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Extended Breastfeeding and Malnutrition: An Example of Reverse Causality

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EXECUTIVE SUMMARY

Introduction

Although it is accepted that breastfeeding improves the health and nutritional status of infants, some researchers have found increased prevalences of malnutrition among children continuing to breastfeed into their second year of life. This study, which used quantitative and qualitative research methods, was undertaken to determine the following: 1) if there is an association between breastfeeding and linear growth in Peruvian toddlers; 2) how is this association varied by toddlers' dietary and health conditions; and, 3) how is child health influencing Peruvian mothers' child-feeding decisions.

The Association Between Breastfeeding and Linear Growth

To examine the role of breastfeeding in toddlers' health, breastfeeding duration was determined from two comparable cross-sectional studies conducted in a low-income community in Lima, Peru in 1986 and 1993. Overall median breastfeeding duration increased from nineteen months in 1986 to 22 months in 1993. The breastfeeding duration for women who breastfed for at least one year increased by three months (22.5 to 25.5 mo; $p<0.02$) over the seven-year period. Increased breastfeeding duration appeared to be a response to the severe economic crisis and may also reflect intensive breastfeeding campaigns by the public and private health sectors.

The association between breastfeeding and linear growth was determined separately for each quarter of the second year of life. Emphasis of this project was placed on the first quarter, twelve to fifteen months of age, as this is a pivotal period in child health. During this period, human milk intake decreases while the increase in complementary foods is inadequate to meet energy and nutrient needs. In this study, prevalence of stunting showed the steepest increase (almost 15%) during the first quarter as compared to the other three quarters.

Linear regression analysis was used to predict length at fifteen months. Explanatory variables of fifteen-month length included twelve-month length, time between length measurements, twelve- to 14.9-month breastfeeding frequency, complementary food intake, and incidence of diarrhea. With twelve-month length in the equation, other variables reflected their effect on twelve- to fifteen-month length gain. When twelve-month length and the interval between twelve- and fifteen-month measurements were controlled, the level of incidence of diarrhea and complementary food intake modified the relationship between breastfeeding and linear growth. When toddlers' complementary food intake was high or when intake was low and incidence of diarrhea was also low, there was no association between breastfeeding frequency and linear growth. Only in the worst health situation, when children's complementary food intake was low and they also had high incidence of diarrhea, was increased breastfeeding frequency associated with decreased fifteen-month length, implying that breastfeeding was harmful for growth.

Toddlers' Dietary and Health Conditions Influence Weaning Decisions

One explanation for these negative results is that the association reflects reverse causality. That is, increased breastfeeding did not cause poor growth; instead, those toddlers growing poorly were not weaned. If this were the case, one would see an increased rate of malnutrition in breastfed children and a lowered risk of being weaned in those growing poorly. To determine if this negative association reflected reverse causality, logistic regression was used to predict weaning by 14.9 months by twelve-month weight-for-age, nine- to 11.9-month complementary food intake, and change in morbidity between nine and fifteen months. There was a significant decrease in probability of weaning with increased morbidity only when weight-for-age and food intake were low. This suggests that the negative relationship between breastfeeding and growth reflected the fact that mothers postponed weaning when the child's health was poor. These conclusions support the hypothesis that the negative association reflects reverse causality.

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Results from in-depth interviews with 36 mothers conducted in 1993-1994 supported the conclusions from the logistic regression. Four areas of influence on the decision to wean (maternal well-being, child health, time obligations, and breastmilk quality) were identified. Mothers perceived weaning to be associated with increased illness and delayed or reversed motor and language development in the child. As a result, children in poor health were not weaned. Continued breastfeeding after twelve months, however, was reported to increase maternal weight loss and back pain. The results suggest that the decision to wean was primarily based on perceived maternal health; yet, mothers often delayed weaning until a time when they believed its negative effects on child health and development would be minimized. These results support the conclusion from the logistic regression analysis that a viable explanation for the negative association between breastfeeding and linear growth is that mothers' perception of their children's health influenced the timing of weaning. Thus, it is not breastfeeding that leads to poor growth. Rather, children who were ill with diarrhea and were also poor eaters were less likely to be weaned.

Finally, additional analyses were carried out to determine the association of breastfeeding with linear growth when the diet was of poor quality. To examine the association between breastfeeding and linear growth without the problem of reverse causality, the group of children for whom there was a negative association between breastfeeding and linear growth were excluded. Multivariate linear regression was used to predict fifteen-month length by twelve-month length, time between twelve- and fifteen-month measurements, breastfeeding frequency, diarrheal illness, and intakes of complementary food and animal protein. The relationship of breastfeeding with linear growth was modified by the animal protein foods consumed. Increased breastfeeding was positively associated with linear growth when animal protein intake was low, suggesting that total protein or micronutrient intake was inadequate. Increased linear growth was also associated with increased protein intake when total complementary food intake was low. This analysis demonstrates the importance of human milk as a source of nutrients when the quality of the diet is poor.

Conclusion

In summary, the negative association noted between breastfeeding and growth in children with poor dietary and health conditions can be explained as follows: mothers evaluated children's nutritional status, health, and dietary intakes and continued to breastfeed those children in the poorest condition. As a result, there appears to be an increase in the proportion of malnourished children in the breastfed group because healthy children were weaned earlier. Inasmuch as mothers recognized weaning as traumatic for the child, interventions should emphasize maternal health during lactation, which—if adequately maintained—will support continued breastfeeding in the second year of life. Breastfeeding in this community continues to have an important positive role in child health after the first year of life and should be promoted.

Programmatic Recommendations

The programmatic implications of this study are as follows:

- Mothers often use a trial-and-error approach to weaning. Health interventions should discourage mothers from trial weaning attempts, as these may result in premature weaning of passive children.
- Mothers should be encouraged to relactate a prematurely weaned infant.
- Messages (such as "only breastfeed for six months") can be misunderstood ("breastfeed only for six months"). The promotion of optimal breastfeeding practices must include information about the timing of introduction of complementary foods as well as messages about the importance of continued breastfeeding.

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- An important factor in feeding decisions is a mother's own health. To be successful, promotion of breastfeeding must include the promotion of women's health.

INTRODUCTION

Optimal feeding of infants and young children has been defined as exclusive breastfeeding for four to six months and, then, continued breastfeeding with adequate complementary foods for two or more years (1). In poor communities where inadequate sanitation and quality of complementary foods contributes to malnutrition (2-4), continued breastfeeding is essential as a source of energy as well as high-quality protein and micronutrients (5). Throughout the first years of life, breastfeeding provides immunological benefits, thus reducing morbidity rates (6) and risk of death (7). Paradoxically, some studies have suggested that breastfeeding during the second year of life is associated with increased incidence of malnutrition (8-10). This association has been assumed to reflect children's preference for breastfeeding and reluctance to eat solid foods, resulting in inadequate total intakes. Critics, however, have suggested that methodological flaws in the analyses are responsible for this negative association (11).

Breastfeeding is an ongoing, complex decision that is influenced by maternal, child, and external factors. Mothers may postpone weaning, re-initiate lactation after weaning, or change their breastfeeding patterns frequently based on these factors (12-14). Programmatically, these distinctions are important as they illustrate areas of behavior change that could be targeted in health-education campaigns.

The success of programs that support optimal feeding practices depends partly on a clear understanding of the benefits of breastfeeding in the second year of life and the identification of the factors that influence positively or negatively a woman's decision to breastfeed a toddler. This study evaluated the association of breastfeeding beyond twelve months with toddlers' nutritional status in poor, peri-urban communities afflicted with high morbidity and chronic malnutrition. The study also explored the perceptions and decision-making processes of mothers, along with health workers' beliefs, concerning the continuation of breastfeeding. Based on these results, programmatic recommendations are made.

STUDY AIMS

The study aims were as follows:

I. to develop a comprehensive conceptual framework to understand the relationship between breastfeeding and growth;
II. to complete a quantitative analysis, based on the conceptual framework, to estimate the magnitude of the association between breastfeeding and growth;
III. to collect qualitative data and complete an analysis to understand mothers' decision-making process concerning continued breastfeeding; and,
IV. to disseminate the results in-country and in international journals to provide information for breastfeeding promotion programs.

GENERAL STUDY INFORMATION

Study Site

The study site comprised two contiguous *pueblos jovenes* ("new towns," an official designation by the municipality that legalizes the area's status as a community) in the northeastern district of Canto Grande, in Lima, Peru. Migration to this valley has been continous and the district has increased to over 500,000 people today. The living conditions found in these communities are replicated in other *pueblo jovenes* throughout Lima. Homes are initially made of straw mats. As families accumulate resources, permanent structures of cement and brick are built. Most families had electricity. Piped water and sewage lines were non-existent until around 1993. To

date, water availability is irregular (water lines are opened about twice weekly). Families continue to store water in tanks in front of their homes because of its irregular availability.

Study Sample

Data for this project were collected in 1985-87 for the quantitative analysis and in 1993-94 for the qualitative analysis.

1985-87 Sample

The 1985-87 Chronic Diarrhea Surveillance project enrolled children from two shanty town communities (15). The sample of 400 households originated from a two-stage random sampling from a census of the two shanty towns in 1984. All children less than three years of age in January 1985 were included in the project. In addition to these 307 randomly chosen children, all newborns in sample households were added and children over three years of age were dropped throughout the project. All families who migrated out of the area and refusals were replaced by randomly chosen neighbors. Approximately 300 children were participants in the project on any given month.

1993 Sample

The 1993-94 data were collected from the same blocks of houses of only one of the two 1985-87 *pueblo jovenes*. Both communities were not used for logistic reasons; no community differences in morbidity or anthropometric measurements had been noted in earlier analyses. Families used in the two samples were not necessarily the same because: 1) families randomly selected in 1985 differed than those randomly selected in 1993; and, 2) although the same lot may have been selected randomly, families often moved. If the same families were selected, the children differed as those participants in 1985 were no longer of the appropriate age group to be studied in 1993.

Breastfeeding and Dietary Practices Survey

The staff of an ongoing field project carried out a census of the designated study area during the week of September 27, 1993. The census identified 1,490 homes with 542 children between zero and 36 months of age. For a breastfeeding and dietary practices survey, a random sample of 317 was selected from among these 542 children. Randomization was carried out by giving a number to all children who previously had been sorted by block and lot number and selecting the 317 corresponding numbers from a table of random numbers.

In-depth Interviews

The sample that participated in the in-depth interview included eight women (pilot studies) and 28 randomly chosen women. Eight pilot mothers (chosen by the field workers as good informants) were included in the final analysis as they did not differ from the randomly selected sample and were found be excellent informants. The remaining 28 women were randomly drawn from the census of the study area previously described. To include a range of child ages in the sample, the children were stratified by age (12-17.9 mo; 18-23.9 mo) and present feeding practice (breastfed; weaned within two months). Then, using a random numbers table, mothers were randomly chosen for each of these four categories. To complete the sample, we followed breastfed toddlers until weaning and enrolled them once weaned.

A sample of twelve health professionals was also selected. First the local health clinics that were available to research site families were identified. These included two Ministry of Health health posts, one mini-hospital with an out-patient clinic, one Social Security clinic, and one non-governmental organization's health clinic. The

directors of each health establishment were asked for the names of up to three professionals who attended young children, and then arranged for the interview. As study families were also attended by the field doctor and staff of the Instituto de Investigación Nutricional (IIN) the field doctor and two of the experienced field workers were included in the study, for a total of fifteen interviews.

Focused Group Discussions

Women who were not part of the in-depth interviews were considered for participation in discussion groups focused on breastfeeding and weaning practices. To facilitate transportation to the group discussions, the study area was divided into two sectors. In the lower sector, all women with breastfed children twelve to 24 months of age were visited. Fifteen women were available to ask to participate; the first eleven women were invited and seven attended. In the upper sector, eleven women with breastfed children twelve to 24 months of age were available to be asked to participate; the first ten were invited and seven attended. In all of the study area, there were twelve mothers who had recently (within six months) weaned their twelve- to 24-month old children. The first ten women were invited to participate, seven women attended. Reasons why women did not attend the discussions included not being home at a pre-arranged time (n=4) or unable to attend because of obligations at home (n=5).

Collection and Analysis of Diet and SES Data

In the 1985-87 study, breastfeeding and food frequency data were collected monthly; socioeconomic status (SES) information was collected once at the end of the study. In 1993, both types of information were collected during one single home visit. As the 1993 survey was conducted in December, dietary data from the month of December for the 1985-87 study were used to avoid seasonal differences in dietary intake.

The breastfeeding and food frequency questions in the 1993 survey followed the original questionnaire used in the 1985-87 project. In addition, socioeconomic questions were selected from those used in the earlier SES survey. Some of these questions were previously shown to be useful in categorizing the family's SES status (16).

Food frequency data were reported as "did not eat," "ate occasionally," or "ate frequently" ($\geq$ 2 times/week). For this analysis, the answers "did not eat" and "ate occasionally" were combined and contrasted with "ate frequently." This approach detected changes in feeding practices that could have an effect on the child's nutritional status. Chi-square statistics were calculated for the comparison of food practices reported in the different years. The Mantel-Hanzel statistic was used to correct for age variation in feeding practices (five age groups were used: 0-5.9 months, 6-11.9 months, 12-17.9 months, 18-23.9 months, $\geq$24 months. If there were cells with fewer than five individuals, three age groups were used: 0-0.9 years; 1-1.9 years; $\geq$2 years).

Descriptive results of the 1993 SES characteristics were compared to those of the families participating in December 1986. Only demographic characteristics of the 1993 sample are shown as it was not possible to compare family demographics (except for people/lot) because of coding problems in the earlier study. Statistical differences were determined using Chi-square test of goodness of fit for proportional data and non-paired Student's *t*-test for comparison of means. Kaplan-Meier estimates for survival curves of breastfeeding duration were calculated using SYSTAT-SURVIVAL (17). The sections before and after the cross-over of lines were tested separately with the log-rank test. All analyses were completed with SPSS (18) or SYSTAT (19).

General Study Results: Descriptive Statistics Comparing the 1985-87 and 1993-94 Samples

Selection of the 1985-87 Comparison Group

The age distributions of participants enrolled in the month of December 1985 and December 1986 were compared to that of those children enrolled in the 1993 study. The sample from 1985 was a significantly older population than either that of 1986 or 1993. The age distribution of children in 1986 was not significantly different than that of 1993; therefore all comparisons between the two study periods are made using data from 1993 and 1986.

SES and Demographic Characteristics

The 1986 sample included 299 children living in 198 households. Most lots (85%) were not shared with other families. *Tugurizacion* (crowding) occurred occasionally; 35 lots had two families and seven lots had three or four families living within the 90-m^2 area. Only one family was interviewed per lot for this survey. A higher proportion of houses in 1993 were made of brick and cement than in 1986 (78.2% vs. 44.9%; $p<0.001$). A steady improvement in housing quality could be seen over time. In 1982, only 19% of the homes of families who had lived there at least three years were permanent structures (20). Even though two-thirds of the families in 1993 had lived in the area for over ten years, only one-third of them had a permanent roof. Many (40%) houses still had dirt floors.

Food consumed in the home was limited, with an average expense of less than US$1. Although this did not account for the prepared foods purchased outside the home, it did indicate the mothers' purchasing power to feed herself and her children.

Maternal

Mothers primarily took care of their children. Grandmothers were the caretaker for only four children whose mothers did not live in the home. Mothers' ages ranged from adolescence to 46 years of age (Table 6). Almost one-half of the mothers (42%) were born in Lima; the origin of the remaining mothers was distributed throughout Peru, with the majority coming from mountain areas. Over one-third of the mothers had lived in the study site for over fifteen years (although not necessarily in the same house). Mothers had a mean of three children presently alive. Few women were illiterate; however, about one-fifth of the mothers had not finished primary school (through sixth grade). Over one-half of the women did not work outside the home and another one-third were independent workers, primarily street vendors. Involvement in community activities was quite low, except for the *Vaso de Leche* (Glass of Milk) program, in which almost half of the sample participated. Less than one-quarter of the mothers participated in a community kitchen, although probably many more purchased meals as non-members.

Paternal

Fathers were absent from 13% of the families surveyed (Table 1). Those fathers present were slightly older than the mothers and were significantly more educated ($\chi^2=17.67$; $p<0.001$). The fathers were more likely to be from the provinces than the mothers ($\chi^2=8.67$; $p<0.005$); only one-quarter were born in Lima. Almost 50% of the men were independent workers; 44% had a salaried job, providing a steady income and health care for the entire family.

Breastfeeding Practices

The probability of continued breastfeeding in 1986 and 1993 is shown in survival curves in Figure 1. The median weaning age was nineteen months in 1986 and 22 months in 1993. The two curves crossed each other around seven months. Although the 1993 curve dropped below the 1986 curve before seven months, suggesting that more infants were weaned early, the two curves were not significantly different. There was a significant difference, however, between the two curves after seven months of age (χ^2=4.89; $p<0.05$). In 1993, more children continued to be breastfed for longer periods such that almost 40% of them were still breastfed past 24 months (as compared to 32% in 1986).

As the study objectives focused on lactation during the second year of life, survival analysis was completed for those children who were breastfed at least twelve months (curves not shown). This subgroup of 150 and 162 children had a median weaning age of 23 and 26 months for 1986 and 1993 samples, respectively. These two curves were significantly different (χ^2=4.360; $p<0.05$). Over the seven year period between studies, the median duration of breastfeeding was prolonged by three months.

Food Frequency Survey

In general, mothers in 1993 reported more variety of foods being served regularly to their children than was offered in 1986 (Table 2). There was an increased use of almost one-half of the foods listed; all but two reductions were minimal. The largest reductions were in the consumption of broths ($p<0.06$) and powdered milk ($p<0.01$; powdered milk was substituted by evaporated milk). Significant increases ($p<0.001$) in consumption were seen in the use of corn starch, grains such as oatmeal, quinua, bulgur wheat and barley, and legumes, and fish.

Discussion of Use of Data from the Two Study Periods

For it to be reasonable to use the 1993 qualitative data to explain 1985-87 quantitative results, mothers must have reacted to their children's living conditions in similar ways during both study intervals. This suggests that: 1) the living conditions in 1993 should have resembled those of 1987 so that mothers had the opportunity to show similar reactions; and, 2) child feeding behavioral changes that occurred in response to poor health conditions should have been similar.

Although the diet improved between 1985 and 1993, it remained poor. More children were consuming animal products and a diversified diet, but many children still were offered a limited number of complementary foods because of poverty. Health conditions continued to be inadequate. Diarrheal morbidity rates were high (the prevalence rate in 1993 was 8.4%) and malnutrition rates remained stable over the past decade. In 1984, 11.3% of Lima metropolitan children were less than -2 standard deviations for length-for-age (21); similar results of 11.2% were found in 1991-92 (22).

Most importantly, data from both time periods show similar behavioral responses to ill, poorly nourished children. As will be shown below, the quantitative data from 1986 showed that mothers postponed weaning under the poorest conditions. In 1993, even with an improvement of the diet, mothers modified weaning decisions based on children's dietary and health factors (as shown in the discussion of the qualitative data below). The consistency of the maternal response across the two studies lends support to the combined use of the quantitative and qualitative data to described the phenomenon of the association between breastfeeding and linear growth.

COMPLETION OF STUDY AIMS I: CONCEPTUAL FRAMEWORK

The quantitative analysis was based on a conceptual framework that was developed from published results of previous studies on growth and observed results from the qualitative field study conducted in 1993-94. The framework (Figure 2) demonstrates the direct effect that breastfeeding, dietary intake, and morbidity have on growth. Breastfeeding, complementary food, and animal protein variables represent the gross energy and nutrient input for the child and therefore are assumed to have a positive association with growth. Diarrheal illnesses reduce energy and nutrients available for growth through increased fecal losses and increased net energy losses through fever and tissue catabolism. Illness, therefore, is assumed to have a negative effect on growth. Child characteristics (e.g., sex, age, previous growth indicators) and time between measurements also directly affect growth.

Breastfeeding, animal protein (as an indicator of dietary quality), and diarrheal morbidity also function as effect modifiers. These factors alter the effect of one variable on another. Breastfeeding ameliorates the effect of illness on growth by decreasing its severity. Human milk components as well as animal protein may increase the growth effect of a poor diet by improving protein quality intake and thereby providing limiting nutrients and increasing the availability of energy.

More distal factors, such as hygiene, SES, and maternal characteristics are viewed as affecting growth *through* the proximal variables of breastfeeding, dietary intake, and morbidity. Improved hygiene, for example, would decrease the incidence of diarrheal illnesses. As diarrheal illnesses are already in the model, the addition of the hygiene variables does not add additional information. Only child care and SES factors were considered to function as possible modifiers of the relationship between growth and a proximal variable. Attentive child care, for example, may reduce the effect of diarrhea on growth by maintaining dietary intake during illness or increasing it during convalescence. Higher SES may permit mothers to treat illnesses early and effectively. None of the SES or child care interactions explained a significant amount of variance and were dropped from the final model. In summary, the primary emphasis was in the variables reflecting biological factors of breastfeeding, the diet, and morbidity and how each modified the effect of the other to explain linear growth.

COMPLETION OF STUDY AIMS II: QUANTITATIVE ANALYSIS OF THE ASSOCIATION BETWEEN BREASTFEEDING AND GROWTH

Efforts to develop the quantitative analyses were placed on understanding factors associated with linear growth. Retarded linear growth is a reflection of long-term nutritional conditions and it is less sensitive to the short-term fluctuations of loss and recuperation that are seen in weight changes during illness.

The analysis was completed separately for the four quarters of the second year. This approach allowed us to maximize the sample size for each analysis and to look at how influences on growth changed across the second year of life. Zeitlin *et al.* (23) found that the beginning of the second year was the critical period in child health. Having passed their first birthday, there was an increased mobility and risk of contamination and illness. In addition, this was a critical period of decreasing human milk intake and stagnation of intake of complementary foods, leading to decreased growth rates. For this reason, the emphasis has been on developing an understanding of factors associated with poor health in the first quarter of the second year (twelve to fifteen months). As will be shown, the relationships are not linear across the rest of the year. Further investigation is needed to fully understand the factors involved in the later parts of the second year.

Descriptive Statistics for the Four Quarters

Sample

Children with anthropometric measurements at the beginning and end of each study period were selected for the four separate quarterly analyses. Table 3 shows characteristics of those children with no missing data for anthropometric measurements, breastfeeding frequency, diarrheal morbidity, and dietary intake. These are briefly described below. The original surveillance study was not a cohort study, therefore children entered and left the study at different ages. The result was that the sample size for each quarter was approximately the same (between 160 and 175); many of the children were not in every quarter.

Variable Definitions

The breastfeeding variable was determined from monthly reports of breastfeeding frequency averaged across the study interval. Breastfeeding as well as other continuous variables were centered at their mean for the analysis. Complementary food intakes were based on the average of the three monthly food frequency surveys. Complementary food intakes were estimated by the number of 27 general food groupings (e.g., fruit, indigenous grains, organ meats) consumed. Foods were counted if consumed by the child two or more times per week. Foods high in animal protein made up the animal protein variable. Diarrheal incidence rates were calculated as the number of new episodes per number of observed days, corrected to three months.

Descriptive Results

Nutritional Status

Many of the study participants were already malnourished by twelve months of age (Table 3, Figure 3). Although wasting (extreme thinness) was infrequent, poor growth was evident through the high proportion (20%) of stunting (extreme short stature) in twelve-month old toddlers. Interestingly, although stunting increased over the first half of the second year (with a large increase between twelve and fifteen months), the proportion of children with low weight-for-age (L/A) actually decreased (from 18% to 15%). The proportion of children with L/A less than -2 SD continued to increase until 21 months, when length appeared to begin to recuperate. This suggests that while an increased number of children were able to gain weight, there remained impediments to support adequate linear growth.

Breastfeeding

Breastfeeding frequency slowly decreased over the second year by only 1.5 feeds (Table 8; Figure 4). The frequency figures most likely are an underestimate of 24-hour suckling, as mothers can estimate feeds during daylight hours but children may suckle frequently at night without the mother waking. Even at 21 months, there were children with high frequency of feeds (up to 15.3 feeds/day).

Morbidity

Incidence and prevalence of diarrhea were relatively constant across the four quarters of the second year (Table 3). The incidence was equivalent to over eight episodes per child-year. Dysentery was uncommon in this sample.

Complementary Foods and Animal Protein

There was little change in intake of complementary foods over the second year of life, with a mean gain of less than one food between twelve and 21 months of age (Table 3; Figure 4). Animal protein showed a similar tendency, with the mean number of consumed foods that were high in animal protein remaining constant at 3.5 throughout the four quarters. This may reflect that intake limitations at this age were less related to beliefs concerning readiness of the child to eat and more related to limited resources available to purchase foods for the entire family.

Bivariate Analyses

Figures 5-7 show the unadjusted association of linear growth with breastfeeding frequency, complementary food intake, and intake of foods high in animal protein. The bivariate associations are strongest in the first quarter of the second year. When dietary intake and illness rates are not considered, the negative association between breastfeeding and growth is only noted in the twelve- to fifteen-month olds.

Association of Breastfeeding and Stunting in Twelve- to Fifteen-month Old Toddlers

To investigate the association of breastfeeding on linear growth, we analyzed longitudinal data from twelve- to fifteen-month olds. As mentioned previously, this study interval was emphasized because it incorporates a time when breastfeeding frequency is still high and human milk still may be providing a large proportion of total energy and nutrient requirements, complementary food intakes are often limited, and diarrheal morbidity is high. In addition, mothers as well as health professionals often consider twelve months an appropriate time for changes in child feeding patterns.

Sample

Of the 200 children with twelve- and fifteen-month measurements, 64 did not have all variables of interest for this and the logistic regression analysis that follows. The data from these 64 children were excluded. Data from two additional children were discarded due to their values varying exceptionally from those of the remaining children. The final sample included 134 children. The excluded children did not differ from those included in the analysis by anthropometric, morbidity, or socioeconomic variables (Table 4).

Data Analysis

The *a priori* model for the linear regression analysis predicted fifteen-month length with proximal biological variables reflecting intakes and losses of nutrients and their relevant modifiers. The variables used in the equation included twelve-month length, time interval between twelve- and fifteen-month measurements, and twelve- to 14.9-month breastfeeding frequency, complementary food intake, and diarrheal incidence variables. Complementary food intake and incidence of diarrhea were categorized as above or below their mean and converted to three indicator variables. The variables were: group 1 (low diet/low diarrhea), group 2 (high diet/low diarrhea), and group 3 (low diet/high diarrhea). High diet/high diarrhea was the base value when all three indicator variables were equal to 0. All continuous variables were centered at their mean. There was no carry-over effect of previous dietary, breastfeeding, and morbidity status; therefore, lagged variables for these factors were not included in the equation.

Characteristics of 134 Children

Anthropometric measurements showed that 19.4% of the children were stunted (<-2 Z-scores H/A) at twelve months; this increased to 29.1% by fifteen months of age. Only four children were wasted at twelve months (3%); none was wasted by fifteen months of age. Almost three-fourths (72.9%) of the children in the sample continued to breastfeed beyond twelve months. The mean duration of breastfeeding for this sample was 16.8 mo, with 13.3% of the children still breastfeeding at 24 months of age. Incidence of diarrhea was high at this age group, with a mean of 2.1 episodes/study interval, or 8.4 episodes/child-year (Table 5). Although the number of episodes was high, the prevalence of diarrhea was only 8.9% days ill. Complementary food intake varied, as shown by the number of food consumed. Many children still had not tried some foods by fifteen months, including bulgur wheat and other whole grains (65%), fish (50%), legumes (51%), organ meats (24%), and eggs (18%).

Association of Breastfeeding with Growth

Linear growth between twelve and fifteen months had a complicated relationship with breastfeeding, morbidity, and dietary variables. The presence of a significant interaction term in the equation (Table 6) demonstrated that, in this population, it is inappropriate to consider the direct effect of breastfeeding alone. That is, the slope of the line for the association of breastfeeding with growth was not the same for the different subgroups of dietary intake and morbidity, as shown in Figure 8. When complementary food intakes and illness were above the mean, breastfeeding frequency was not associated with a significant increase in length gain, regardless of diarrheal incidence (Figure 8, panel a). The effect of breastfeeding on growth, however, was very different when complementary food intake was low.

When incidence of diarrhea and complementary food intakes were both below their mean values, breastfeeding frequency was associated with no increase in linear growth (Figure 8, panel b). Under the worst health conditions of low intake of complementary foods and high incidence of illness, breastfeeding was associated with a significantly lower linear growth. Under these circumstances, the mean breastfeeding practice would be associated with 1.0 cm less in linear growth than that associated with weaned toddlers over the three-month interval. This would be equivalent to over 1 SD if this difference were to be continued during all of the second year. This reverse relationship was examined to determine if it could be explained by maternal breastfeeding decisions.

Understanding the Negative Association

If the reason for a negative association between growth and breastfeeding was mothers' decisions to not wean because of their children's poor health (referred to as "reverse causality," where the outcome variable causes the explanatory variable and not vice versa), then one would expect to find delayed weaning in those children in the poorest health. Linear logistic regression was used to predict the probability of weaning by the end of fourteen months of age. The sample for this analysis included only those children who still were breastfeeding at the end of their thirteenth month and were therefore at risk of being weaned (n=127). Determinants of weaning included twelve-month weight-for-age, 9- to 11.9-month complementary food intake, and change in incidence of diarrhea between 9-11.9 and 12-14.9 months of age. Lagged variables and an indicator of change in morbidity were used to decrease the analysis problems with events occurring simultaneously.

The results demonstrated that when dietary intake was high, the value of weight-for-age made little difference in a child's chance of being weaned. (Table 7; Figure 9). In contrast, when complementary food intake was low, weight-for-age and change in morbidity both affected the probability of weaning. If weight-for-age was high, then increased morbidity was associated with increased weaning. The opposite was true when weight-for-age was low; increased morbidity was associated with decreased probability of weaning. Therefore, when children

had both poor diet and low weight-for-age, mothers made different decisions than those made by mothers with healthier children. When the morbidity conditions worsened, mothers weaned less often.

Discussion

The negative association between breastfeeding and growth has frequently been reported in the literature. Although reverse causality often has been mentioned as a possible explanation for these results, no previous studies have provided evidence to support this hypothesis. The results of this study argue plausibly for the reverse causality hypothesis. In this poor peri-urban Lima community, increased frequency of breastfeeding was associated with poorer growth only in children with low dietary intake and high morbidity. If reverse causality were to account for these negative findings, then the probability of weaning for those children with the poorest nutritional status, low dietary intake, and high morbidity should be decreased. In this study, it was.

Modification of the Association Between Breastfeeding and Linear Growth with Animal Protein Intake

Human milk may provide up to one-fifth of the total protein and a greater proportion of a number of micronutrients in a toddler's diet. This next analysis was designed to determine whether the level of animal protein intake changed the above mentioned relationship between breastfeeding and linear growth.

Sample

This analysis was based on the 134 children used for the analyses. As already shown, a group of 27 children with below the mean complementary food intakes and above the mean incidence of diarrhea had a significantly different slope for the association between linear growth and breastfeeding frequency as compared to the remaining 107 children. Because of the evidence that the observed negative association for this subgroup was due to reverse causality which obscures the effect of breastfeeding on growth, the present analysis uses data only from those 107 children where breastfeeding was not associated with linear growth.

Data Analysis

The breastfeeding, complementary food, and other variables have been described previously. Animal protein intake was determined from five complementary food categories that were high in animal protein (e.g., bovine milk, organ meats). As animal protein was a subset of the complementary food, there was concern about multi-collinearity (i.e., when two of the explanatory variables are highly correlated and reflect much of the same information in the equation), causing statistical problems. Several formal and informal methods demonstrated no multicollinearity problems.

Conceptually it is logical that there was no problem of multicollinearity. Although animal protein foods are a subset of the complementary foods, they represent a completely different component of the diet. Each food category that was part of the complementary food variable had an equivalent weight of one. That is, the contribution of meat was considered equivalent to tubers, which is reasonable for an energy-related variable. Each food, however, was *not* equivalent when dietary quality (protein and micronutrient contribution) was considered. For a variable reflecting quality, for example, meat would have a much higher weight than tubers or fruits or other non-animal products. Thus, the addition of an animal protein variable adds unique information to the equation.

Characteristics of Children Included and Excluded from Analysis

As compared to the children included in the analysis, those children excluded had, as expected, significantly lower intakes of complementary food and animal protein, and a greater incidence of diarrhea (Table 8; $p<0.001$). There was no difference in breastfeeding frequency between the two groups of children. Excluded children had similar lengths at twelve months of age as those children included in the analysis. The length-for-age of excluded children tended to be lower ($p<0.1$) and length gain was considerable less (about 0.5 cm). No significant differences were found between the groups in twelve-month W/A and W/L, family demographics, or socioeconomic indicators.

Modification of the Relationship Between Breastfeeding and Linear Growth

The manner by which animal protein modulated the relationship of breastfeeding frequency and linear growth is illustrated in Table 9 and Figure 10. Breastfeeding was associated with an increase in linear growth only when children had a low intake of animal protein products (Figure 10, panel a). With all other factors equal, over a three-month period there was a 0.5 cm difference between weaned children with low animal protein intake and those consuming about the average number of feeds of human milk (seven feeds/day), i.e. among these children weaning had a negative effect on growth.

When animal protein was high, there was no relationship between breastfeeding frequency and linear growth (Figure 10, panel b). Under these conditions, the difference between a weaned child and a breastfed child consuming seven feeds/day was less than 0.01 cm.

Modification of the Relationship Between Complementary Foods and Linear Growth

The slopes for the association between animal protein and linear growth differed significantly ($p<0.05$) for low and high complementary food intakes. Whereas increased protein intake was not significantly associated with growth when complementary food intake was high (Figure 11, panel b), it was associated with a large increase in growth when complementary food intake was low (Figure 11, panel a).

Association of Diarrheal Morbidity with Linear Growth

The association of morbidity with growth depended on the level of complementary food the child consumed. When complementary food intake was low, increased morbidity had a negative association with linear growth (Figure 12, panel a). The negative association between morbidity and linear growth was eliminated by high complementary food intakes as shown in the right panel of Figure 12. When all other explanatory variables were held at their mean, there was a 0.35-cm difference in linear growth between the lowest and highest complementary food intake groups when morbidity was high.

Discussion

For most children living in low-income communities, human milk remains an important source of energy and nutrients during the second year of life. The results from this analysis show that the contribution of human milk to these Peruvian toddlers' diet had a positive association with linear growth. It was not possible to determine which components of human milk were most associated with this growth. The growth response was associated with breastfeeding only when protein intake was low. This would suggest that linear growth was limited by either total protein, specific essential amino acids, or micronutients that are associated with animal protein. The protein or accompanying nutrients (e.g., essential fatty acids, zinc, iron) in human milk, were associated with improved linear growth. If this growth response associated with increased breastfeeding was maintained throughout the

second year of life, there would be a cumulative difference of 2 cm, or approximately two-thirds of a Z-score for length-for-age. This is almost 50% of the mean deficit in linear growth by 24 months of age as compared to the WHO/NCHS standards.

The dietary intakes high in complementary foods reflected an intake that was adequate in energy and nutrients to reach the child's specific growth potential under the given living circumstances. If the high diet were still inadequate for growth, improved intake with increased animal protein would be expected to increase growth. In this group of children, however, this did not occur. Similarly, when morbidity was low, increased energy had little effect, suggesting that additional diet was not required. Only under stressed conditions (i.e., limited diets or high morbidity) were the benefits of breastfeeding noted.

COMPLETION OF STUDY AIMS III: QUALITATIVE DATA COLLECTION AND ANALYSIS

The field study focused on influences on maternal decisions to either continue breastfeeding or attempt weaning. Child feeding was a continually reevaluated process, leading to breastfeeding or attempted weaning, or if weaned recently, to permanent weaning or relactation. Although participants were chosen based on a history of breastfeeding through at least twelve months, over half of the mothers (n=19, 59%) reported previously having attempted to wean their children. Of the thirteen mothers who successfully weaned their children, eight did so after one to four failed attempts. Mothers attempted to wean their children when their children were as young as three months of age through the second year of age. The number of mothers who reported unsuccessful attempts peaked around 21-23.9 months of age.

The principal influential factors, how mothers defined them, and what modified the importance of these factors are described below. Then, frequent changes in breastfeeding behaviors are described.

Pilot Studies

Eight women, who were enrolled in another field study, were asked to participate to pre-test the interview guide. The women were selected based on a field worker's choice of good informants, that included being experienced at child-care as well as breastfeeding, cooperative with the field personnel, and verbally expressive of their opinions and the norms of their community. The remaining portion of the sample for the qualitative study has been described earlier.

Data Collection

The interview guide was tested and further refined during the pilot case studies. The first set of interviews with the mothers took place between September and December 1993. Twenty-two (sixteen lactating and six non-lactating) mothers were interviewed a second time between January and April 1994. An interview guide was used for each occasion; however, mothers were encouraged to talk freely and the interview often included information not directly related to child feeding but pertinent to understanding the mother's life within the household. Each interview ranged in duration from 40 minutes to 1.5 hours and took place in the woman's home. In the majority of the homes, the interview was with the woman alone or with young children playing in the vicinity.

Three focused group discussions were held with nine, seven, and seven women who lived in the community and had toddlers, but had not been interviewed on an individual basis. The characteristics of women in these discussions are shown in Table 10. These discussions were held between the first and second interviews to confirm concepts that had emerged from the analysis of the first interviews and help formulate the questions that would be discussed in the second interview. The group discussions supported most of the results of the initial set of in-depth interviews. The emphasis placed on two themes was revised based on the group discussions, including: 1) "jalar sangre" (suckling blood) as a primary reason for weaning; and, 2) the belief that healthy

women had to be "plump" (it was later found that weight change was the more important factor in determining influences on weaning. The group discussions supported the importance of maternal health as an influence on weaning, and gave additional support to the mixed opinions concerning the relationship between breastfeeding and appetite for complementary foods.

Health professionals and the IIN personnel were interviewed only once between January and April 1994. The interviews were conducted in private at the clinics or health posts. All of the interviews of the mothers, the health professionals, and IIN staff were taped and transcribed verbatim.

Data Quality

The quality of the data used in these analyses was assured by: 1) repeated interviews with the majority of the women; 2) independent coding of the interviews by two of the staff; 3) analyses conducted jointly by the entire staff; 4) focused group discussions with community women not interviewed to discuss the themes and the interim results; 5) a final presentation of the results to the institutional staff for discussion (many of the field staff are community members and therefore were helpful in interpreting the results); 6) a comparison of the quantitative and qualitative results; and, 7) previous experience of staff members who have worked for many years in the community and on issues concerning child feeding behaviors.

Data Analysis

The analyses were based on the results from 73 interviews with 23 lactating mothers, thirteen mothers who had already weaned their children, twelve health professionals (five general practitioners, four pediatricians, two nurses, and one auxiliary nurse) and three IIN personnel (one field doctor and two field surveillance workers). The number of interviews for each group is shown in Table 11.

The text of the interviews was coded and entered in the computer, using the computer software *Ethnograph* (24). Four categories emerged as the principle components of the interim analysis of the first set of interviews. These focused on how feeding decisions were related to: 1) child factors (appetite, previous and present food intake and food behaviors, health status, personality); 2) human milk factors (its characteristics by child's age and maternal characteristics and health); 3) maternal factors (work responsibilities, reproduction, health, food intake, personality); and, 4) external factors (economy, cultural beliefs and norms, recommendations from others). The categories emerged in part because of the limits set by the interview guide that had been developed to address the primary interests of this research project. Other researchers may have developed different guides about child feeding that would have elicited other information and other categories of interest.

Results from the focused group discussions were used to confirm the interim interview analysis of the first round of interviews and develop the guide for the second round. The answers often reflected what the mother thought, not what she did with the study child, or what she had done with her older children. Numeration provided an idea of how prevalent a given concept was in the minds of the women, but not necessarily how important it was for taking action. To identify those beliefs that led to decisions being made, a comparison is made between the overall number of women who mentioned a theme and the number of times it was a primary reason given to explain an actual weaning event. Quotes from study participants are included to support the discussion. After mothers' responses on each theme are developed, the opinions of the health professionals are given and contrasted to those of mothers.

Sample Characteristics

Characteristics of the sample are shown in Table 12. In general, the families were poor, with limited resources available to purchase food. Women ranged in age from nineteen to 45 years old; most were born in the mountains

and had migrated to Lima. They had lived in the community for a mean of almost ten years. Children in this sample were frequently ill; about one-third of the time (34.0 ± 22.2%) they reported being ill with respiratory illnesses and less of the time (8.4 ± 10.7%) with diarrhea.

Individual Influences on Child Feeding Decisions

Maternal Health

The most common, single reason mothers cited for deciding to wean their toddler was concern for their own health (Table 13). The primary indicator for mothers of the deterioration of their own health was undesired weight loss during lactation. Another indicator was back pain. Mothers considered both of these to be physical evidence of the risk of onset of more serious illnesses (e.g., tuberculosis). Tuberculosis was an understandable merited fear in this community; about 10% of the 36 women interviewed were on or recently had ended treatment for the disease. Mothers perceived other illnesses also to be associated with continued breastfeeding, including anemia, pneumonia, and other respiratory diseases.

Weight Loss

In industrialized countries, promoters of breastfeeding often cite weight loss as a benefit that can be a motivating factor for lactation. In the study community, however, healthiness was more closely tied to *weight maintenance*. It was accepted that women may differ in their normal weight, but regardless of that initial state, weight loss was viewed as debilitating.

What were the factors that led to weight loss? The majority (n=25; sixteen lactating and nine non-lactating) of the mothers identified continued breastfeeding as the primary reason. Three mothers said that they gained weight during lactation while three maintained their weight (five women did not discuss weight loss).

> What she [the mother] eats, the child suckles with force. It [the food] nourishes more the child and, then, the child has taken away the mother's energy. For this reason she ends up thin.
>
> L3: 763-768

Weight loss was also associated with economic difficulties, marital and health problems.

Back Pain

Back pain was seen as a discomfort or an indication of serious illness. Mothers frequently reported that back pain occurred with continued lactation (n=16; nine lactating, seven non-lactating). They associated back pain with breastfeeding an older (over twelve months of age) or male child and with night feeds [because of the frequency and lengthy duration of the feeds, exposure of the mother's chest to the cold night air, and the intake of all available milk after which the child was thought to *chupar sangre* (suck blood)].

A few mothers (n=3) commented on having no physical discomfort during breastfeeding. For the woman quoted below it was the feeling of well-being, in addition to having only one child, that encouraged her to continue to breastfeed.

> Well, a neighbor who sells in the marketplace told me that it does damage to the lungs....In the day it's ok to breastfeed, but in the night no she says because she says that it consumes you. But no, it seems to me to be a lie. I feel the same. I feel the same. I wake up normal. I don't feel any pains. I don't feel anything. I feel perfect. I feel like myself.
>
> L6: 1322-1337

Beliefs Lead to Behaviors?

Table 13 lists the factors that mothers mentioned as influential in their feeding decisions. The first column of the table gives the number and proportion of mothers who ever mentioned each factor. We have assumed that these statements reflect how prevalent each factor is in the culture. The second column gives the number of mothers who mentioned each factor specifically in reference to a successful weaning event of a study child. These latter factors are those that appear to have had a real effect on mothers' breastfeeding decisions.

The proportion of mothers (75%) who mentioned maternal health as a influential factor was almost equivalent to the proportion (53%) who noted it as the primary reason for the complete weaning of their child. This suggests a congruence between the theoretical beliefs and the actual reasons used in deciding to wean. As will be seen below, this consistency between beliefs and practices is not maintained for all of the four themes. Interestingly, the next greatest consistency between answers was found with "lack of time"; a factor that, as with maternal health, is oriented toward the mother. Some factors that have been frequently reported as primary influences for weaning, such as "pregnancy" and "the child is big," were not mentioned as primary reasons for weaning.

Health Professionals

Most health professionals interviewed did not accept the mothers' opinion that breastfeeding was an important determinant of their health. Nine of the fifteen health professionals and IIN personnel mentioned that mothers whom they had attended were concerned about weight loss during lactation. They attributed the weight loss in their patients to insufficient food supply, excessive work outside the home, or tuberculosis. Their recommendations to the mother were centered on tuberculosis testing or general comments to eat better, to "eat more vegetables, protein because of the B factor, calcium..." (M3: 644-649). One physician, however, encouraged mothers to wean because of poor maternal health:

> The mothers that have poor economic resources, the mother is all thin, all pale and wiped out, the mother is malnourished with anemia, then I tell the mother, little by little you should wean that baby...
> M4: 574-581

Child Health

In general, mothers in this study weaned children who were considered to be sufficiently "big" (*grande*), an expression for stage of development, that encompassed age, motor and language development, as well as nutritional status. In addition, mothers preferred to wean healthy children who were eating well. These three areas of the child's well-being (stage of development, morbidity, and appetite) were the central child-related issues influencing maternal decisions concerning breastfeeding.

Child Development

Twenty-two mothers mentioned that being "big" was a reason to wean a child. Mothers recognized that each child was slightly different in their development and that they naturally became "big" with time. Some mothers (n=9) said that "big" was two years of age; the range was from one year to five years. Other indicators of "big" were presence of teeth, acquired skills of walking and talking, and being plump. Weaning was recognized as a traumatic event that could set the child back in her/his development. A child who was just learning to walk, for example, may return to the crawling stage if weaned. Mothers, therefore, preferred to wean a child who was well advanced in their motor and language development, thereby diminishing the negative effects of weaning.

Appetite

The mother's perception of the child's appetite was based on whether the child asked for food or had to be offered, the desire (*avidez*) with which the child ate, and the amount consumed. Only eleven of the 36 mothers (eight breastfed and three weaned children) interviewed stated that their children had a good appetite. Appetite was influenced by breastfeeding behaviors, the form in which the food was served, and child factors. Breastfeeding behaviors included: 1) frequent and poorly-timed feeds that interrupted the appetite for other foods; and, 2) abrupt weaning that could depress the child and cause anorexia as a response to the trauma. More than two-third of the mothers (n=25; fourteen lactating, eleven non-lactating) said that there was a close relationship between breastfeeding and a child's appetite. When children breastfed frequently, their appetite for other foods decreased (only one of the 25 mothers said that increased breastfeeding was associated with an increased general appetite).

> Does she breastfeed when she wakes up?
> No, I don't give it to her so that she will eat breakfast.
> You don't breastfeed her?
> No, if I do, she won't eat breakfast.
> L14: 54-61

Few mothers (n=2) said that when children breastfeed less, they ate more solid foods or when the child ate more solid foods they breastfed less (n=4). A more common opinion was that a child with a good appetite would breastfeed frequently too. Some mothers (n=4) felt that a traumatic weaning event could have a temporary anoretic effect on a child; therefore, they wanted their children eating well before weaning. In the long-term, however, many mothers felt that children's appetites improved and food intake eventually increased with weaning (n=15; six lactating and nine non-lactating).

As can be seen by the frequency of mothers' responses on breastfeeding-appetite relationships, there was a strong belief that frequent breastfeeding decreased intakes of other foods but decreasing breastfeeding did not necessarily increase the intake of other foods (except with total weaning). In accord with these responses, few mothers discussed increasing food intake as a method of weaning. This may reflect an understanding of the complexity of breastfeeding and the multiple reasons, in addition to hunger, why children continue to breastfeed.

Other factors determining appetite included the form in which food was presented: 1) how the food was served; 2) the eating atmosphere; and, 3) feeding history during the first year. Characteristics of the child that influence intake included: 1) daily fluctuations in intake; 2) nutritional status and nutritional deficiencies; 3) health status; and, 4) intrinsic characteristics (e.g., the child was a poor eater). Health status was recognized to be the most important in determining appetite. One mother explained that she did not wean a sickly child just in case the child refused other foods in a future illness.

> Sometimes when he gets sick, for example last week, almost 15 days he had diarrhea, pure milk, milk and water, milk and water. That was his food. He didn't want to eat soup, a little, but milk and water, milk and water, in that plan was he. So I say, perhaps he's going to get sick again and if he doesn't breastfeed, perhaps he'll get even thinner. It's best that I not wean him yet.
> L4: 127-141

Beliefs Lead to Actions?

Unlike maternal health, beliefs concerning the child's health were less directly influential in weaning decisions. As shown below in the analysis of patterns of reasons, the child being "big" or having a poor appetite were not primary reasons to wean. They were, however, limiting factors in whether or not mothers acted for other reasons. Mothers, for example, may have wanted to wean because of their own weight loss, but they did not stop breastfeeding until their child was eating well.

When reviewing the reasons why mothers relactated (after a failed attempt at weaning), the primary motivation was the child. The child who did not accept the weaning process and cried too much and/or stopped eating was put back on the breast. So, a child's health was a limiting factor in the decision to wean but the primary influencing factor in the decision to relactate.

Health Professionals

The majority of the health professionals examined physiological causes of poor appetite before behavioral causes. Physiological causes included acute infections and parasites. Two pediatricians blamed the mother for laziness in introducing foods during the first year, which caused the child to be reluctant to try solid foods. Only two general practitioners and a well-baby clinic nurse (M5, M6, M7) mentioned breastfeeding behaviors as interfering with the intake of other foods and discussed feeding recommendations to increase the child's appetite for table food.

Many health professionals seemed ill-equipped to attend a behavioral feeding problem. Their efforts were concentrated on the acute illness (and the anorexia with which they might have been associated) and other nutrition-trained professionals were not available to assist mothers in behavioral feeding problems.

Time and Work Considerations

Breastfeeding was considered a time-demanding practice, not because of the time spent feeding but because of the interruptions to daily chores. Many mothers (n=14) stopped their daily chores to breastfeed the child who was crying or bothering them. Two mothers said that they breastfeed before starting the chores, one mother planned her chores around the child's nap, whereas others gave a bottle, sweets, or other foods to distract the child during her chores.

> They cry a lot so that all the time the mother breastfeeds them, they don't let the mother do anything. That is, they have to be there, there breastfeeding them when they are bigger. Very bothersome when they breastfeed. A lot of times many people quit breastfeeding for that. They give them their bottle, there they are holding on to it, walking over there and not bothering. Then they let one do her work tranquilly. When they are babies you breastfeed them and put them in the bed and they are there tranquilly. But when they are his age, when they breastfeed, they want to be here, bothering and bothering the mother. Then they don't leave her in peace, therefore many mothers prefer to wean so that the child doesn't bother her. D4: 826-847

Mothers considered there to be a conflict between their work obligations and breastfeeding when the dual responsibilities affected their health (they became too tired, lost weight, or became ill) or their ability to finish their obligations was hindered (especially if paid work was involved).

For some women, however, the demands of traveling to and from work, working outside the home, and returning to a breastfeeding child were too strenuous. Mothers discussed three reasons why the dual roles came in conflict, leading them to wean their child. First, breastfeeding became too tiring or too bothersome for the mother when she returned home from work. In addition, breastfeeding during the night did not allow the mother to rest completely and she would awaken to go to work tired the next day.

A second reason for weaning was that some types of work were deleterious to the milk, making it harmful for the child. This was specific to two strong cultural beliefs concerning a hot-cold imbalance and "stored milk." Mothers who washed (e.g., clothes, bottles in factories) had breastmilk that had been chilled from exposing the hands to cold water. If consumed straight away, their milk would cause gastrointestinal or respiratory illnesses. Normally, the mother would drink something hot before breastfeeding, but mothers did not always have something hot prepared. Another remedy for cold milk was to discard the first drops of milk to decrease the risk of harm to the child. For some mothers, however, the only answer was to wean the child.

For mothers who were absent for lengthy periods (e.g., street merchants), the milk in a full breast was *stored* and, if consumed, could cause diarrhea. Most women believed that one should discard the first drops of *stored* milk before breastfeeding. In both of these examples, there were acceptable solutions (other than weaning) to these culturally-perceived problems. Some women, however, continued to use these explanations for weaning. A final reason for weaning for a few women was the discomfort because of milk leakage. This was the least frequent reason offered.

Beliefs into Actions?

Conflicting time commitments were not a primary reason for weaning (Table 13). Almost three times the proportion of mothers discussed the factor as influential than actually named it as a primary reason for weaning. It is not surprising that only two mothers mentioned time as influential. To be interviewed, mothers had to be available during the afternoons, which meant that they did not work full-time outside the home. The two mothers who did wean due to work were interviewed on the days they were home between changing jobs. The importance of employment in these results may be underestimated for the community as a whole because many other women did work full-time. It is worth noting that weaning references linked to work were in conjunction with maternal health (the woman was too tired after work) or child's health (bad milk). Work *per se* (i.e., the absence of the woman from the home throughout the day) was not a reason to quit breastfeeding in this community.

Health Professionals

Health professionals considered that the primary reason for weaning young children was maternal employment (nine out of ten health professionals mentioned employment). This proportion was much higher than what mothers reported and may, once again, reflect the difference between this sample population of mostly non-working mothers and the community as a whole.

Human Milk as a Nutritious Food

One of the most frequent opinions heard from mothers was that their milk after six to twelve months was of poor quality and could be harmful to the child. Those beliefs did not lead mothers to wean their children but appeared to be used more to support a weaning decision that had already been made. Mothers linked their milk's nutritional qualities primarily to the child's age and maternal characteristics.

Mothers evaluated the quality of the milk by its physical characteristics, the quantity produced, its effect on the nutritional status of their children (visible fatness), and its effectiveness in satisfying their children's hunger.

The quality of breastmilk was thought to decrease when the perceived viscosity of the milk changed from thick to thin (*ralito*), and the color changed from white to watery-white (*blanquisa*). Mothers associated the fatness of children with thick milk; a child's thinness was caused by a mother having watery milk. Interestingly, these ideas contradict their belief that human milk was not a "food"; here, milk nourished a child.

The belief that milk was not nutritious was tightly associated with children's weight gain. Mothers knew that foods other than human milk were needed after six months, they reasoned that if their milk alone could no longer sustain growth, then the milk must have become less nutritious. Most mothers did not recognize milk's complementary role in the diet.

> If it [her milk] nourished her then the child would be with more body, more filled out. That is to say, at one year, until eight months, my daughter was super-fat, she was over-nourished... But after eight months, around a year, she lost weight because I think that the milk already had gone down in consistency and at 1.5 years also she was skinny because she breastfed more.... What foods was it [breastmilk] going to give her I realized. That milk doesn't nourish her, because if my baby were nourished then she would be fat...
>
> 2L2: 1643-1677

One mother rejected the idea that human milk was a food because milk alone did not satisfy her child's hunger. Women's perception of human milk was similar to that they held of snacks. Snacks given before meals were not considered food because, although they temporarily diminished a child's appetite, they did not satisfy hunger.

> When I gave him my milk, he asked to eat, he wasn't full. That is to say, that for me, that my milk wasn't normal any longer, water, water. Because I breastfed him, he asked to eat ... Yes, always he breastfed, that he took all the milk and wasn't full. I said why isn't he full if he has breastfed from my two breasts, he breastfed, he asked me [for food]. For me it wasn't a food, it didn't fill him any longer, but was just pure liquid, water, water. It wasn't a food any longer really.
>
> D1: 473-486

Some mothers thought that all human milk was nutritious. They believed that the quality of the milk was not affected by the diet, nor the mother's health, nor the child's age. According to them, their milk was perfectly fine, even better than Gloria-brand evaporated milk (the most prestigious brand of milk used in Peru).

This positive opinion of human milk was not, however, held by the majority of women. Almost two-thirds of the mothers (n=23) considered that human milk lost its nutritional qualities over time. The range in which mothers identified milk as not nutritious ranged from six months to over two years or more, with the largest number of mothers (n=12) mentioning twelve to eighteen months. Before six months, the milk was unanimously considered to be an excellent "food" for the infant. As the child grew and began to consume solid foods, milk lost its identity as a "food." Mothers considered that the milk was no longer normal; it no longer had vitamins, it was similar to giving nothing to the child or just a refreshment, it became like water, and broth was more nutritious than it was. Mothers often mentioned that the doctor had said the their milk was pure water. Comments such as these from health professionals may have been made with the intention of encouraging mothers to feed more solids to their children. The health professionals placed emphasis on increasing the intake of table foods and did not frequently discuss the role that human milk continued to have in the child's diet during the second year of life. The explicit, or implicit, message was that human milk was less nutritious as the child grew older.

Maternal characteristics also determined the nutritive quality of breastmilk. These included an intrinsic quality of each mother, her diet because "everything we eat passes through the breastmilk" (L5: 252-258), and her parity. Some mothers had 'thick' milk (a positive characteristic) and others had thin milk; it was not clear if a change in diet or other factors could affect this basic characteristic of the milk.

Milk volume was tightly tied to the concept of quality of milk. In this community, it was generally agreed that certain foods increased milk quantity, such as thinned oatmeal and broth. The quantity of milk was also related to stress and the nutritional status of the mother. Some other mothers recognized that the amount the child suckled determined the amount available. Parity was associated also with physical depletion of the mother's own reserves and a determinant of the quality of milk. One mother described an interaction between parity and child's age, such that the milk of the first child was the considered to be the best quality and that which maintained its quality the longest.

> It depends, Señorita, because as they say, the mothers that have their first baby, the milk is still strong until two years, and then... when there are more than two children then well, the milk the first month is fine, but then at a year, eight, nine months the milk is a little watery, it isn't the same as with the first baby.
>
> 2D4: 944-971

In some cases, the mothers saw the milk of the toddler and older child as a noxious substance. It was considered *suero* (serum), blood, or was viewed as curdled. It could harm the stomach or give the child diarrhea, especially if it was *stored* milk (when the breast had not been emptied recently). A few mothers expressed concern about the effect of breastfeeding beyond two to three years of age because of behavioral (misbehaving, being spoiled), academic (could not learn), and gastrointestinal problems.

Beliefs into Actions?

Milk characteristics were influential in weaning in only two cases, both related to the hot-cold belief system and tied to the mother working (Table 13). If most mothers considered that their milk was not nutritive and in some cases harmful, why did they continue to breastfeed? These beliefs appeared to be beliefs that were held, shared within the community, and verbally expressed, but they were not necessarily the factors upon which mothers made their decisions. They may have been used, however, after weaning or when a child was thin to help explain the decision or circumstance. Lactating and non-lactating mothers held similar beliefs, which suggests that these beliefs were not primary reasons for weaning.

When mothers were asked for their reasons for continuing to breastfeed even though the milk was thought to be of poor quality, the responses included: 1) if the child became ill and did not want to eat solids, the breastmilk at least would "sustain" the child; 2) to spoil or entertain the child; 3) to prevent further pregnancies; 4) it was a habit; 5) economic reasons (unable to purchase other milks); and, 6) the mother's sadness to quit because child

would cry. These reasons demonstrated positive characteristics of human milk separate from its nutritional (i.e., promoting growth) role: birth control, life-sustaining function during illness, economical feeding, and emotional support. These roles apparently took precedent for the mother over the lack of a nutritional role for the toddler and even over the noxious characteristic or anoretic effect of the human milk.

Health Professionals

There was agreement between mothers and health professionals that human milk loses its nutritious qualities over time. The same expressions used by the mothers were also heard among some of the health professionals, such as the milk becoming thin (*ralito*) after one year. Only three (out of fifteen) of the health professionals considered human milk to be an important part of the child's diet after twelve months. Doctors in particular were focused on increasing children's intake of semi-solid foods after six months and did not encourage the continued dietary role of lactation.

The mothers frequently quoted physicians saying that human milk was not nutritious after six months. This most likely came from a misinterpretation of educational material to promote exclusive breastfeeding. The message stated "only human milk until six months" but appeared to be often misunderstood to mean "human milk only until six months."

A number of the doctors expressed concern that continued lactation (especially beyond two years of age) had a negative psychological impact on the child leading to an over-dependence on the mother. For them, this was sufficient reason to wean the child.

Patterns of Influential Factors

Mothers evaluated multiple factors in making their decisions concerning continued lactation, weaning, and relactation. Although it is useful to consider factors individually to explore their variability, it does not lead to a clear understanding of the decision-making process. A new pregnancy, for example, may be a primary motive for weaning a child who is eating, growing well, and over eighteen months of age. A mother, however, may ignore cultural beliefs concerning breastfeeding during pregnancy if the child is younger and is a poor eater. Table 14 shows the combination of motives for weaning that were discussed by 32 mothers and ten health professionals. The multiple responses are considered separately for lactating and non-lactating mothers, as one might expect that the importance given to each theme would vary. Lactating mothers reflected on what they expected to do, what they attempted to do (but failed), or what they did with other children. Non-lactating mothers primarily discussed what they did with the study child. The differences may not be just a reflection of what was done versus what may be done in the future. They may also reflect fundamental differences in these groups of women.

For lactating mothers, work and time constraints were less of an influential component of the weaning decision. Only one-third of the mothers included this as one of multiple factors, no one mentioned work nor mother's health as a single motivating factor. Only three mothers gave the child's health as a single motive.

Over 50% of the women (n=17) gave reasons that reflected a balance between the mother's health and the child's well-being. As mothers believed that the child's status as "big" affected directly their own health, the combination of these two factors would be expected. Support from others often strengthened a woman's determination to wean.

In contrast to lactating mothers, over 60% of the non-lactating mothers (n=7) included work or time constraints as a reason to wean. Health professionals were similar in their opinions to non-lactating mothers. Ninety percent of health professionals included work as a reason for weaning; only 20% gave it as the sole reason.

COMPLETION OF STUDY AIMS IV: PRESENTATION AND PUBLICATION OF RESULTS

The results from this study have been widely published to date. Through written and oral presentations, audiences have been reached in Peru and in the United States, including the para-professional, medical and scientific communities.

The primary findings from the qualitative field study were published in Spanish through a quarterly publication, *Al Dia*, of the IIN. Approximately 2,000 copies were distributed nation-wide in 1994 to health professionals in the Ministry of Health and non-governmental organizations, university libraries, and private subscribers. The publication was used by the Population Council in teaching a course on lactation in March 1995.

Different components of the project have been presented in five scientific meetings: three US-based, one international, and one regional (Latin American) meeting.

The complete project was presented as a dissertation in the Field of Nutrition at Cornell University by Grace Marquis and is available through the University of Michigan's microfilm service.

Individual chapters will be published separately. One paper has been accepted for publication to the *International Journal of Epidemiology*.

REPLICABILITY OF FINDINGS

The living conditions in the study area are not unique. High rates of diarrheal illnesses, inadequate dietary intakes, and increasing rates of malnutrition are seen in many parts of the world. What is less common in many urban settings is a median duration of breastfeeding that reaches into the second year of life. In those communities where one sees breastfeeding, there is emerging evidence that changes in breastfeeding practices resemble those seen in Lima. Launer *et al.* (14), for example, found that Indonesian women changed feeding patterns because of child well-being. Although the reasons for returning to exclusive breastfeeding or relactation were not mentioned by Zohoori *et al.* (13) and Bisgrove *et al.* (12), changing feeding patterns were common in the Philippines. The priority of reasons why women change their breastfeeding behavior may differ between communities or regions of the world, however, it appears likely that we will see similar patterns occurring in areas where women control the feeding decision.

The analyses of the determinants of linear growth in this study are based only on the biological explanatory factors (diet, illness, and breastfeeding). As a result, we would expect to be able to repeat the findings in populations that live under similar conditions of frequent illness, poor diets, and frequent breastfeeding. Previous studies have not analyzed their data in terms of variables that modify the relationship of breastfeeding and linear growth which most likely explains the absence of similar results in the literature.

RECOMMENDATIONS

The results of this study provide many recommendations for educational programs and community interventions. Further education of health professionals is needed to support mothers breastfeeding practices. Doctors do not have time nor the knowledge to do nutrition education with mothers when they come into the health post with a sick child. Nutrition education needs to be provided from another source.

Specific recommendations for health professionals include:

1. Mothers often use a trial-and-error approach to weaning. There may be an increased risk of early weaning of passive infants (those who do not protest). Recognition of the infant's personality may give an indication of his/her risk of being weaned. A prospective research project is needed to determine if this is so.
2. Relactation is commonly practiced and widely accepted. Health professionals should take advantage of this practice when an infant is prematurely weaned.
3. Messages (such as "only breastfeed for six months") can easily be misunderstood. Health professionals need to check to make sure the mother has *correctly* understood the message.
4. Knowledge and understanding of the Ministry of Health's norms for breastfeeding (same as WHO) is needed.
5. Knowledge and understanding of the benefits of breastfeeding after six months is needed.

Interventions that promote breastfeeding should recognize that:

1. Mothers weigh a multiple number of factors when making a feeding decision. One important factor is her own health. To be successful, promotion of breastfeeding *must* start with promotion of women's health.
2. Evaluation of the relationship of breastfeeding with growth should always consider those factors that may modify the relationship. When all children are analyzed together, important associations may be masked.

Finally, these results support the efforts of the Peruvian Ministry of Health to promote the WHO's recommendation to breastfeed into the second year of life or beyond.

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TABLES

Table 1. Maternal and paternal demographic, education, and occupation characteristics of the 1993 sample.

	Maternal (n=284)[1]		Paternal (n=247)[2]	
Characteristic	Mean ± SD	n (%)	Mean ± SD	n (%)
Age (y)	29.0 ± 7.1		33.3 ± 8.0	
Number of live children	3.4 ± 2.3			
Birth place: Lima		120 (42.3)		73 (29.6)
Province[3]		164 (57.7)		174 (70.4)
Time in study site (y)				
<1		11 (3.9)		
1-10		71 (25.0)		
>10		202 (71.1)		
Education: Illiterate		7 (2.5)		1 (0.4)
Primary incomplete		50 (17.6)		23 (9.3)
Secondary incomplete		140 (49.3)		112 (45.3)
Secondary completed		58 (20.4)		68 (27.5)
College/trade school		29 (10.2)		41 (16.6)
Unknown				2 (0.8)
Work: Home[4]		160 (56.4)		2 (0.8)
Salaried		18 (6.3)		109 (44.1)
Independent		106 (37.3)		136 (55.1)
Community participation[5]				
Glass of milk program		114 (40.1)		
Community kitchen		43 (15.1)		
Mothers' clubs		71 (25.0)		

[1] Four were grandmothers and excluded from the age definition.
[2] 37 fathers did not live with their children.
[3] 85% of the immigrants come from the mountain states.
[4] 2 fathers were ill and unable to work.
[5] Participation in more than one organization was common.

Table 2. Number and proportion of children regularly consuming 27 food groupings in 1986 (n=299) and 1993 (n=327). Differences between the proportion consuming each food was tested, controlling for age. Changes in the proportion of children regularly consuming the foods are shown.

Food grouping	1986 study		1993 study		Changed intake
	n	%	n	%	%
Sweetened teas	274	91.6	296	90.5	-1.1[1]
Broths	297	99.3	284	86.9	-12.4
Fruit juices	139	46.4	173	52.9	+6.5
Fresh milk[2]	9	4.5	23	7.0	+2.5[3]
Powdered milk	173	57.9	155	47.4	-10.5[4]
Evaporated milk	130	43.5	187	57.2	+13.7[5]
Dried formula[2]	20	6.6	22	6.7	+0.1
Corn starch	120	40.1	197	60.2	+20.1[5]
Oatmeal	179	59.9	231	70.6	+10.7[5]
Rice[2]	258	78.9	279	93.3	+14.4
Noodles	268	89.6	294	89.9	+0.3
Quinua	94	31.4	182	55.7	+24.3[5]
Wheat/barley	95	31.8	162	49.5	+17.7[5]
Baby cereals[2]	16	5.4	40	12.2	+6.8[4]
Green leafy vegetables	224	97.8	245	74.9	-22.9
Tubers	273	91.3	294	89.9	-1.4
Other vegetables	262	87.6	282	86.2	-1.4
Hot peppers	52	17.4	34	10.4	-7.0[4]
Fruits	265	88.6	297	90.8	+2.2
Breads/crackers	268	89.6	294	89.9	+0.3
Legumes	177	59.2	256	78.3	+19.1[5]

Table 2. (Continued)

Food grouping	1986 study		1993 study		Changed intake
	n	%	n	%	%
Red meats and chicken[2]	215	71.9	277	84.7	+12.8[5]
Organ meats	199	66.6	245	74.9	+8.3[4]
Egg white	207	69.2	238	72.8	+3.6
Egg yolk	215	71.9	249	76.1	+4.2
Fish	169	56.5	259	79.2	+22.7[5]

[1] Change = proportion regularly consuming food in 1993 minus proportion in 1986.
[2] Statistical test completed with 3 age groups because of small cell numbers. All other tests were run with 5 age groups.
[3] $p<0.05$
[4] $p<0.01$
[5] $p<0.001$

Table 3. Sample size with data on anthropometry, morbidity, breastfeeding frequency, complementary foods, and animal protein foods, by analysis period.

Characteristic	Analysis period			
	12-14.9 mo (n=174)	15-17.9 mo (n=169)	18-20.9 mo (n=164)	21-23.9 mo (n=161)
Anthropometry				
Initial weight (g)	8.8±1.2[1]	9.5±1.1	10.0±1.1	10.5±1.1
Final weight (g)	9.5±1.2	10.1±1.1	10.5±1.1	11.1±1.1
Weight gain (g)	0.7±0.5	0.6±0.5	0.6±0.4	0.6±0.4
<-2 sd initial W/A [n (%)]	33(19.0)	25(14.8)	20(12.2)	21(13.0)
<-2 sd final W/A [n (%)]	23(13.2)	25(14.8)	21(12.8)	14 (8.7)
Initial length (cm)	71.9±3.0	74.4±2.9	76.7±3.0	79.0±3.2
Final length (cm)	74.6±3.0	77.0±3.0	79.1±3.1	81.3±3.1
Length gain (cm)	2.7±1.0	2.6±0.9	2.4±0.8	2.4±1.0
<-2 sd initial L/A [n (%)]	35(20.1)	57(33.7)	62(37.8)	61(37.9)
<-2 sd final L/A [n (%)]	53(30.6)	60(35.5)	60(36.6)	44(27.3)
<-2 sd initial W/L [n (%)]	6(3.5)	0(0)	1(0.6)	2 (1.2)
<-2 sd final W/L [n (%)]	0(0)	1(0.6)	3(1.8)	2 (1.2)

Table 3. (Continued)

Diarrheal illness				
Episodes/3 mo	2.2±1.8	2.3±2.1	2.3±2.1	2.1±1.9
Days ill/3 mo	8.5±10.9 (5.0)[2]	8.4±12.1 (4.0)	8.7±11.6 (3.6)	7.9±10.3 (3.9)
Days with dysentery/3 mo	0.3±1.0 (0.32)	0.2±0.9 (0.0)	0.3±1.3(0)	0.4±1.4(0)
Dietary intake				
Breastfeeding frequency (feeds/d)[3]	6.2±2.8	5.7±3.2	5.1±3.1	4.5±3.0
Total number of complementary foods	14.1±2.2	14.6±2.0	14.7±2.5	14.7±2.1
Total number of animal protein foods	3.4±1.1	3.6±1.02	3.6±1.2	3.5±1.1

[1]Mean ± SD
[2]Median
[3]Includes only breastfed toddlers: n_{12}=123, n_{15}=110, n_{18}=90, n_{21}=66

Table 4. Anthropometric, morbidity, and family characteristics of children included in and excluded from the analysis

Characteristic	Included (n=134)	Excluded (n=66)
12-mo length (cm)	72.0 ± 3.0[1]	72.0 ± 2.7
12-mo weight-for-length (Z-score)	-0.3 ± 0.9	-0.1 ± 1.0
Season for 15-mo measurement (% warm)	54.5	43.3
Study interval duration (mo)	3.0 ± 0.2	3.0 ± 0.3
Incidence of diarrhea 12-14.9 mo (episodes)	2.1 ± 1.7	2.2 ± 1.8
Food expenditure/person (soles)[2]	13.9 ± 6.5	12.5 ± 6.6
Accumulated wealth (appliances)[3]	2.4 ± 1.4	2.5 ± 1.2

[1] mean ± SD
[2] n=98 for included and 50 for excluded sample because of missing SES data.
[3] Summative score for ownership of radio, television, blender, sewing machine, and refrigerator. n=107 for included and 54 for excluded sample

Table 5. Descriptive statistics of anthropometric measurements, complementary food intake, breastfeeding practice, and diarrheal morbidity of study participants (n=134)

Characteristics	Mean ± SD	Median
Nutritional status (12 mo)		
Length (cm)	72.0 ± 3.0	71.9
Weight (g)	8.87 ± 1.2	8.8
Dietary intake (12-14.9 mo)		
Supplemental foods (foods)	14.3 ± 2.0	14.3
Animal products (foods)	3.4 ± 1.1	3.3
Breastfeeding (12-14.9 mo; feeds/d)[1]	6.5 ± 2.9	6.3
Diarrhea (12-14.9 mo)		
Incidence (episodes)	2.1 ± 1.7	2.0
Prevalence (d ill)	8.2 ± 10.3	4.9
Fever with diarrhea (d ill)	0.8 ± 1.5	0.0

[1] Only includes children who breastfed, n=119.

Table 6. Multivariate linear regression coefficients for 15-mo length, predicted by 12-mo length, interval period, breastfeeding frequency, and indicator variables for high/low combinations of complementary food intake and incidence of diarrhea (n=134)

Variable	β	S.E.	p
Constant	74.674	0.165	0.000
Length at 12 mo (cm)	0.976	0.024	0.000
Time interval (mo)	0.860	0.244	0.001
Breastfeeding (feeds/d)	0.043	0.044	0.338
Group 1 (1=yes;0=no)[1]	-0.044	0.212	0.835
Group 2 (1=yes;0=no)[2]	-0.006	0.203	0.978
Group 3 (1=yes;0=no)[3]	-0.340	0.233	0.147
Breastfeeding*Group 1	-0.039	0.059	0.505
Breastfeeding*Group 2	-0.033	0.054	0.542
Breastfeeding*Group 3	-0.157	0.059	0.009

[1] Low diet and low incidence of diarrhea; n=37
[2] High diet and low incidence of diarrhea; n=46
[3] Low diet and high incidence of diarrhea; n=27
High diet and high incidence of diarrhea was the value when group 1, 2, and 3 were all set to 0; n=24

Table 7. Logistic linear regression coefficients for 14-mo weaning, predicted by 12-mo weight-for-age, 9- to 11.9-mo complementary dietary intake, and change in incidence of diarrhea between 9 and 15 mo (n=127)

Variable	β	S.E.	95% C.I.
Constant	-3.303	0.644	-4.566, -2.040
12-mo weight-for-age (Z-score)	-0.024	0.446	-0.899, +0.850
9- to 11.9-mo diet (foods)	0.093	0.267	-0.430, +0.616
Change in illness (episodes)	0.542	0.322	-0.088, +1.173
Change in illness* 12-mo weight-for-age	0.336	0.179	-0.015, +0.687
Previous diet*Change in illness	-0.143	0.144	-0.426, +0.140
12-mo weight-for-age* Previous diet	0.046	0.211	-0.367, +0.459
Previous diet*12-mo weight-for-age*Change in illness	-0.202	0.096	-0.389, -0.014

Table 8. Comparison of dietary, morbidity, and growth characteristics of those children with anthropometry included in the analysis to those children excluded because of reverse causality (mean ± SD).

Characteristic	Children included (n=107)	Children excluded (n=27)
Breastfeeding frequency (feeds/d)	6.3 ± 2.8[1]	5.5 ± 4.0[2]
Complementary food intake (foods)	14.8 ± 1.9	12.4 ± 1.0[3]
Animal protein intake (foods)	3.6 ± 1.0	2.7 ± 0.8[4]
Diarrheal morbidity (episodes/3 mo)	1.7 ± 1.5	3.9 ± 1.2[5]
Length at 12 mo (cm)	72.2 ± 3.0	71.3 ± 3.0
Length-for-age at 12 mo (Z-score)	-1.1 ± 1.1	-1.4 ± 1.[6]
Length gain 12-15 mo (cm)	2.8 ± 0.8	2.3 ± 0.9[7]

[1] Includes only 76 breastfed children.
[2] All children were breastfed.
[3] $t = 8.485$; $p<0.001$
[4] $t = 4.910$; $p<0.001$
[5] $t = -8.515$; $p<0.001$
[6] $t = 1.725$; $p<0.1$
[7] $t = 2.572$; $p<0.05$

Table 9. Estimated coefficients, standard errors, and significance levels of predictors of 15-mo length from a multivariate linear regression analysis. Equations are based on a sample of 107 children who showed no indication of reverse causality.

Variable	β	S.E.	p
Constant	74.612[1]	0.106	0.000
12-mo length (cm)	0.977[1]	0.026	0.000
Time interval (mo)	0.758[2]	0.311	0.017
Diarrhea (episodes)	-0.111	0.068	0.108
Diet (foods)	0.109	0.073	0.138
Protein (foods)	0.060	0.113	0.598
12-mo weight-for-length (Z-score)	0.124	0.083	0.135
Breastfeeding (feeds/d)	0.034	0.023	0.147
Breastfeeding*Protein	-0.050[2]	0.024	0.037
Diet*Protein	-0.083[2]	0.034	0.015
Diet*diarrhea	0.082[2]	0.039	0.039

[1] $p<0.001$
[2] $p<0.05$

Table 10. Descriptive statistics for socioeconomic and demographic characteristics of the participants in the focussed group discussions

Characteristics	n (%)	Mean ± SD
Socioeconomic indicators:		
Housing quality[1]		
High	3 (16)	
Medium	11 (58)	
Low	5 (26)	
Families with father present	18 (95)	
Families/lot[2]		
Only 1	11 (58)	
2 or more	8 (42)	
Maternal characteristics:		
Age (y)		31.2 (7.2)
Born in Lima	5 (26)	
Time living in study site (y)		8.7 (5.8)
Education		
Primary school not completed	5 (26)	
Secondary school completed	5 (26)	
Works outside the home	6 (32)	
Paternal characteristics[3]:		
Age (y)		35.4 (8.7)
Education		
Primary school not completed	3 (16)	
Secondary school completed	10 (53)	

[1] High=completed cement/brick structure; medium=cement/brick walls; low=walls made of straw mats

[2] This does not include family members staying for short visits. Lots were 90 m^2.

[3] n=18

Table 11. Summary of the 71 completed interviews, by type of participant (mother, health professional, or IIN staff). Mothers are further identified by child-feeding practice and age at the first interview, and number of interviews completed.

	Number of completed interviews	
	1	2
Mothers		
Lactating		
12-17.9 mo[1]	2(1)[2]	10(2)
18-23.9 mo	5(1)	6(2)
Total	7(2)	16(4)
Non-lactating		
12-17.9 mo	3(1)	1(0)
18-23.9 mo	4(0)	5(1)
Total	7(1)	6(1)
Health professionals	12	
IIN personnel	3	

[1] Age at first interview.
[2] Total number of participants. The number of pilot studies included in the total is shown in parentheses.

Table 12. Descriptive statistics for socioeconomic and demographic characteristics of the 36 study families.

Characteristics	n (%)	Mean ± SD
Socioeconomic indicators:		
Housing quality[1]		
High	8 (22)	
Medium	20 (55)	
Low	8 (22)	
Families with father present	32 (89)	
Families/lot[2]		
Only 1	10 (28)	
2 or more	26 (72)	
Maternal characteristics[3]:		
Age (y)		29.9 (7.4)
Born in Lima	10 (28)	
Time living in study site (y)		8.9 (6.2)
Education		
Primary school not completed	9 (35)	
Secondary school completed	7 (27)	
Works outside the home	10 (39)	
Paternal characteristics[3]:		
Age (y)		33.7 (9.1)
Education		
Primary school not completed	4 (19)	
Secondary school completed	10 (48)	

[1] High=completed cement/brick structure; medium=cement/brick walls; low=walls made of straw mats

[2] This does not include family members staying for short visits. Lots were 90 m^2.

[3] n=26

Table 13. Frequency [n (%)] that mothers mentioned factors that influenced their child-feeding decisions. The frequency of responses are categorized by whether the factor was ever mentioned as a determinant of feeding decisions or whether it was the primary reason for weaning permanently the study child[1].

Factor	All references[2] n (%)	Primary reference to permanent weaning[3] n (%)
Mother's health	24 (75)	8 (53)
Little milk	8(32)	1 (7)
Child is 'big'	19 (59)	0
Hot/cold belief[4]	2 (13)	1 (7)
Appetite	10 (31)	1 (7)
Mother's pregnancy	12 (38)	0
Maternal time commitments	17 (53)	2 (13)
Child quit alone	2 (13)	2 (13)

[1] The former responses included all interviewed mothers who may have given multiple responses; the latter included only the 15 mothers who had permanently weaned their children. These 15 mothers included 11 women who had weaned their children before study enrollment, 2 mothers who weaned her child during the study, and 2 grandmothers who weaned the study child (in both cases the child continued breastfeeding with the mother). Reasons for weaning from the grandmother included little milk and child quit by himself.
[2] These responses are in reference to the mothers' experiences with the study child, their other children, and their general opinions.
[3] These responses are only in reference to the study child.
[4] This refers to the milk being "chilled" (from washing with cold water) and making the child ill if consumed without the mother "warming" her body by drinking something hot or discarding the first milk.

Table 14. Distribution of the frequency that multiple factors were ever mentioned to jointly influence maternal decisions to wean. The frequency of responses are categorized by respondent (32 mothers and 10 health professional)[1]; mothers are further identified as lactating or non-lactating. n (%)

Influential factor	Mothers		Health professionals (n=10)
	Lactating (n=21)	Non-lactating (n=11)	
Maternal health	0	0	0
Work or time constraints	0	0	2 (20)
Child health	3 (14)	0	1 (10)
Maternal health & work	1 (5)	1 (9)	2 (20)
Maternal health & child health	11 (52)	3 (27)	0
Work & child health	0	0	2 (20)
Maternal health & work & child health	6 (29)	6 (55)	3 (30)
Weaned alone[2]	0	1 (9)	0

[1] Not all interviews provided enough information to be used in this table. Responses refer to general indicators of weaning, not to the permanent weaning of the study child. Health professional here includes those working in health posts and clinics as well as the IIN staff. Grandmothers' responses are not included here.
[2] One child weaned herself.

FIGURES

Figure 1. Survival curve for duration of breastfeeding in 1986 and 1993

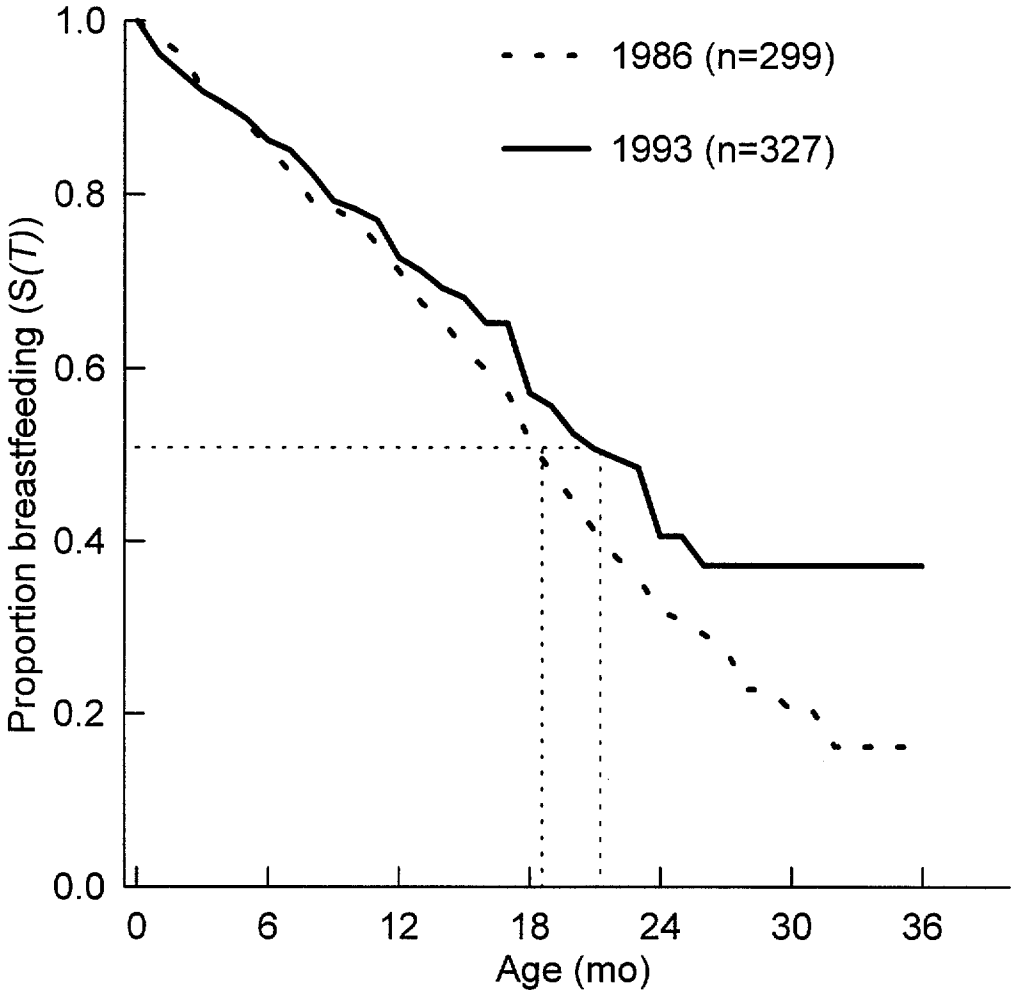


Figure 2. Conceptual framework used in the linear regression analyses

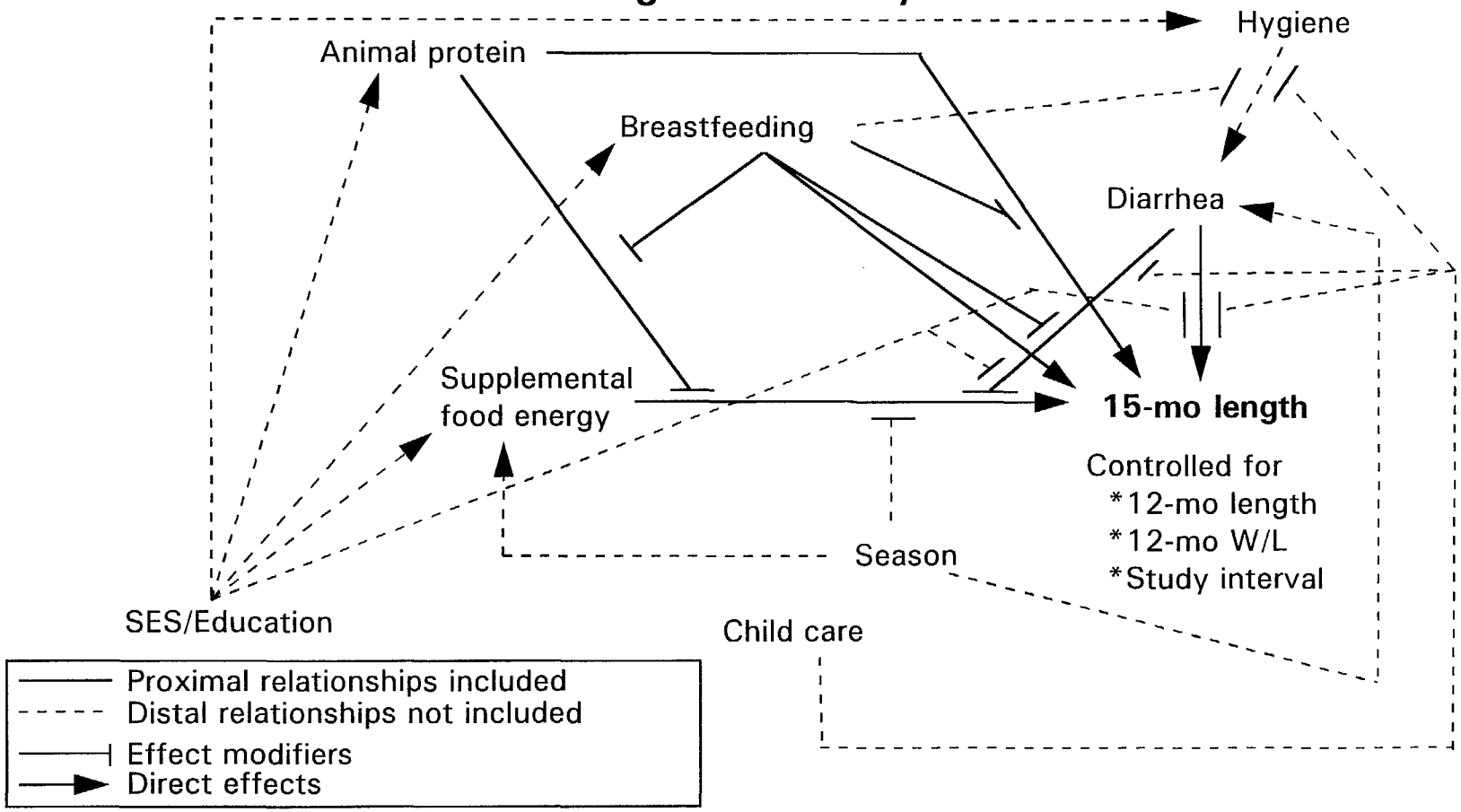
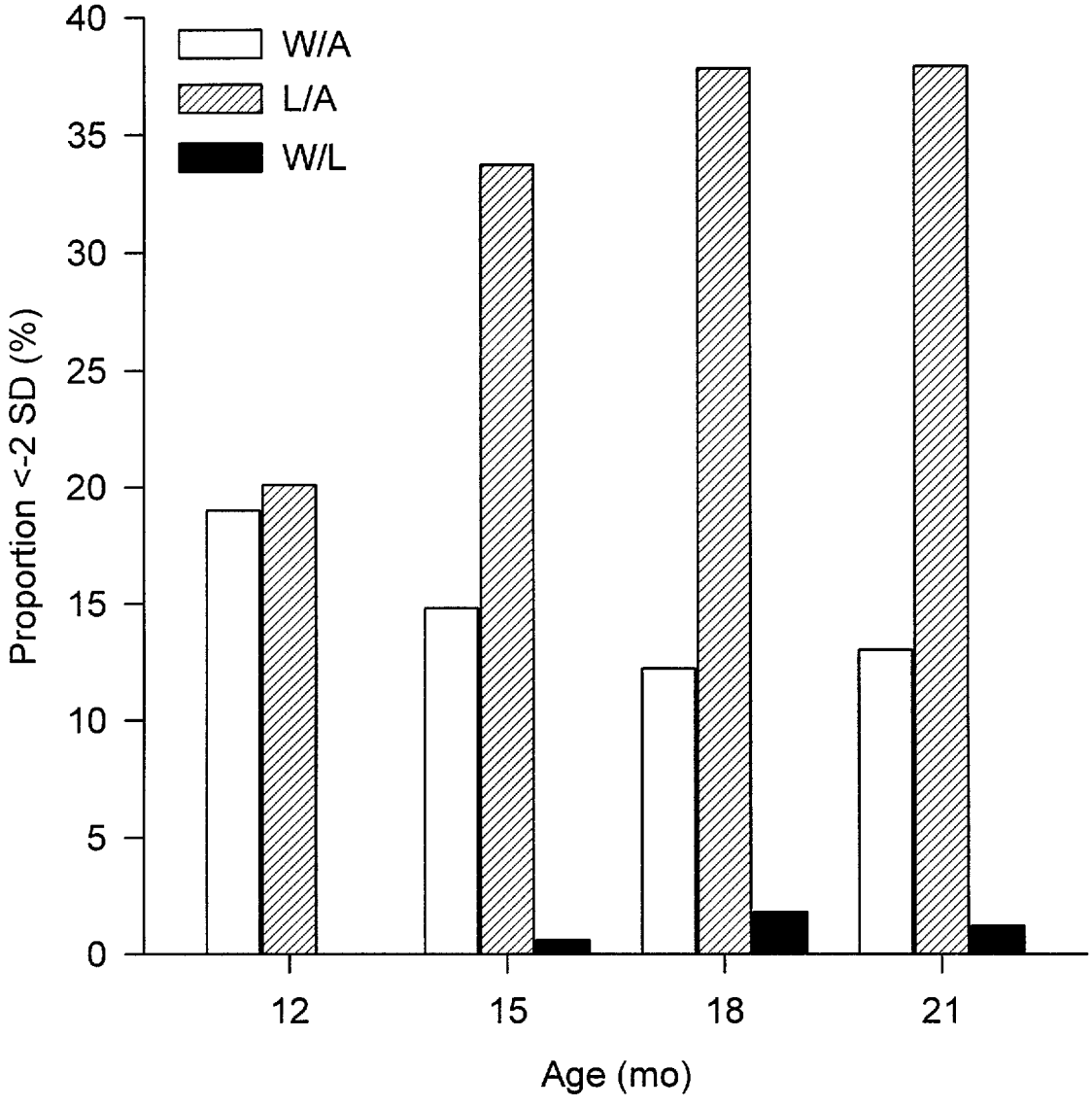
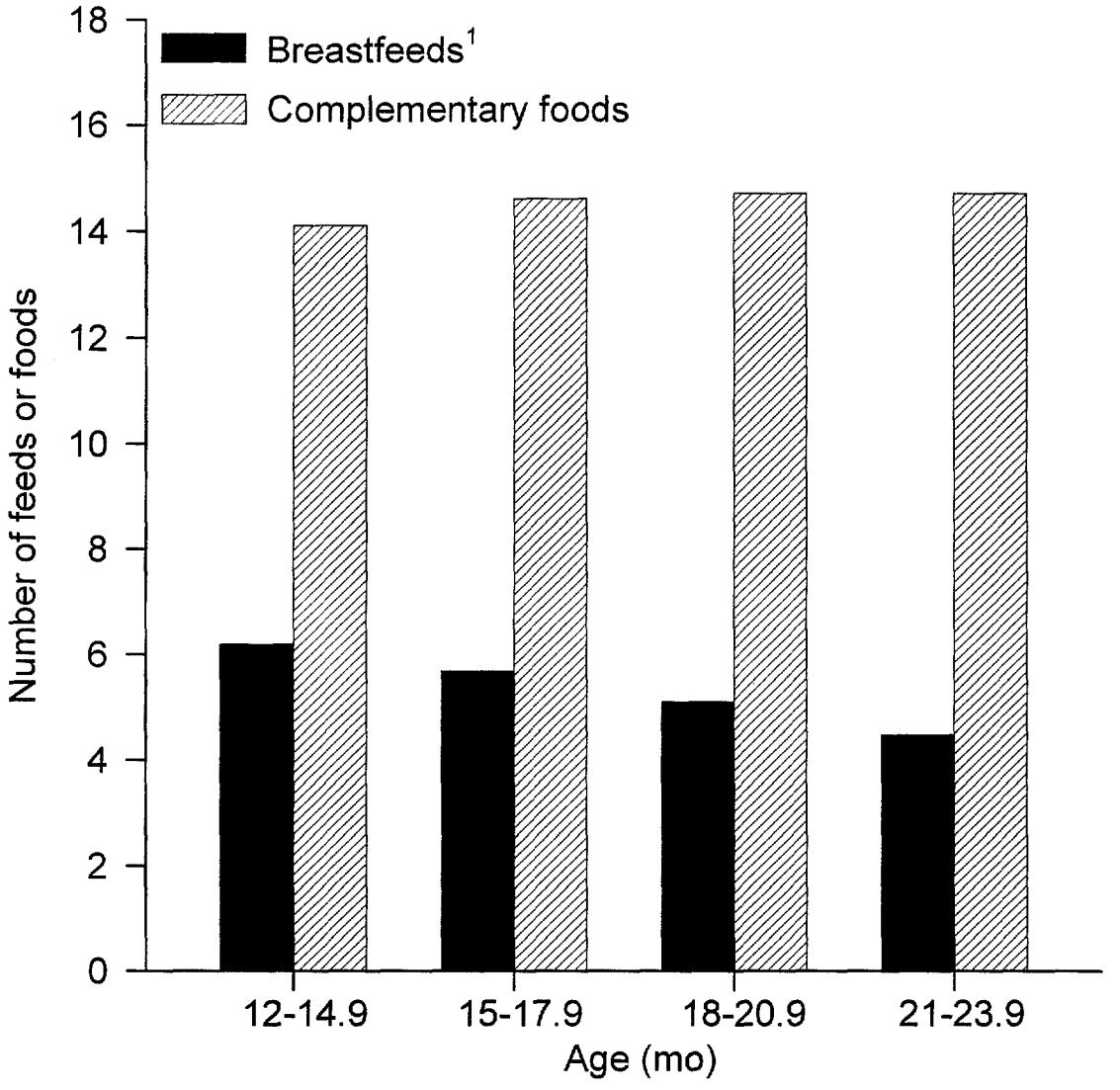


Figure 3. Proportion of children with weight-for-age (W/A), length-for-age (L/A), and weight-for-length (W/L) Z-scores < -2 SD, by age*



*Not all children are in each age group (n_{12}=174, n_{15}=169,n_{18}=164,n_{21}=161)

Figure 4. Number of breastfeedings and different complementary foods consumed per day 12-21 mo of age



[1] Includes only breastfed toddlers

Figure 5. Association between linear growth and breastfeeding frequency, by age

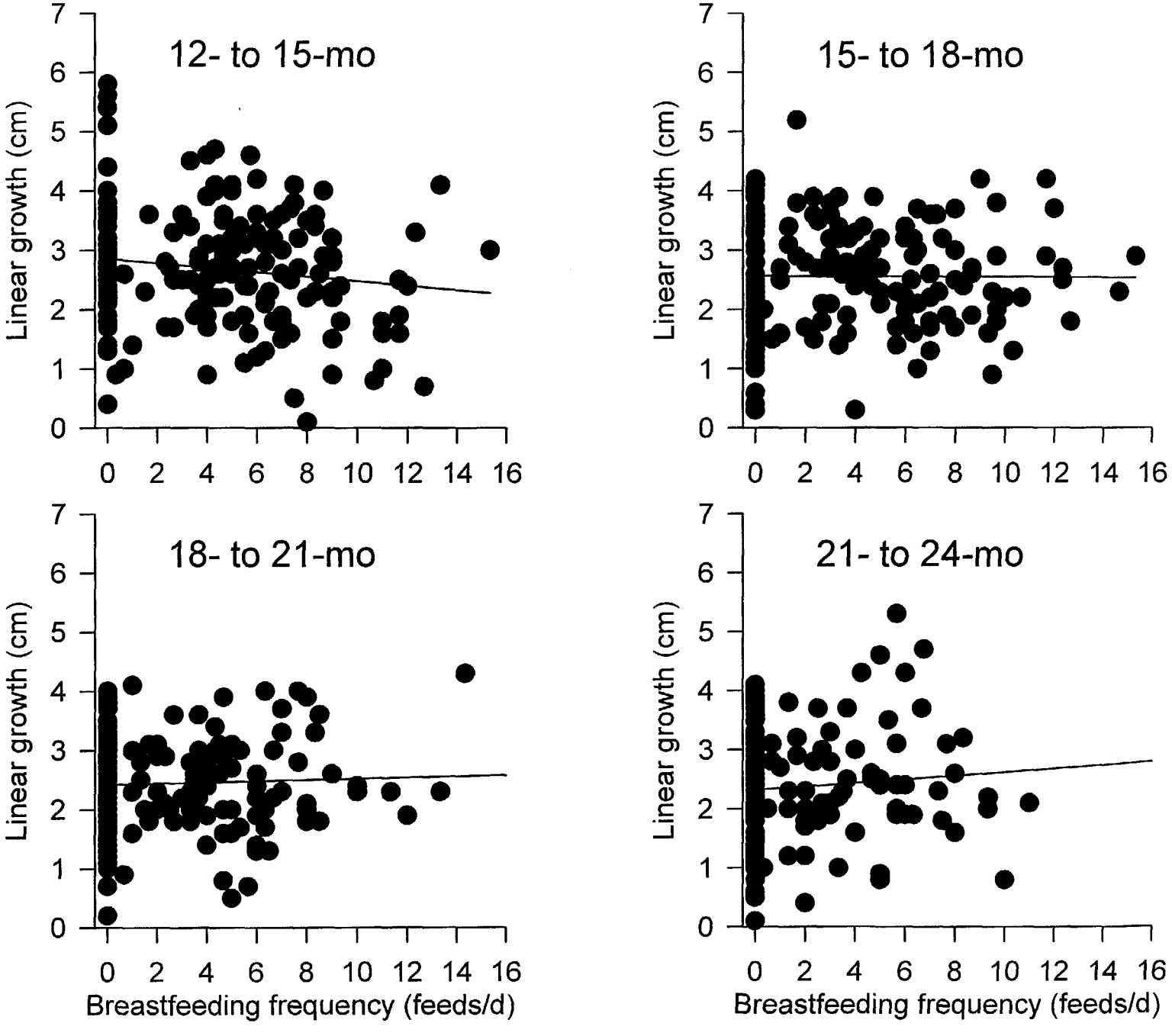


Figure 6. Association between linear growth and complementary food intake, by age

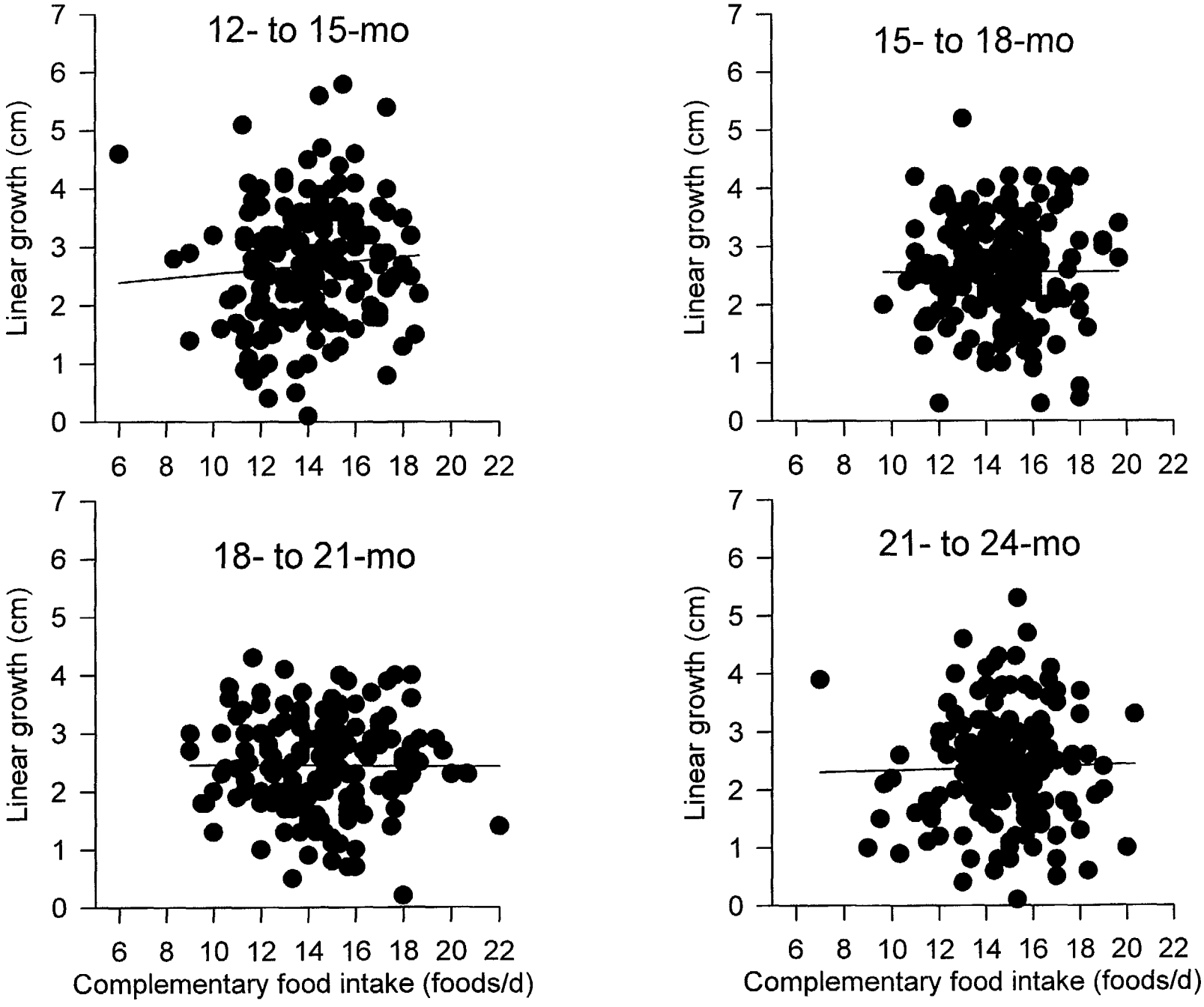


Figure 7. Association between linear growth and animal protein intake, by age

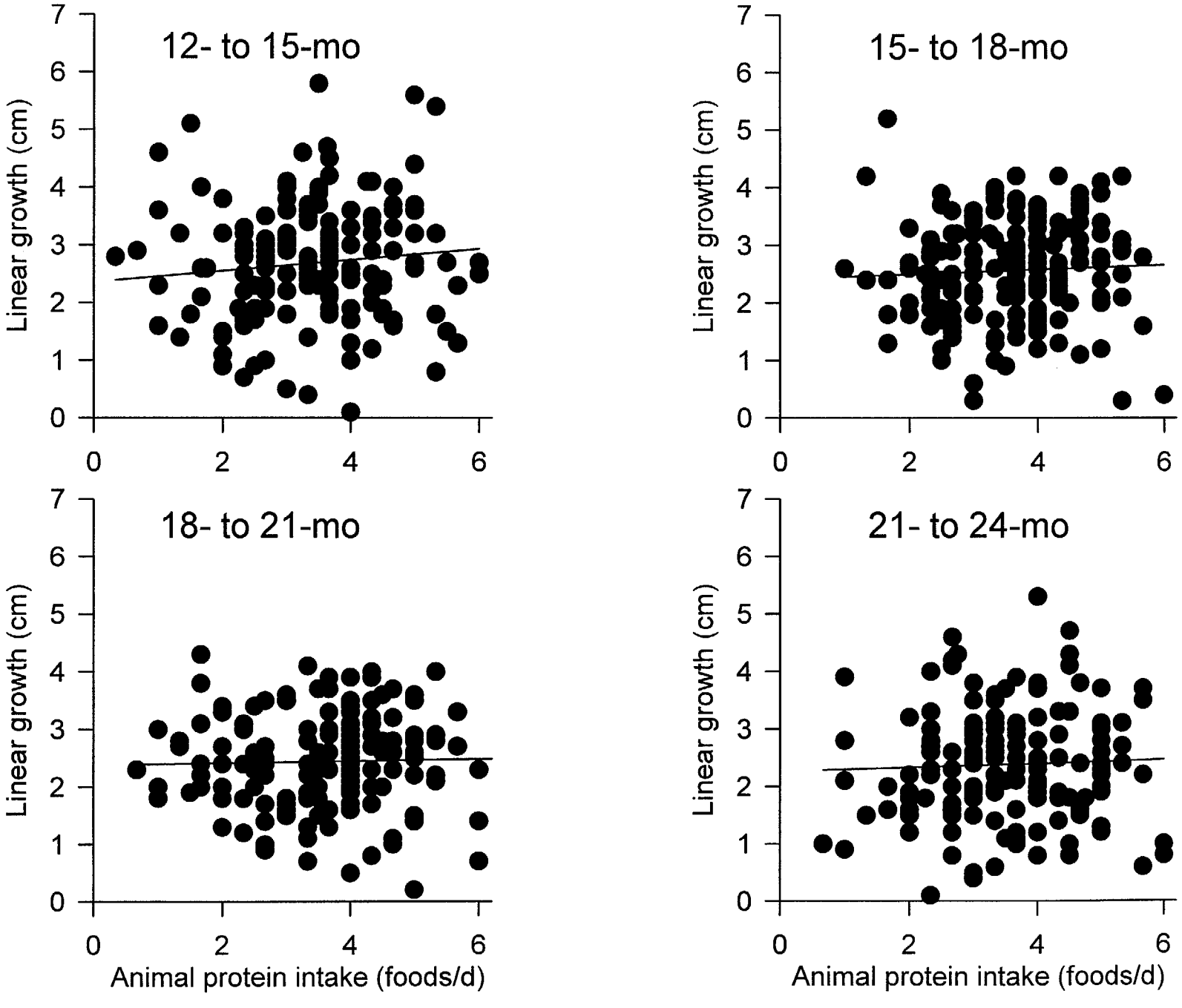


Figure 8. Association of 12- to 15-mo length gain with breastfeeding, by degree of diarrhea, in toddlers with high and low complementary food intakes

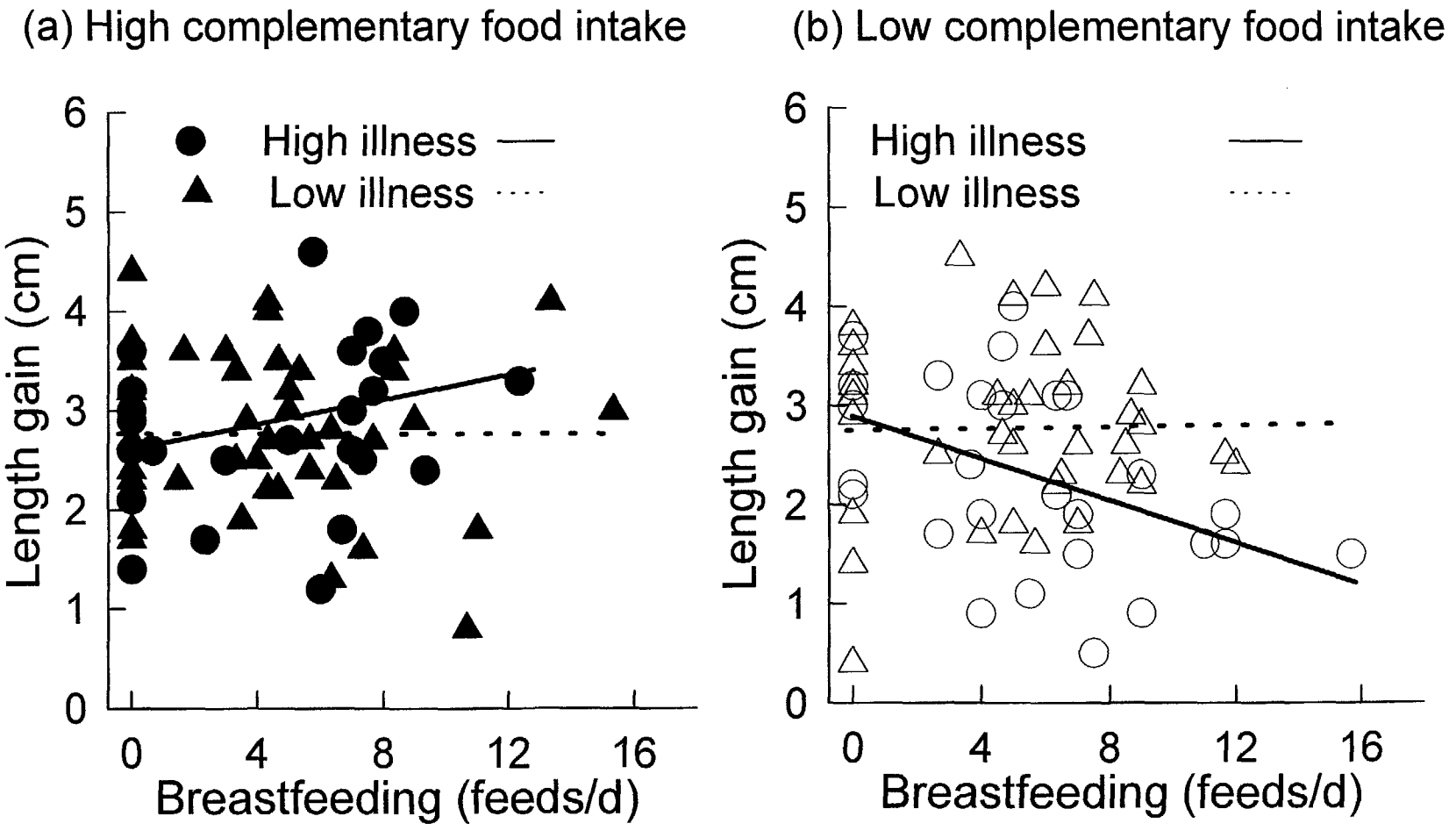


Figure 9. Risk of weaning at 14 mo of age, by diet, 12-mo W/A, and change in incidence of diarrhea

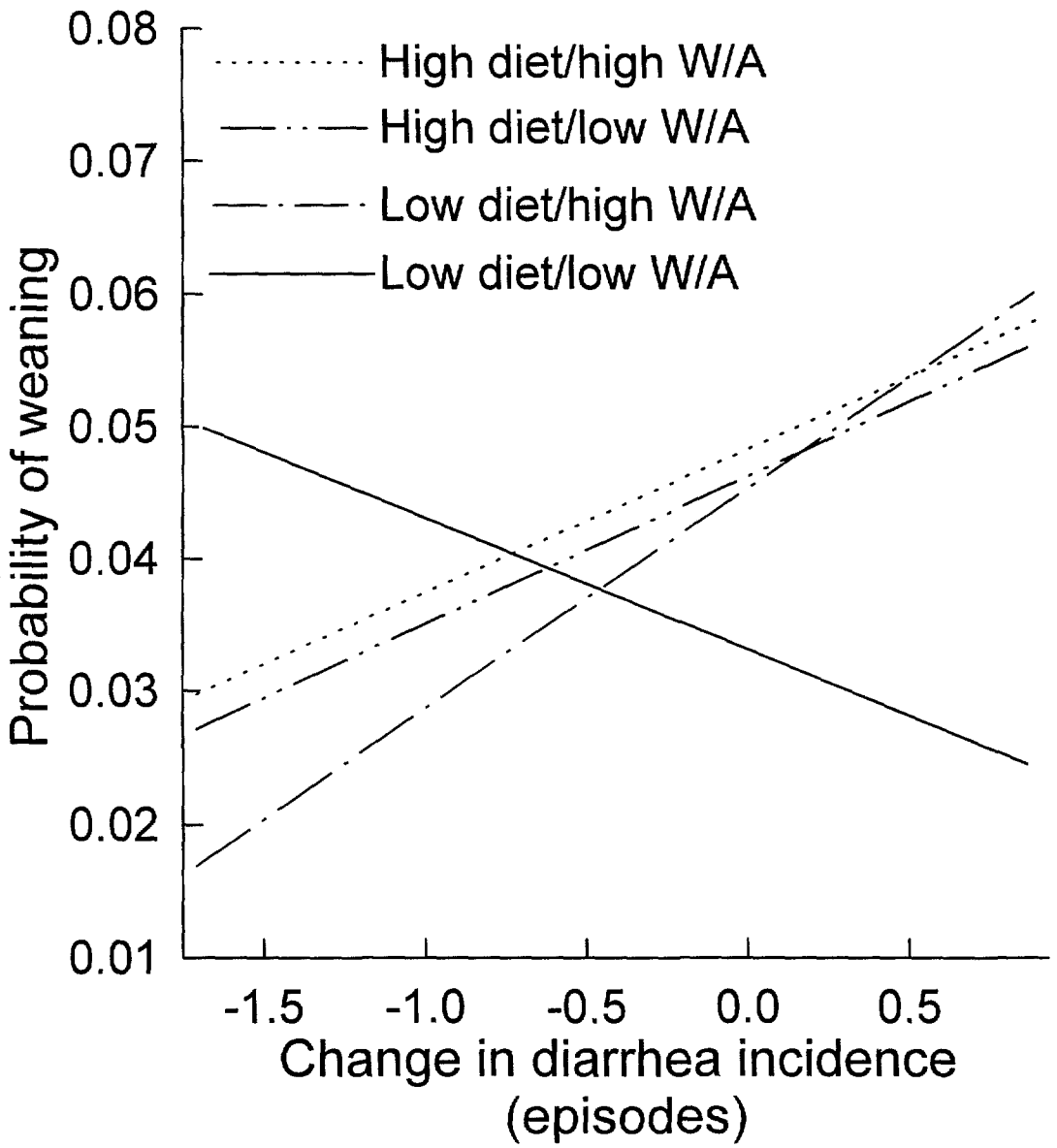


Figure 10. Association of 12- to 15-mo length gain with breastfeeding, by intake of foods high in animal protein

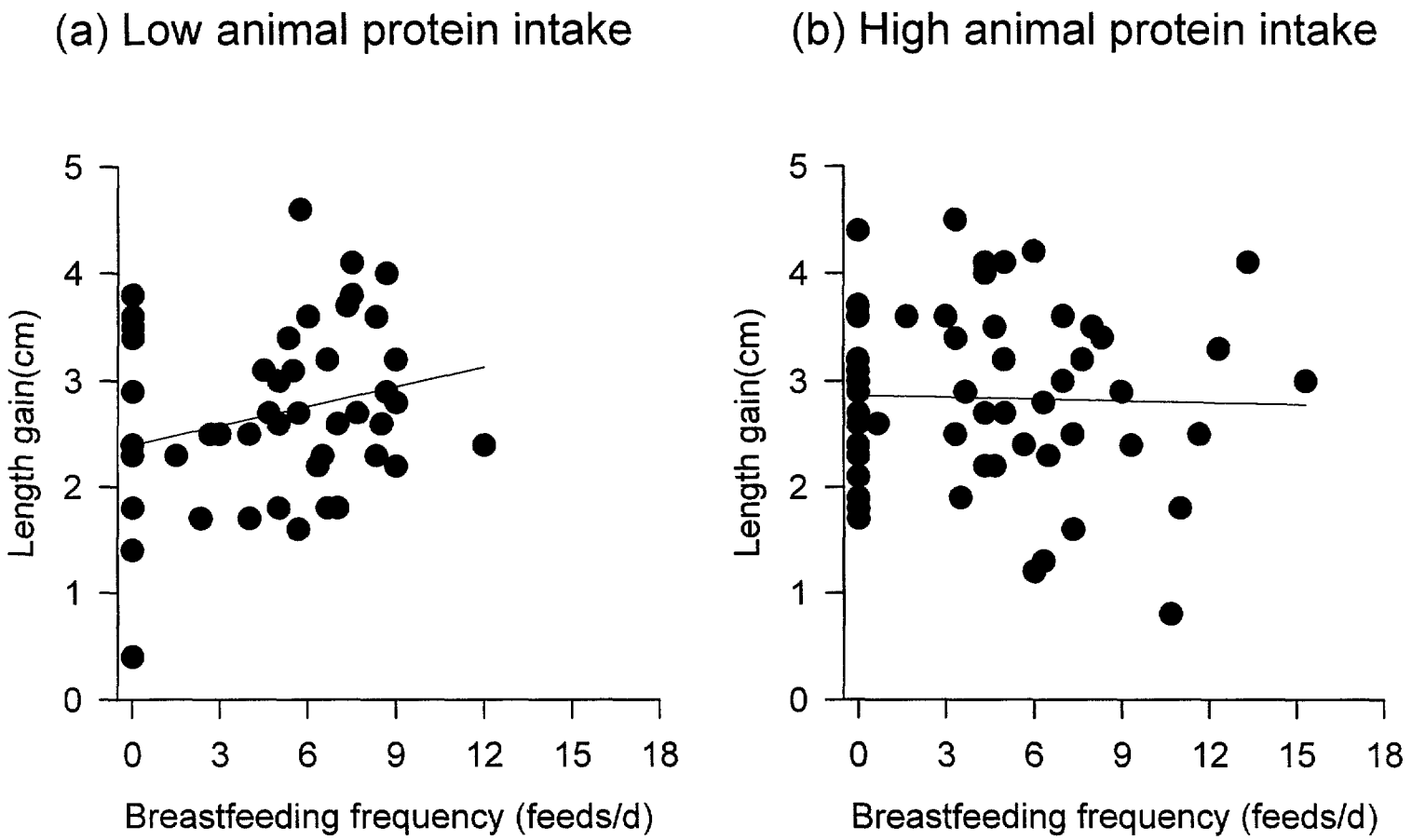


Figure 11. Association of 12- to 15-mo length gain with animal protein intake, by complementary food intake

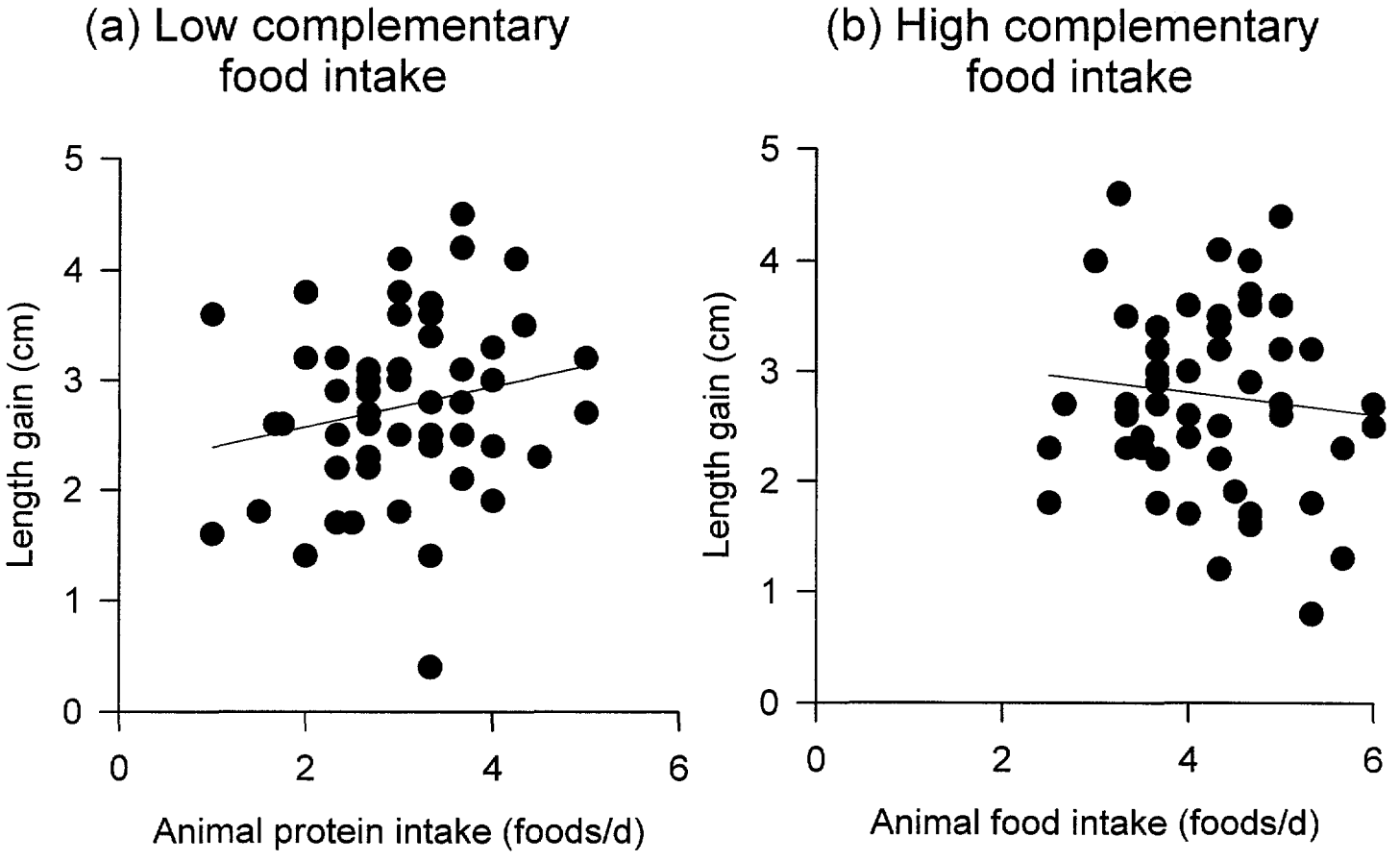
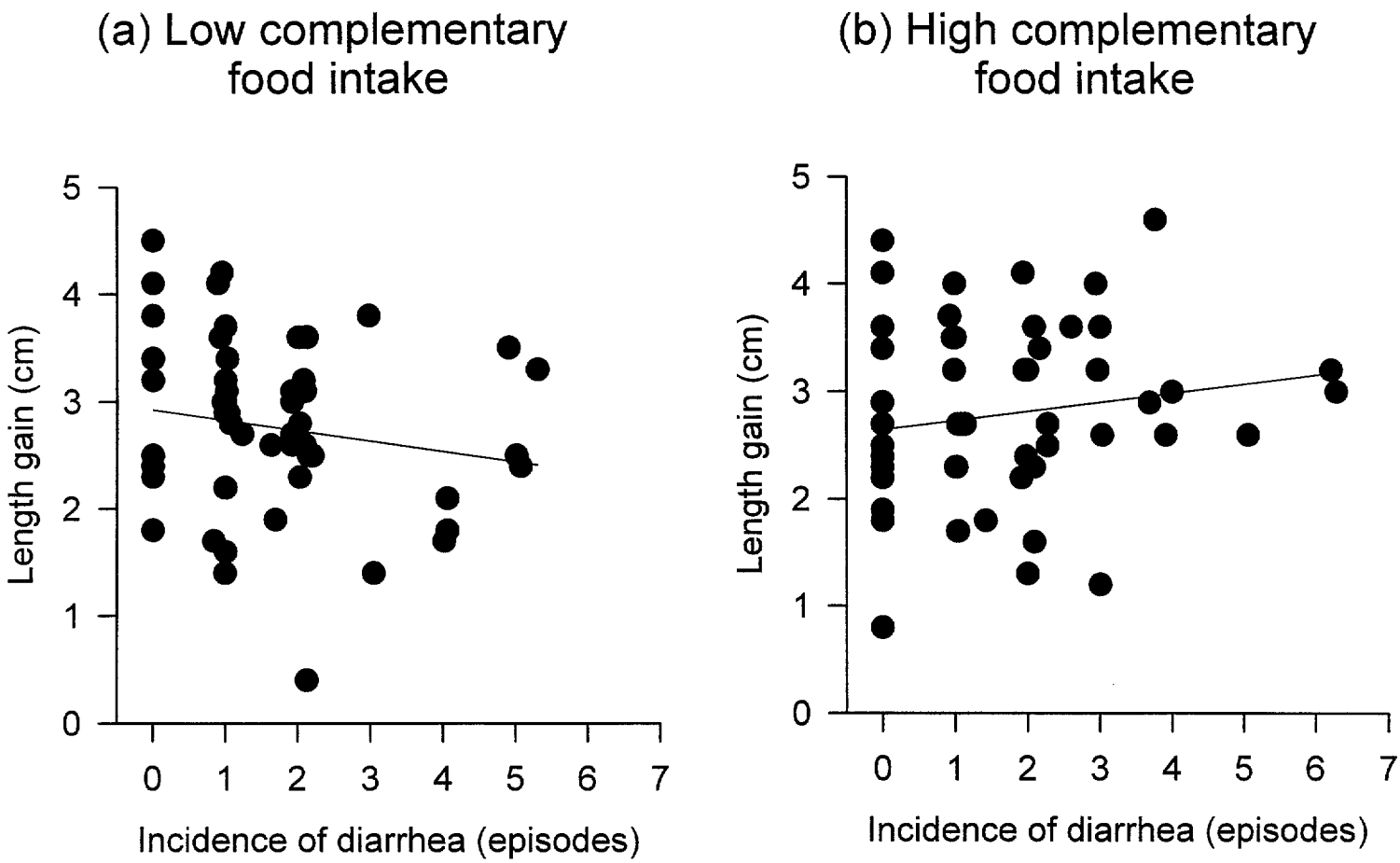


Figure 12. Association of 12- to 15-mo length gain with incidence of diarrhea, by complementary food intake



WELLSTART INTERNATIONAL

Wellstart International is a private, nonprofit organization dedicated to the promotion of healthy families through the global promotion of breastfeeding. With a tradition of building on existing resources, Wellstart works cooperatively with individuals, institutions, and governments to expand and support the expertise necessary for establishing and sustaining optimal infant feeding practices worldwide.

Wellstart has been involved in numerous global breastfeeding initiatives including the Innocenti Declaration, the World Summit for Children, and the Baby Friendly Hospital Initiative. Programs are carried out both internationally and within the United States.

International Programs

Wellstart's *Lactation Management Education (LME) Program*, funded through USAID/Office of Nutrition, provides comprehensive education, with ongoing material and field support services, to multidisciplinary teams of leading health professionals. With Wellstart's assistance, an extensive network of Associates from more than 40 countries is in turn providing training and support within their own institutions and regions, as well as developing appropriate in-country model teaching, service, and resource centers.

Wellstart's *Expanded Promotion of Breastfeeding (EPB) Program*, funded through USAID/Office of Health, broadens the scope of global breastfeeding promotion by working to overcome barriers to breastfeeding at all levels (policy, institutional, community, and individual). Efforts include assistance with national assessments, policy development, social marketing including the development and testing of communication strategies and materials, and community outreach including primary care training and support group development. Additionally, program-supported research expands biomedical, social, and programmatic knowledge about breastfeeding.

National Programs

Nineteen multidisciplinary teams from across the U.S. have participated in Wellstart's lactation management education programs designed specifically for the needs of domestic participants. In collaboration with universities across the country, Wellstart has developed and field-tested a comprehensive guide for the integration of lactation management education into schools of medicine, nursing and nutrition. With funding through the MCH Bureau of the U.S. Department of Health and Human Services, the NIH, and other agencies, Wellstart also provides workshops, conferences and consultation on programmatic, policy and clinical issues for healthcare professionals from a variety of settings, e.g. Public Health, WIC, Native American. At the San Diego facility, activities also include clinical and educational services for local families.

Wellstart International is a designated World Health Organization Collaborating Center on Breastfeeding Promotion and Protection, with Particular Emphasis on Lactation Management Education.

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