTT should be considered a single symptom that describes growth deficiency,<sup>9-12</sup> others have used nonorganic FTT as a clinical syndrome that encompasses children who exhibit FTT in addition to psychosocial risk factors.<sup>1,3,4</sup> Consequently, several authors have argued strongly for disentangling FTT (growth deficiency) from psychosocial factors and examining FTT as a single symptom of a feeding disorder, rather than a clinical syndrome.<sup>11,13,14</sup> Such a distinction is critically important for identifying the developmental consequences specifically related to growth deficiency, as well as the multiple pathways that can lead to growth deficiency.<sup>11,13,14</sup> Although many factors, genetic and environmental, can contribute to cognitive development in young children, the goal of this article is to tease apart the effects of growth deficiency and psychosocial risk on cognitive development.

The study described in this article focused on infantile anorexia, a feeding disorder that is characterized by extreme food refusal, growth deficiency, and an apparent lack of appetite.<sup>15,16</sup> Importantly, infantile anorexia is not associated with maternal deprivation or neglect, and most children with this feeding disorder come from middle- to upper-middle-class families.<sup>15,17</sup> Therefore, studying this population affords the opportunity to disentangle the contributions of growth deficiency and psychosocial risk factors to cognitive outcomes.

Infantile anorexia was first described in a series of case studies by Chatoor and Egan,<sup>18</sup> and at that time it was referred to as a separation disorder. Infantile anorexia arises in the first 3 years of life, most commonly between the ages of 9 and 18 months, as infants become more autonomous and make the transition to spoon- and self-feeding. Children with infantile anorexia fail to communicate signals of hunger, but they show a strong interest in exploration, play, and/or interaction with their caregivers. They exhibit extreme food refusal and frequently fail to take in sufficient calories to sustain growth. As a result, these children display acute and/or chronic malnutrition.<sup>16</sup>

Drawing from the rich literature on growth deficiency and the multiple factors that can have an impact on the cognitive development of young children, this article examines the relationship of cognitive development to physical growth, mother-toddler interactions during feeding and play, maternal education, and SES. We examine these relationships in a group of children who have infantile anorexia and exhibit growth deficiency, a control group of picky eaters with normal weight, and a second control group of healthy eaters with normal weight.

The primary questions addressed by this study were as follows: 1) Is infantile anorexia associated with lower scores on the MDI? Although toddlers with infantile anorexia do exhibit growth deficiency, they typically do not experience maternal neglect and tend to be from middle- to upper-middle-class families.<sup>15,17</sup> Consequently, we hypothesized that they would not demonstrate significant developmental delays. 2) Do psychosocial variables (SES, maternal education, quality of mother-child interactions) and growth deficiency make independent contributions to MDI scores? We hypothesized that SES, maternal education, and the quality of mother-toddler interactions would be stronger predictors of cognitive development than growth deficiency.

## METHODS

### Subjects

Toddlers with infantile anorexia ( $n = 34$ ), picky eaters ( $n = 34$ ), and healthy eaters ( $n = 34$ ) were recruited for a diagnostic study of infantile anorexia. Previous publications from this data set have focused on the diagnosis of infantile anorexia and attachment patterns, temperament characteristics, and parental characteristics associated with this feeding disorder.<sup>15,19,20</sup> The current report focuses on the cognitive development of toddlers with infantile anorexia in relation to picky and healthy eaters, and it included a subset of toddlers from the original study ( $n = 88$ ) who were between the ages of 12 and 33 months.

After Institutional Review Board approval was obtained, par-

ents of toddlers who had infantile anorexia and were referred to the study by pediatricians and gastroenterologists at the hospital and in the community were asked to participate in the study. None of the parents refused consent. The diagnosis of infantile anorexia was made independently by 2 child psychiatrists, who had excellent interrater agreement ( $\kappa = .89$ ). The diagnosis was based on the following criteria: 1) refusal to eat adequate amounts of food for at least 1 month; 2) onset of the food refusal under 3 years of age, most commonly during the transition to spoon- and self-feeding; 3) failure to communicate hunger signals, lack of interest in food, but strong interest in exploration and/or interaction with caregivers; 4) significant growth deficiency; and 5) no evidence that the food refusal followed a traumatic event or is associated with an underlying medical illness.

Picky eaters and healthy eaters were recruited from an urban ambulatory care center. Parents of toddlers who ranged in age between 12 and 36 months were asked to complete a brief questionnaire on their children's feeding habits. When the parents described their toddlers as "often" or "always" healthy eaters, they were considered for recruitment to the healthy eater group. When the parents described their children as "often" or "always" picky eaters, they were considered for recruitment to the picky eater group. Assignment to the picky eater group also depended on additional screening for medical and growth problems. Specifically, toddlers were assigned to the picky eater group when they demonstrated 1) persistent refusal (for at least 1 month) to eat all types of food or certain types of food to cause concern to the parents and 2) no evidence of growth deficiency. The requirements for placement in the group of healthy eaters were 1) no food refusal of concern for at least 1 month and 2) no evidence of growth deficiency. Only parents whose toddlers matched the study subjects by age, gender, race, and SES were invited to participate in the study. Ten toddlers from the original sample were excluded from this study because they were >33 months old at the time of testing. The final sample included 34 children in the healthy eater group (age: 23 months; standard deviation [SD]: 5 months), 26 children in the picky eater group (age: 24 months; SD: 5 months), and 32 children in the infantile anorexia group (age: 21 months; SD: 6 months). The 3 groups did not differ in regard to gender ( $\chi^2 = 4.54, P = .11$ ), or race ( $\chi^2 = 2.21, P = .90$ ). The specific demographic characteristics of the sample (excluding SES) are summarized in Table 1. Because SES was used as a predictor variable, data pertaining to SES are included in Table 2.

### Procedures

All children underwent a medical evaluation before the study, and they were excluded from the study when they had any medical, neurologic, or genetic illness or when they demonstrated a psychiatric disorder associated with developmental delays (eg, autism spectrum disorders). All mothers were asked to complete several questionnaires, and each mother and toddler completed 2 laboratory sessions. During the first session, all mothers and toddlers were videotaped during feeding and play interactions. After these interactions, a child psychiatrist administered a diagnostic interview to assess the toddler, and a nutritionist evaluated the toddler's height and weight.

Two child psychiatrists independently evaluated each child via maternal interview, observing mother-toddler interactions during feeding and play, and the nutritional assessment. One psychiatrist

**TABLE 1.** Demographic Characteristics of the Study Sample by Diagnostic Group

	Diagnostic Group					
	Healthy Eaters		Picky Eater		Infantile Anorexia	
	%	f	%	f	%	f
Gender (female)	53	18	35	9	62	20
Ethnicity						
Black	6	2	12	3	16	5
Asian	29	10	27	7	25	8
White	59	20	54	14	56	18
Hispanic	6	2	8	2	3	1

f indicates frequency.

**TABLE 2.** Means and Standard Deviations for Cognitive Development and Risk Variables by Diagnostic Group

Variable	Diagnostic Group					
	Healthy Eaters		Picky Eater		Infantile Anorexia	
	Mean*	SD	Mean*	SD	Mean*	SD
Cognitive development						
MDI score	109.9 <sup>A</sup>	16.0	96.3 <sup>B</sup>	19.5	99.2 <sup>B</sup>	19.1
Growth deficiency						
Percentage of ideal body weight	107.7 <sup>A</sup>	9.7	101.4 <sup>B</sup>	5.7	84.3 <sup>C</sup>	4.9
Psychosocial risk factors						
SES level	2.00 <sup>A</sup>	1.0	1.9 <sup>A</sup>	0.8	1.8 <sup>A</sup>	0.9
Maternal education level	16.0 <sup>A</sup>	2.8	16.4 <sup>A</sup>	2.6	16.0 <sup>A</sup>	3.7
Feeding interactions						
Feeding conflict	4.2 <sup>C</sup>	4.1	8.6 <sup>B</sup>	5.4	12.0 <sup>A</sup>	5.5
Feeding reciprocity	33.5 <sup>A</sup>	4.4	31.3 <sup>B</sup>	3.7	28.2 <sup>C</sup>	4.8
Feeding noncontingency	1.0 <sup>B</sup>	1.3	2.0 <sup>AB</sup>	2.1	2.8 <sup>A</sup>	2.6
Feeding talk and distraction	6.3 <sup>B</sup>	2.0	7.4 <sup>A</sup>	1.9	7.2 <sup>AB</sup>	2.1
Feeding struggle for control	2.2 <sup>B</sup>	1.7	3.5 <sup>B</sup>	2.0	4.6 <sup>A</sup>	2.8
Play interactions						
Play reciprocity	26.8 <sup>A</sup>	3.8	26.1 <sup>A</sup>	4.2	24.5 <sup>A</sup>	5.5
Play nonresponsiveness	1.0 <sup>A</sup>	1.4	0.9 <sup>A</sup>	1.1	1.2 <sup>A</sup>	1.6
Play conflict	0.9 <sup>B</sup>	1.2	1.2 <sup>B</sup>	0.9	1.9 <sup>A</sup>	1.5
Play intrusiveness	4.7 <sup>A</sup>	2.5	5.2 <sup>A</sup>	2.4	5.8 <sup>A</sup>	2.5

SD indicates standard deviation.

\* Means with common superscript letters are not statistically different ( $\alpha = .05$ ).

observed the mother and the toddler during feeding and play from behind a 1-way mirror and interviewed the mother, whereas the second psychiatrist evaluated the toddler through the written interview and by observation of the videotape of the mother and the toddler during feeding and play. Each psychiatrist had access to the toddler's nutritional assessment.

During the second session, the toddler's cognitive development was assessed with the Bayley Scales of Infant Development (BSID). A psychologist who was blind to the psychiatrists' diagnostic assessment of the toddlers performed the developmental assessment. Two trained observers who were blind to the diagnostic group assignment of the toddlers rated mother-toddler interactions during feeding and play with the Feeding Scale and the Play Scale described below.

All toddlers completed the first laboratory session; however, 2 toddlers with infantile anorexia and 2 picky eaters could not be scheduled for the developmental assessment because of technical difficulties or parents' time constraints. Therefore, complete data were collected for 88 of the 92 toddlers.

## Measures

### SES and Maternal Education

Each mother completed a demographics questionnaire that asked her to report her highest level of education and occupation and her husband's highest level of education and occupation. SES was based on Hollingshead's Four-Factor Index,<sup>21</sup> which takes both parents' level of education and occupational status into consideration. The Hollingshead index yields 5 SES groupings, with group 1 reflecting the highest SES status and group 5 reflecting the lowest. Maternal education was determined from the same questionnaire and was categorized according to the highest level of education that the mother completed (high school, college, graduate school, or postgraduate degree).

### Growth Deficiency

The Waterlow criteria were used to assess children's degree of growth deficiency.<sup>22</sup> These criteria compare the children's actual weights and heights with the 50th percentile (median) reference standard on the National Center for Health Statistics growth charts.<sup>23</sup> The child's weight for height at the 50th percentile is considered to be the ideal body weight for that length/height. Because this study was conducted before the release of the Centers for Disease Control and Prevention growth charts, the National Center for Health Statistics charts were used.<sup>24</sup> Percentage of ideal body weight was used for the correlation analyses to determine

associations between nutritional status and cognitive development.

The Waterlow criteria for acute and chronic malnutrition were used for the diagnostic assessment of each toddler's nutritional status. To meet diagnostic criteria for infantile anorexia, the toddlers had to meet the following Waterlow criteria for acute and/or chronic malnutrition. Acute malnutrition is an index of muscle depletion or wasting. It is determined by dividing the child's current weight by his or her weight for height at the 50th percentile and multiplied by 100. The remaining value represents the percentage of ideal body weight. Mild, moderate, and severe malnutrition corresponds with 80% to 89%, 70% to 79%, and <70% of ideal body weight, respectively.<sup>22</sup> Chronic malnutrition, an index of faltering linear growth or stunting, is determined using the 50th percentile for height for age, or ideal length or height. The child's current height is divided by his or her ideal height and multiplied by 100. Mild, moderate, and severe chronic malnutrition corresponds with 90% to 95%, 85% to 89%, and <85% of ideal height, respectively.<sup>22</sup>

### Cognitive Development

The BSID<sup>25</sup> was used in the current study to provide a measurement of the children's cognitive status. The BSID is 1 of the most commonly used infant assessment tools. The BSID Mental Scale consists of 163 items and is used to assess infants' cognitive development between 1 and 30 months of age. Children receive an MDI score that indicates the degree to which they are functioning at an age-appropriate level. MDI scores between 85 and 115 generally indicate that the child is at an age-appropriate level. The BSID is based on a sample of the US population in regard to race, ethnicity, gender, and SES and has demonstrated good test-retest reliability.<sup>25</sup>

In the current study, 7 toddlers were between 31 and 33 months of age. To interpret the scores of these older toddlers, we extrapolated the results (based on the relationship described by Bayley<sup>25</sup>) between the raw scores and the MDI scores for children between 26 and 30 months of age. The algorithm for extrapolation involved a regression analysis, using a log scale that seemed to fit the listed values very well. The  $R^2$  values for the regression equations ranged from .841 to .983, indicating excellent agreement between the regression and the actual scores. Because these toddlers came from all 3 diagnostic groups and none of these older toddlers reached the maximum raw score of 163, we believed that this method was adequate to include these children in the study.

## Mother–Toddler Interactions During Feeding

The Feeding Scale used in this study is a global rating scale that includes 46 items describing mothers' and toddlers' behaviors during feeding.<sup>17</sup> To rate the quality of mother–toddler interactions during feeding, observers use a 4-point Likert scale to indicate the frequency and/or the intensity with which specific behaviors are displayed in a 20-minute feeding session (0 = none, 1 = a little, 2 = pretty much, 3 = very much). The items are grouped into 5 subscales: 1) Dyadic Reciprocity—positive exchanges between mother and toddler; 2) Dyadic Conflict—toddler's food refusal and negative affect, as well as mother's negative affect and negative comments regarding her toddler; 3) Talk and Distraction—engagement in talk and play by mother and toddler that interferes with feeding; 4) Struggle for Control—controlling maternal behaviors (eg, overriding the toddler's cues or forcing food into the toddler's mouth) and the toddler's resistance (eg, spitting out food); and 5) Maternal Noncontingency—inappropriate maternal behaviors during feeding (eg, ignores toddler's cues, handles toddler excessively, restricts toddler's movements). In a previous study, the Feeding Scale discriminated between feeding-disordered and non-feeding-disordered populations and demonstrated acceptable test-retest reliability over a 2-week period.<sup>17</sup> Interrater reliability was high for each subscale, with intraclass correlations ranging from .95 to .99.

## Mother–Toddler Interactions During Play

The Play Scale used in this study provides a global rating of the behaviors that toddlers and their mothers display during free play. To rate the quality of mother–toddler interactions during a 10-minute free play situation, observers assess 32 mother and toddler behaviors by using a 4-point Likert scale (0 = none, 1 = a little, 2 = pretty much, 3 = very much). The individual items are grouped into 4 subscales: 1) Dyadic Reciprocity—positive exchanges between mother and toddler; 2) Maternal Nonresponsiveness to Toddler's Needs—inappropriate maternal behaviors during play (eg, handles toddler in an abrupt manner, restricts toddler's movements, seems detached and/or oblivious to toddler's activities); 3) Dyadic Conflict—mother and toddler seem distressed and/or angry, or mother makes critical remarks about toddler and/or toddler's play; and 4) Maternal Intrusiveness—mother directs toddler or controls play without regard for toddler's cues. In a previous study, the Play Scale discriminated between feeding-disordered and non-feeding-disordered groups.<sup>26</sup> In addition, the 2-week test-retest reliabilities for the individual subscales ranged from .39 to .58.<sup>27</sup>

## Data Analysis

Analysis of variance was used to determine whether diagnostic group (infantile anorexia, picky eater, healthy eater) is associated with MDI score. In this analysis, the diagnostic group was used as the single factor. Duncan's multiple range test was used to rank the 3 groups and to assess the degree to which specific diagnostic groups differed from each other. An  $\alpha$  level of .05 was used for each analysis.

The next set of analyses focused on associations between MDI scores and previously identified risk factors for low MDI scores: growth deficiency (percentage of ideal body weight), SES level, maternal education level, and quality of parent–child interactions during feeding and play. First, we examined the associations between the diagnostic group and the risk factors. Analysis of variance was used to determine whether the 3 diagnostic groups differed in regard to any of the hypothesized psychosocial risk factors. When there were statistically significant differences of mean between the diagnostic groups, the Duncan multiple range test was used to determine where those differences occur. An  $\alpha$  level of .05 was used for each analysis.

Second, Pearson correlations were used to assess associations among the growth deficiency, the psychosocial risk factors, and the children's MDI scores. Because we sought to determine whether psychosocial variables predict variance in MDI scores independent of growth deficiency, we also conducted additional multiple regression analyses that assessed the relationship between feeding conflict and MDI score, controlling for the effects of percentage of ideal body weight. An  $\alpha$  level of .05 was used for each analysis.

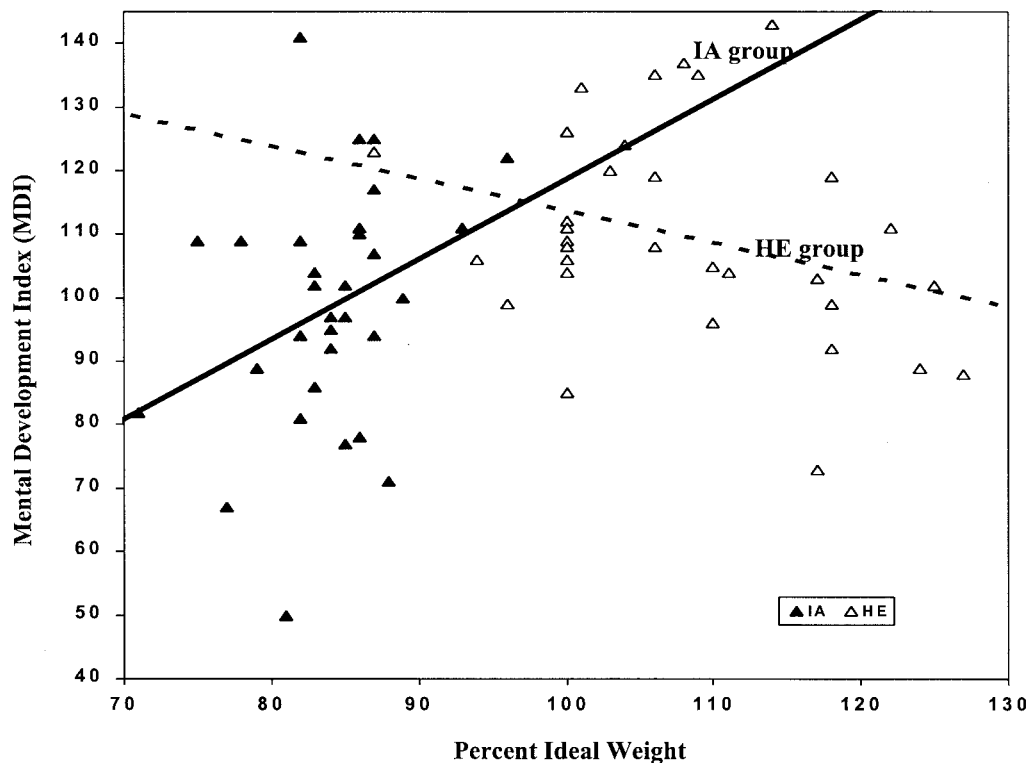
## RESULTS

A primary question of the current study was whether the diagnostic group was associated with the children's cognitive development. As indicated in Table 2, on average, all 3 groups seemed to function within the normal range of cognitive development. However, there was a significant effect of diagnostic group on MDI scores ( $F[2,85] = 4.75, P < .05$ ). The healthy eater group exhibited significantly higher MDI scores than the infantile anorexia and picky eater groups. The last 2 groups did not differ from each other.

The second question addressed by this study was the degree to which growth deficiency and psychosocial risk variables explain variance in MDI scores. Table 2 includes the means and standard deviations for MDI scores and each risk factor by diagnostic group. The 3 groups did not differ in regard to SES level and maternal education level. However, the 3 groups differed in regard to percentage of ideal body weight ( $F[2,89] = 91.16, P < .0001$ ). Consistent with the diagnostic criteria for infantile anorexia, the toddlers in the infantile anorexia group displayed significantly lower percentage of ideal body weight than the toddlers in the remaining groups. In addition, however, the picky eater group displayed significantly lower percentage of ideal body weight when compared with the healthy eater group. The feeding and play subscales were also related to diagnostic group. The infantile anorexia group displayed significantly higher levels of feeding conflict ( $F[2,88] = 19.67, P < .0001$ ), struggle for control during feeding ( $F[2,88] = 8.95, P < .001$ ), play conflict ( $F[2,89] = 5.90, P < .01$ ), and less reciprocity ( $F[2,88] = 12.43, P < .0001$ ) than the remaining groups. In addition, the infantile anorexia and picky eater groups displayed more feeding noncontingency ( $F[2,88] = 2.84, P < .10$ ) than the healthy eater group.

These findings suggest that the lower MDI scores of the infantile anorexia and picky eater groups may be explained by percentage of ideal body weight or by variables associated with feeding conflict. To test these possibilities, we computed Pearson correlations for each of the risk variables and MDI scores. The overall correlation between percentage of ideal body weight and MDI score was not statistically significant ( $r = .16$ ). However, the correlation between percentage of ideal body weight and MDI score varied by diagnostic group (Fig 1). The correlation between MDI score and percentage of ideal body weight was positive for the infantile anorexia group and approached significance ( $r = .32, P < .10$ ). In contrast, this association was negative within the healthy eater group ( $r = -.31, P < .10$ ). The picky eater group also evidenced a positive association between percentage of ideal body weight and MDI score; however, this association did not approach statistical significance ( $r = .25, P > .10$ ). These differences are depicted in Fig 1.

The remaining correlations between SES and maternal education level and MDI scores did not vary across the diagnostic groups. Consequently, correla-



**Fig. 1.** Relationship between percentage of ideal weight and MDI for each of the 2 diagnostic groups. ▲, Children with infantile anorexia; △, healthy eaters. The lines represent the results of an analysis of covariance with percentage of ideal weight as a continuous covariate and indicator variables for each diagnostic group. The slopes of those regression lines are different to a statistically significant degree ( $P = .029$ ).

**TABLE 3.** Correlations Between Psychosocial Risk Variables and MDI Scores

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. MDI score	—											
2. SES	-.36‡	—										
3. Maternal education	.33†	-.50§	—									
4. Feeding conflict	-.33†	.10	-.20	—								
5. Feeding reciprocity	.30†	-.02	.23*	-.65§	—							
6. Feeding noncontingency	-.22*	.20	-.27*	.67§	-.53§	—						
7. Feeding talk and distraction	-.02	-.15	.25*	.25*	-.08	.11	—					
8. Feeding struggle for control	-.34†	.22*	-.16	.64§	-.47§	.61§	.13	—				
9. Play nonresponsiveness	.02	-.07	-.15	.20	-.22*	.18	.07	.12	—			
10. Play reciprocity	.16	-.09	.16	-.42§	.46§	-.35‡	-.08	-.31†	-.71§	—		
11. Play conflict	-.21	.11	-.11	.45§	-.40§	.27†	.16	.43§	.33†	-.54§	—	
12. Play intrusiveness	-.39‡	.29†	-.28†	.40§	-.26*	.31†	-.02	.43§	.03	-.11	.52§	—

\*  $P < .05$ .

†  $P < .01$ .

‡  $P < .001$ .

§  $P < .0001$ .

tions for the entire sample are presented in Table 3. Consistent with previous studies, SES level was inversely related to MDI score, indicating that children from middle- to upper-middle-class families (eg, Hollingshead scores of 1 and 2) tended to have higher MDI scores. Higher maternal education level was also positively associated with MDI score. In regard to mother-toddler interactions, the following feeding subscales were negatively associated with MDI score: Feeding Conflict, Feeding Noncontingency, and Feeding Struggle for Control. One feeding subscale, Feeding Reciprocity, was positively associated with MDI score. In regard to the play interactions, only maternal intrusiveness was nega-

tively associated with MDI score. In summary, more problematic and conflictual mother-toddler feeding and play interactions were associated with lower MDI scores. Last, Table 3 indicates that many of the psychosocial risk factors were related to MDI score as well as to each other. Specifically, SES level and maternal education were associated with each other and with play intrusiveness. In addition, lower SES level was related to more struggles for control during feeding, whereas lower maternal education was associated with more feeding conflict, feeding noncontingency, and feeding talk and distraction and with lower feeding reciprocity.

In the final set of analyses, we explored the degree

to which psychosocial risk variables predicted variance in MDI scores that was independent of growth deficiency (ie, percentage of ideal body weight). Because the feeding subscales and play subscales were highly intercorrelated (Table 3), factor analysis using a promax rotation was used to generate composite scores for parent-child interactions during feeding and play sessions. This analysis yielded 2 general factors. Factor 1 included all of the feeding subscales, as well as the Intrusiveness subscale for play. The loadings for factor 1 were .84 for Feeding Struggle for Control, .83 for Feeding Conflict, .79 for Feeding Maternal Noncontingency,  $-.60$  for Feeding Reciprocity, and .68 for Play Maternal Intrusiveness. Overall, this factor reflected conflict and struggles for control between mothers and toddlers and was named Interactional Conflict. The second factor included only play scale subscales and was named Interactional Responsiveness. The loadings for factor 2 were .95 for Play Maternal Nonresponsiveness, .45 for Play Conflict, and  $-.90$  for Play Reciprocity. Factor scores for Interactional Conflict and Interactional Responsiveness were generated for each subject. Although the Interactional Conflict Factor score was significantly correlated with MDI score ( $r = -.41$ ,  $P < .0001$ ), SES level ( $r = .23$ ,  $P < .05$ ), and maternal education level ( $r = -.27$ ,  $P < .001$ ), the Interactional Responsiveness score was not associated with MDI score ( $r = -.07$ ), SES level ( $r = -.02$ ), or maternal education level ( $r = -.15$ ).

Multiple regression was used to examine the degree to which psychosocial factors (eg, SES, maternal education) versus mother-child interactions were related to MDI scores. In all, 2 multiple regression analyses were conducted. In the first regression, the association between SES level and maternal education level and MDI score was computed, controlling for percentage of ideal body weight. In the second analysis, the association between the Interactional Conflict Factor score and MDI score was computed, controlling for percentage of ideal body weight, SES level, and maternal education level. The results of these analyses are presented in Table 4.

In the first regression, SES level, maternal education level, and percentage of ideal body weight col-

lectively explained 17% of variance in the toddlers' MDI scores ( $F[3,79] = 5.25$ ,  $P < .01$ ). Given that the association between percentage of ideal body weight and MDI score was statistically nonsignificant ( $\beta = .17$ ), most of the explained variance could be attributed to SES level and maternal education level. Of these 2 predictors, SES level explained the most unique variance in MDI scores. When the Interactional Conflict Factor score was included in the second regression analysis,  $R^2$  increased to 22%, suggesting that this variable alone explained 5% of the variance in MDI scores. SES level continued to explain unique variance in MDI scores. The  $\beta$  weights, however, indicate that the unique contributions of SES level and Interactional Conflict score were equivalent. Consequently, although SES level and Interactional Conflict score were significantly correlated, both variables explained unique variance in MDI scores.

## DISCUSSION

This study examined the unique and combined contributions of growth deficiency (ie, FTT) and psychosocial risk factors to MDI scores in 3 groups of toddlers. The study revealed 2 important findings: 1) although toddlers with infantile anorexia exhibit growth deficiency, they performed within the normal range of cognitive development, and 2) the MDI scores of toddlers with infantile anorexia and that of the normal-weight picky eaters were, respectively, 11 and 14 points below that of the healthy eaters without feeding problems.

Although we found a positive correlation between percentage of ideal body weight and the MDI score for the group of toddlers with infantile anorexia, the correlation was not strong and only approached statistical significance. It is interesting that whereas the correlation between MDI and percentage of ideal body weight was positive for the infantile anorexia group, these variables were inversely related for the healthy eater group. This is a most interesting finding, which indicates that more malnourished toddlers and heavy toddlers may perform less well cognitively. Although a negative effect of growth deficiency, or FTT, on cognitive development has been reported by several studies,<sup>2,4-6</sup> the inverse relationship between weight and cognitive development for heavy toddlers was unexpected, and this finding should be replicated with a larger sample of normal and overweight toddlers. However, as stated previously, it should be kept in mind that within both groups, the correlation between percentage of ideal weight and MDI was only marginally significant, indicating that the effect size of percentage of ideal weight was small.

Because percentage of ideal body weight accounted for only a small portion of variance in the MDI score of toddlers within all 3 groups, other factors clearly contributed to the cognitive development of these young children. Several studies have examined the independent effects of psychosocial risk variables on children's cognitive development, including SES, maternal education, the quality of parent-child interactions, and child maltreat-

**TABLE 4.** Predicting MDI Scores From Psychosocial Risk Variables, Controlling Toddlers' Percentage of Ideal Body Weight

Risk Variable	$\beta$	T
Multiple Regression I		
Percentage of ideal body weight	.17	1.63
SES level	$-.32^*$	$-2.72$
Maternal education	.11	0.97
	$F(3,79) = 5.25^{\dagger}$	
	$R^2 = .17$	
Multiple regression II		
Percentage of ideal body weight	.04	0.36
SES level	$-.26^*$	$-2.18^*$
Maternal education	.08	0.73
Feeding conflict	$-.27^*$	$-2.25^*$
	$F(4,77) = 5.37^{\ddagger}$	
	$R^2 = .22$	

\*  $P < .05$ .

$\dagger P < .01$ .

$\ddagger P < .0001$ .

ment.<sup>28–38</sup> Although most of the toddlers in our study came from middle- and upper-middle-class families and had well-educated mothers and none of the toddlers had a history of neglect or abuse, we still found that many of the psychosocial variables assessed were related to MDI scores across all 3 groups. Specifically, higher SES, maternal education, and feeding reciprocity were related to higher MDI scores. In contrast, higher levels of conflict, noncontingency, and control struggles during feeding interactions and maternal intrusiveness during play interactions were related to lower MDI scores. When mothers and toddlers were in conflict with each other over the toddler's refusal to eat and struggled for control, with the mothers overriding the toddlers' cues and/or forcing food into the toddlers' mouths, these interaction behaviors correlated negatively with the toddlers' cognitive performance. It is interesting that maternal intrusiveness during play, when mothers directed the toddlers' and/or controlled the play without regard for the toddlers' cues, also correlated negatively with the toddlers' cognitive performance.

These findings are consistent with previous studies. For example, in a 4-year longitudinal study, Bee et al<sup>28</sup> found that mother–infant interactions and the quality of the environment were among the best predictors of child IQ and language at 24 and 36 months of age. Similarly, Coates and Lewis<sup>29</sup> reported that maternal responsiveness was related to the children's reading and conversation skills, as well as to their math skills over a 6-year period. Crandell and Hobson<sup>30</sup> also found that the degree to which parent–child interactions were synchronous was related to child IQ. Additional studies have documented significant associations between child maltreatment and deficits in cognitive functioning.<sup>31,32</sup> Importantly, Mackner et al<sup>33</sup> reported that maternal neglect and FTT have similar but independent effects on cognitive development and that both factors represent additive risks for deficits in cognitive functioning. This latter finding underscores the importance of differentiating neglect and FTT as 2 separate risk factors.

Previous studies also have found that maternal education, which is frequently used as an indicator of SES, has been associated with children's cognitive outcomes.<sup>34,35</sup> In addition, Singer and Fagan<sup>36</sup> reported that lower parental education levels were associated with lower levels of cognitive development in 3-year-old children with a history of FTT. As these studies have shown, maternal IQ and education are significant predictors of cognitive development of their children.<sup>35,37,38</sup>

In the final set of analyses, we examined the cumulative effects of psychosocial factors on MDI scores. Collectively, SES, maternal education, and Interactional Conflict explained 22% of the variance in MDI scores, with only negligible contributions from children's percentage of ideal body weight. These findings further underscore that previously found associations between FTT and MDI score may have been primarily explained by the child's social world.

In summary, we found that although toddlers with infantile anorexia displayed growth deficiency (ie, low percentage of ideal body weight), they still were within the normal range of cognitive development and received MDI scores that were similar to those of normal-weight picky eaters. Subsequent analyses indicated that psychosocial variables were more potent predictors of MDI than nutritional status. Although several studies have related cognitive development to mother–infant interactions and the quality of the home environment,<sup>29,30,39</sup> this is the first study that revealed a significant correlation between mother–toddler interactions during feeding and play sessions and the toddlers' cognitive performance. In addition, SES and maternal education were significantly related to MDI scores. Together, the quality of mother–child feeding and play interactions, SES, and maternal education explained 22% of variance in MDI. Although this finding is significant, other factors clearly contribute to MDI scores. For example, children's temperament characteristics and attention levels also may have influenced children's scores. Future studies are needed to explore the impact of these variables on MDI as well as on the quality of parent–child interactions. Last, it should be noted that our findings rely on correlational data. Consequently, the direction of effects between MDI and parent–child interactions cannot be established conclusively. It is possible that lower MDI scores may contribute to feeding problems. However, given that most children in the infantile anorexia group had MDI scores within the normal range, it is unlikely that MDI contributed significantly to feeding problems within this particular group.

The findings from this study also emphasize the importance of distinguishing between nonorganic forms of growth deficiency related to maternal neglect and growth deficiency that is related to dyadic conflict during feeding. The concern over the effect of poor weight gain on the cognitive development of infants and young children often overrides the management of their feeding difficulties. Because parents become worried about the future cognitive development of their infants, they resort to coercive feeding, which ultimately intensifies parent–child conflict during feeding. Although correlations do not allow for the interpretation of causality, the findings from this study suggest that the concern for the nutritional needs of young children needs to be balanced with the management of their feeding difficulties.

#### ACKNOWLEDGMENTS

The research and the preparation of the manuscript were supported by a grant from the National Institute of Mental Health awarded to Dr Chatoor (R01-MH58219) and a grant from the National Center for Research Resources awarded to the Children's Clinical Research Center (RR13297).

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*Pediatrics* 2004;113:440-447  
DOI: 10.1542/peds.113.5.e440

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