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Infant Feeding and Child Health: Lessons from Indramayu, West Java

Budi Utomo

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Abstract

Although exclusive breastfeeding in the first four to six months has long been promoted, mothers in Indonesia continue to violate exclusivity, confront increasing constraints to breastfeeding, and maintain practices of delayed initiation of breastfeeding, discarding colostrum, and prelactual feeding. Against this background, a study set out to examine the effect of infant feeding on infant health in two rural subdistricts, Indramayu, West Java, where the longitudinal system of demographic surveillance was taking place.

The overall community malnutrition problem in these two study areas could be categorized as moderate to severe. The relatively acceptable growth during the first six months of life, but a progressive faltering till about 24 months followed by a steady growth, parallel to reference curves but at a lower level, and somewhat lagged, suggest the profound problems of supplementary feeding and weaning practices. The most important lesson demonstrated by the study is the adverse effect of early supplementary feeding on child health. The adverse health effect of early supplementary feeding continues beyond the infant period, but declines in the second year of life. The negative health effect of delayed initiation of breastfeeding is limited to early months of life. While the study was unable to demonstrate the negative effect of discarding colostrum and prelactual feeding on child health status, it stresses the importance of breastfeeding on child survival. Mother’s and child’s health status at birth were shown to be the important confounders in attempts to determine the effect of infant feeding on child health. The confounding effect of child’s health status at birth on child health is particularly great in the early months of life. Other significant confounders include health care, socio-economic status, mother’s education, mother’s working status, and mother’s and child’s demographic variables.

The study concludes that efforts to improve the nutritional status of children should include not only programs to promote and protect breastfeeding, but, also equally important, programs to promote safe and healthy weaning food. Finally, the study also underscores the importance of promoting healthy mothers for healthy births and children.

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1. Introduction

Infancy is only a relatively short portion of the human life span, but because of the many growth and developmental processes occurring during that time, infant feeding affects many aspects of later life. Infant feeding may simply be defined as a matter of giving food to the infant, but the act of infant feeding is the product of a complex web of behaviour involving other people, not only the mother and her infant, but also the household members, the neighbours, the health worker, the policy makers, and the infant food producers. In Indonesia, exclusive breastfeeding in the first four to six months has long been promoted, but mothers continue to violate exclusivity, confront increasing constraints to breastfeeding, and maintain traditional practices of delayed initiation of breastfeeding, discarding colostrum, and prelactual feeding. Against this background, a study set out in two rural subdistricts of Indramayu, West Java, where a longitudinal system of demographic surveillance was taking place, to examine why mothers feed their infants the way they do, whether practices of infant feeding are amenable to improvement through an educational intervention, and to what extent practices of infant feeding are detrimental to health (Utomo, 1996). This paper specifically analyzes the relation between infant feeding and child health. While a variety of characteristics can be included when describing infant feeding (Popkin et al., 1986; Labbok and Krasevec, 1990), the analysis stresses the continuing effect of early supplementary feeding, delayed initiation of breastfeeding, discarding colostrum, and prelactual feeding on a series of child health outcomes expressed in growth and mortality.

* Faculty of Public Health and Center for Health Research, University of Indonesia, Depok, West Java. Phone 62-21-727-0154; Fax 62-21-727-0153.
2. Methodology

2.1 Conceptual framework

Infant feeding is likely to affect directly not only infant health, but also the mother's nutritional status and fertility and the household's use of time and money (Popkin et al., 1986: 2). As the primary effects of infant feeding on each immediate participant - infant, mother, and other household members - are also likely to create secondary effects, it is difficult to determine what portion of the net effect is because of the direct effect of infant feeding on that outcome and what portion is because of indirect effects operating through other outcomes. Infant feeding affects infant health through three pathways: exposure to pathogens through the method of feeding and its preparation, the infant's immune status by the provision of active immunizing substances, most notably from breastmilk; the infant's nutritional status, by which physical and biochemical characteristics are shaped, independent of the effects of genetics or infectious diseases (see Figure 1; Popkin et al., 1986: 19-20). Not only infant feeding, but also other factors, including the health status of mother and/or infant at birth, health care variables, cultural practices, environmental factors, and socio-economic and demographic variables, affect infant and child health (Sims, Paolucci and Morris, 1972; Seward and Serlula, 1984; Popkin et al., 1986: 23-24).

2.2 Source of data

The demographic surveillance in the two rural subdistricts of Indramayu, refer to here as the Indramayu Sample Registration System (SRS), started with a baseline survey in October-December 1989 covering 5,000 randomly sampled households in Gahno Wetan subdistrict and another 5,000 randomly sampled households in Sliyeg subdistrict (Chapter 3 in Utomo, 1996). Demographic data collected during the baseline survey were maintained and updated prospectively through household visitation cycles of every 90 days by incorporating the demographic events which occurred since the last household visit. The household socio-economic data were last updated in October-December 1993. Data used for this study were mostly obtained through cross-sectional surveys and case studies nested in the demographic surveillance system. The informants were primarily mothers, but, in particular cases, also included mother's parents, husbands, traditional birth attendants, outreach workers, and health personnel. Observations of practices of infant feeding during three periods of 24 hours were also conducted for a few children of varying ages. Growth and survival indicators were used to measure child health status. Anthropometric data, such as weight, height, and mid-upper arm circumference, were cross-sectionally collected in October-December 1993 for all Indramayu SRS children under 36 months of age. Most of the data refer to all children born during the four-year period of demographic surveillance, from 1990 to 1993.

2.3 Methods of analysis

The analysis is particularly geared to test the following research hypotheses: early supplementary feeding has an adverse effect on the health of infants and children; and practices of delayed initiation of breastfeeding, discarding colostrum, and prelacteal feeding negatively affect the health of young infants.

Data on practices of delayed initiation of breastfeeding, discarding colostrum, prelacteal feeding, and early supplementary feeding were collected at the seventh and 42nd day after birth from mothers whose pregnancies identified prospectively during 1991-1992. Data on child-feeding patterns on the day and night preceding the day of interview, which were longitudinally collected in cycles of 90 days for all children under 36 months of age, were used to indicate the timing of supplementary feeding.

Delayed initiation of breastfeeding is defined as a practice by which the mother did not give her breast to her newborn infant within the first 24 hours from birth. The use of 24 hours, instead of 30 minutes, as the cut-off point is based on the fact that only very few newborns were breastfed immediately within 30 minutes of birth. Discarding colostrum is defined as a practice by which the mother disposed of her first breastmilk after birth, disregarding the quantity of the first breastmilk discarded and the number of days the practice was performed. Prelacteal feeding is defined as a practice by the mother or somebody else to cause a newborn infant to receive any food or liquid other than breastmilk within the first three days of birth or before the infant was breastfed for the first time. Timing in initiating supplementary feeding is defined as the time after birth when food or liquid other than breastmilk begins to be given
regularly to the infant. 'Food to be given regularly' means that the infant received the food or the liquid more than twice a week for at least four weeks. As the majority of infants received supplementary foods in early months of life, the analysis may use two or three months of age as the cut-off points in defining the timing of supplementary feeding.

Various anthropometric indicators, most measured as Z-scores, are used to portray levels, patterns, and determinants of child health and nutritional status (United Nations, 1986; Zarfas, 1991). The weight-for-age, height-for-age, and weight-for-height Z-scores were computed through Epiinfo Version 6.0, a public domain software developed and supplied by the Center for Disease Control (CDC), USA. The Epiinfo software uses the WHO-NCHS-CDC normalized reference curve. Compared with other measures, Z-scores are more correct statistically, to interpret and compare variations in the reference population between indicators and ages (Dibley et al., 1987a, b). A cut-off point is selected, a score below which reflects a particular form of undernutrition: underweight (low weight-for-age), stunting (stunting or low height-for-age), thinness (wasting or low weight-for-height), or low MUAC (arm wasting). In regard to the cut-off points for Z-scores, -2 SD, -3 SD, and -4 SD are selected for categorizing children into levels of nutritional status. A score below -2 standard deviations (SD) of the normalized reference curve denotes undernutrition and below -3 SD or -4 SD, severe undernutrition.

1 Liquid is included in the definition because of its potential for exposing the infant to pathogens.
2 Weight, height (or length), mid-upper arm circumference, and age and sex are the components for the following major indicators: weight-for-age: weight of a child compared with weight of the reference child of same age and sex; height-for-age: height of a child compared with height of the reference child of same age and sex; weight-for-age: weight of a child compared with weight of the reference child of same height and sex; MUAC (mid-upper arm circumference): MUAC of a child compared with the MUAC of the reference child of same age (Zarfas, 1991: 5).
3 Use of this normalized reference curve has been suggested by the WHO (Dibey et al., 1987a; Mors, 1989).
4 The cut-off point of -2 SD is based on the following reasons: statistical (as the reference curve is approximately a normal distribution, a child whose value is below -2 SD is very unlikely to belong to the healthy group); clinical signs (concomitance with wasting appearance with low weight-for-age); immunological and biochemical (testing concomitance); outcome mortality (studies show a much higher risk of mortality in children with low weight and height-for-age); compatibility with anthropometry at other ages such as low birth weight (Zarfas, 1991: 6).

Given the prospective nature of data collection, the dates of demographic events, such as birth, death, and in- and out-migration, that occurred during the period of demographic surveillance, could be accurately recorded. The most important contribution of the demographic surveillance to the study was the production of relatively accurate information not only on the number of births, deaths, and other demographic events but also on the duration of survival and age of child. Age of child, particularly, is an important variable required for the many analyses and measures of anthropometric indicators.

Univariate and bivariate analyses are exercised as the initial steps toward multivariate analyses of child undernutrition and mortality determinants controlling statistically for the effect of socio-economic, demographic, and other potential confounding variables. Multiple linear regression, Cox regression, or logistic regression analysis is used as appropriate to examine the effect of infant feeding practices on child growth or survival. As variables are derived from different data sets with different number of records, use of such data sets may significantly reduce the overall number of cases included in that analysis. Thus, not only differing variables, but also differing numbers of cases may lead into differing multivariate statistical models.

3. Levels and patterns of undernutrition

Levels and patterns of undernutrition among children portray not only the extent and dynamics of child nutritional and health status, but also the extent of the relation between child growth and infant feeding. Based on the weight-for-age percentage of median, the prevalence of undernutrition among children by age or by cut-off point is consistently higher in the two study areas than in rural West Java and rural Indonesia (Table 1). For example, the prevalence of underweight, below 80 per cent of reference median, for children aged 12-23 months is 70 per cent for Gabus Wetan, and 78 per cent for Siliyg, but only 51 per cent for rural Indonesia and 60 per cent for rural West Java. In sum, 63 per cent of children under 36 months of age in both study areas suffer from mild to severe undernutrition; 19 per cent in Gabus Wetan and 24 per cent in Siliyg suffer from moderate to severe undernutrition, and three per cent in both study areas suffer from severe undernutrition.
Different cut-off points and different indicators may produce not only different prevalence estimates, but also different patterns of undernutrition. For example, no difference in the level of undernutrition by the study area is observed if the cut-off point of 80 or 60 per cent is used, but Gabus Wetan has a lower level of undernutrition than Sliyeg if the cut-off point of 70 per cent is used. With the cut-off points of 80 or 70 per cent, the level of undernutrition in both study areas increases with increasing age of children until 24 months of age. After 24 months of age, the level of undernutrition stabilizes. On the other hand, with the cut-off point of 60 per cent, no difference is found in the level of undernutrition across ages. Such age-patterns of undernutrition are also demonstrated by the anthropometric data of the National Socio-Economic Survey 1989 and 1992, but only if the cut-off point of 80 or 60 per cent is used (Table 1).

Table 2 presents prevalence estimates of undernutrition among children under 36 months of age based on various cut-off points of the weight-for-age, height-for-age, and weight-for-height Z-scores. The prevalence of underweight children, weight-for-age Z-score below -2 SD, is 55 per cent in Gabus Wetan and 54 per cent in Sliyeg. This prevalence estimate is lower than the prevalence estimate made by the weight-for-age percentage of median below 80 per cent. While the prevalence of moderately to severely underweight children, with weight-for-age Z-score below -3 SD, is 16 per cent in Gabus Wetan and 21 per cent in Sliyeg, the prevalence of severely underweight children, weight-for-age Z-score below -4 SD, is only 1.2 per cent in Gabus Wetan, and only 1.6 per cent in Sliyeg.

Compared with these prevalence estimates of underweight children, the prevalence estimates of short children (low height-for-age) or thin children (low weight-for-height) are much lower. The prevalence of short children, height-for-age Z-score below -2 SD, is 29 per cent in Gabus Wetan and also in Sliyeg, and the prevalence of thin children, weight-for-age Z-score below -2 SD, is 31 per cent in Gabus Wetan, and 34 per cent in Sliyeg. The prevalence of severely short children, height-for-age Z-score below -4 SD, is 0.6 per cent in Gabus Wetan, and 0.7 per cent in Sliyeg, and the prevalence of severely thin children, weight-for-height Z-score below -3 SD, is three per cent in Gabus Wetan, and four per cent in Sliyeg. Thus, most of the undernourished children in the two study areas are mildly to moderately undernourished as a result of both acute and chronic nutritional stresses. This accords with the notion that the number of children with mild and moderate malnutrition is generally tens of times greater than the number who are severely malnourished (Martorell and Ho, 1984: 49). But, as stunting is marked and moderate levels of wasting are observed, the overall community malnutrition problem in the two study areas could be categorized as moderate to severe (see Martorell and Ho, 1984: 51).

Use of recently proposed anthropometric measures, the Mora standardized prevalence (Mora, 1989) and the Monteiro percentage of 'non-optimal growth' (Monteiro, 1991), results in much higher prevalence estimates of undernutrition than the use of conventional measures (Table 3). Like the conventional measures, however, these two new measures also lead to the conclusion that the prevalence of underweight children is much higher than the prevalence of short children or of thin children, confirming that both acute and chronic nutritional stresses prevail in the two study areas. While the standardized prevalence of underweight children is 69 per cent in Gabus Wetan, and 68 per cent in Sliyeg, the standardized prevalence of short children and of thin children are 54 and 53 per cent respectively in Gabus Wetan, and 48 and 58 per cent respectively in Sliyeg. These Mora prevalence estimates of undernutrition, however, are still much lower than the prevalence estimates based on the Monteiro percentage of non-optimal growth. While the percentage of non-optimal weight-for-age is 93 per cent in Gabus Wetan and also in Sliyeg, the percentage of non-optimal height-for-age and the percentage of non-optimal weight-for-height are 88 and 81 per cent respectively in Gabus Wetan, and 79 and 90 per cent respectively in Sliyeg.

It is noteworthy to compare the prevalence estimates of undernutrition based on weight-for-age, height-for-age, and weight-for-height with those based on MUAC, the easiest anthropometric measure. While use of weight-for-age, height-for-age, and weight-for-height Z-scores results in an insignificant portion of severe undernutrition, use of MUAC, using the modified Echeverri cut-off points (see Gopalan and

6 The choice of indicators and cut-off points will generally depend on the objectives of the nutritional assessments (Zerfas, 1991: 6-21).
Chatterjee, 1985: 47), results in a significant portion of severe undernutrition. Based on the MUAC measure, the prevalence of severe undernutrition and the prevalence of moderate undernutrition are 21 and 34 per cent respectively in Gabus Wetan, and 18 and 48 per cent respectively in Sliyeg. Thus, severe undernutrition accounts for 30 to 40 per cent of all cases of undernutrition according the MUAC measure, but only two to nine per cent according to the weight-for-age, height-for-age, and weight-for-height Z-scores. In total, the prevalence of undernutrition, based on the MUAC, is 55 per cent in Gabus Wetan, and 56 per cent in Sliyeg (Table 4). As noted by Zerfas (1991: 7), these MUAC prevalence estimates seem to correspond with the weight-for-age Z-score prevalence estimates using -2 SD as the cut-off point (Table 2).

Given that Gabus Wetan has a much lower infant mortality than Sliyeg (Utomo, 1996: 111), it is important to compare the level of undernutrition between the two study areas. The prevalence of low weight-for-age is found to be similar if the 80 per cent of reference median, the -2 SD, or the standardized prevalence is used, but such a prevalence is higher in Sliyeg than in Gabus Wetan if the 70 per cent of reference median or the -3 SD is used (Tables 2, 3). On the other hand, the MUAC measure, the corresponding measure of weight-for-age, indicates that the prevalence of undernutrition is higher in Gabus Wetan than in Sliyeg (Table 4). The prevalence of low height-for-age is similar between the two study areas if the -2 SD, -3 SD, or -4 SD is used, but such a prevalence is higher in Gabus Wetan than in Sliyeg if the standardized prevalence or the percentage of 'non-optimal growth' is used. On the other hand, the prevalence of low weight-for-height is consistently higher in Sliyeg than in Gabus Wetan despite various indicators with various cut-off points being used, suggesting that a short-term adaptation to nutritional stress is more likely to occur in Sliyeg than in Gabus Wetan. One related study also indicates that the incidence of acute morbidity, such as fatal pneumonia and diarrhoea, is also higher in Sliyeg than in Gabus Wetan (Sutrisna and Reingold, 1992). Thus, this study supports the notion that among the anthropometric indicators, weight-for-height is the most powerfully predictive of child mortality (see Martorell and Ho, 1984).

In sum, the Indramayu Study shows no clear differential in measures of child's underweight and underheight between the two study areas, but notable differentials in infant mortality measures, suggesting that cross-sectional anthropometric measures, except weightage, may not always be in line with the mortality indicators. Dugdale (1980) in his 20 years study on infant feeding, growth and mortality among the Australian Aboriginal community demonstrated that the infant mortality rate fell dramatically although the growth, infant feeding and health facilities remained almost the same. Hence, Martorell and Ho (1984: 39) noted that the relationship between malnutrition and mortality tends to be non-linear, of the threshold type curves. Conversely, however, one recent reassessment of six relevant studies by Pellestor et al. (1993) suggests that mortality increases exponentially with declining weight-for-age and there is no apparent threshold effect on mortality.

One review indicates that both biological and behavioural factors may explain why child nutrition differs by sex (Elfandri, 1995: 32-35). Previous studies conducted in Indonesia presented inconsistent sex differentials. A study in Madura (Lauper, 1987) and another analyzing national data (Just, 1991) noted that male children had lower nutritional status than female children. On the other hand, two studies, one in rural and urban areas of Indonesia by Hull and Hull (1992: 430) and another in Central Java by Sato (1990: 336), found the opposite. The Indramayu Study showed that the prevalence of low weight-for-age or low weight-for-height or arm wasting was lower among male than among female children (Tables 2-4). This sex-pattern of child nutrition, in which boys are better-off than girls, is most clearly shown in weight-for-age, especially at ages 18 to 35 months, even after controlling for the effects of infant feeding, mother's health status, and socio-economic and other demographic variables, and is also found in mid-upper arm circumference status (Table 5). The final multiple regression models for children under 36 months of age show that sex of child is significantly associated with weight-for-age Z-score; the

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7 The severe level of undernutrition is defined as follows: weight- and height-for-age under -4 SD and weight-for-height under -3 SD (Zerfas, 1991: 6).
8 It is noteworthy to mention that differential in the feeding practices between the two study areas are not associated with the notable differential of infant mortality between the two study areas.
9 A short-term adaptation to nutritional stress is often due to a recent infection, compounded with poor food intake (Zerfas, 1991: 7).
10 Based on the coefficients of the final multiple regression models, the negative coefficient means that the Z-score for measuring anthropometric status is higher for boys than for girls.
negative regression coefficient suggests that male children tend to have better nutritional status than female children. But, as sex of child is not significantly associated with weight-for-age Z-score for children under 18 months of age, the sex differential in weight-for-age noted in the previous analysis must exist only after 18 months of age. As there was no clear evidence of sex discrimination in child care in the two study areas, such a sex differential in child nutrition is difficult to explain. On the other hand, the sex differential in weight-for-height and also height-for-age is not entirely clear. Once the effects of infant feeding, mother's health status, and socio-economic and other demographic variables are controlled, however, no sex differential in height-for-age and weight-for-height is noted (Table 5).

Age of child is the most consistent variable associated with undernutrition. By sex and study area, the prevalence of undernutrition, whether based on weight-for-age, height-for-age, or weight-for-height, is lowest below six months, but increases dramatically at ages six to 11 months, and is highest at ages 12 to 35 months (Tables 2, 3). Based on Z-scores below -2 SD, the prevalence of low weight-for-age is about eight per cent for ages under six months, about 40 per cent for ages six to 11 months, and over 60 per cent for ages 12 to 35 months; the prevalence of low height-for-age is five to nine per cent for ages under six months, nine to 15 per cent for ages six to 11 months, and over 35 per cent for ages 12 to 35 months; and the prevalence of low weight-for-height is seven to eight per cent for ages under six months, 25 to 30 per cent for ages six to 11 months, and over 30 per cent for ages 12 to 35 months (Table 2). This age-pattern of child undernutrition is similar to those reported by the National Socio-Economic Surveys (Jus'at, 1991: 108; CBS, 1992, 1993) and by all other studies (Heering, 1990: 22; Kardjaji et al., 1994), except one by Suryadhi (1989), conducted in other parts of Indonesia. Moreover, in regard to the growth of Indonesian children, Heering (1990: 22) noted that the common features are acceptable growth during the first four to six months, a progressive faltering till about 24 months and a steady growth, parallel to reference curves but at a lower level, afterwards. The growth faltering, defined as a sustained departure from a reference pattern (Underwood and Hofvander, 1982: 19), beginning at around the sixth month is, in fact, the statistically average pattern in many, if not most traditional societies to this day (Waterlow and Thomson, 1979: 238; Wray, 1991: 72); it occurs because

culturally determined weaning practices are simply inadequate (Wray, 1991: 72). A review by Motaajemi et al. (1995) demonstrates that supplementary or weaning foods in developing countries are frequently heavily contaminated with pathogens and thus are a major factor in the cause of diarrheal diseases and associated malnutrition in children after six months of age.

4. The onset of growth faltering

It is important to pay attention to the onset of growth faltering, especially in the context of efforts to prevent and combat problems of infant and child nutrition. Data from this study, as presented in Figures 1 to 9, suggest that growth faltering in infants may begin some time before six months of age, notably after two or three months. 11 While the age-pattern of growth faltering is generally similar between the two study areas (see Figures 1 to 2) and between male and female children (see Figures 4 to 6), it may differ between different households' per capita income levels; children from households with low per capita income level tend to have an earlier start to growth faltering than children from households with high per capita income level (see Figures 7 to 9). Because of differences in mother's nutritional status, life style, and living environment, children from households with lower socio-economic level, measured by the household's per capita income, tend to have earlier exposure both to inadequacy of nutrients and to infections, thus an earlier start to growth faltering, than children from households with higher socio-economic level (Waterlow and Thomson, 1979).

It is also possible that low-birthweight infants that are not excluded from the analysis may, in part, contribute to the image of such early growth faltering and also to the socio-economic differential in the start of growth faltering. Although the exclusion of low-birthweight infants is important for the analysis, it cannot be done because birthweight information is not available for all infants. Using the 1987 National Socio-Economic Survey data, Jus'at (1991: 56-59) concludes that growth faltering of Indonesian infants, based on weight-for-age Z-score, begins after two months, but the conclusion does not mention the possible bias due to low-birthweight infants. Although birthweight is said to have very little effect on the increment of weight after

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11 A study by Soedirman (1983: 79-80) in the city of Semarang showed the trend of deteriorating growth of infants after three months of age including those with normal nutritional status.
the first month from birth (Waterlow, Ashworth, and Griffiths, 1980: 1177), data from this study show that birthweight is the most consistent variable affecting child nutritional status, even after one year of age. The continuing effect of birthweight on child growth after one year of age, as demonstrated by this study, suggests that most low-birthweight infants in the two study areas are intra-uterine growth retarded newborns. Infants who have suffered from intra-uterine growth retardation remain smaller, on average, than normal babies throughout infancy and early childhood (Seward and Serdula, 1984: 728). A study conducted in seven selected rural areas of Indonesia reported a wide range of low birthweight (less than 2500 grams) incidence, from two per cent in Manado to 18 per cent in Ujung Pandang (Alisjahbana, 1991: 18), suggesting the possibility of geographic variation in long-term infant growth patterns, irrespective of postpartum feeding practices.

Various inter-related factors play significant roles in growth, but, ultimately, they create growth faltering through inadequate dietary intake, increased infections, or both (Seward and Serdula, 1984; Popkin et al., 1986). Thus, the early growth faltering noted in the two study areas suggests that problems of insufficient food and/or increased exposure to infections may have occurred within the first six months of life (see also Waterlow and Thomson, 1979). As the majority of mothers still breastfeed their babies at the sixth month, a question arises in regard to the adequacy of breastfeeding. A review of studies by Underwood and Hofvander (1982) suggests that in countries where undernutrition and deprivation are prevalent, growth faltering in exclusively breastfed infants may theoretically occur before three months, but generally it is not evident until after three months, in most environments not before four to five months, and in almost all studies, by six months.

It is possible that while the breastmilk could be inadequate some time after three months of age, increasing exposure of the infant to infection at a time when its passive immunity is shrinking could also induce early growth faltering. Hence, while the level of immunoglobulin in the infant is low at four to six months of age (Popkin et al., 1986: 28), the common practice of early supplementary feeding exposes the infant to infections. This practice may also be associated with early growth faltering. Studies have indicated the adverse effect of early supplementary feeding on infant health (Plank and Milanesi, 1973; Seward and Serdula, 1984: 749-750; Shahidullah, 1994). The observed progressive growth faltering after six months (Tables 2, 3; Figures 1 to 3) suggests the worsening problems of inadequate diet and infections because of decline in the health benefits of breastmilk and breastfeeding (Underwood and Hofvander, 1982). Moreover, the occurrence of frequent infections, which distorts the balance between food intake and nutrient requirements, also further aggravates the growth status after six months of age (Briscoe, 1979; Waterlow and Thomson, 1979: 241; Martorell and Ho, 1984).

5. Confounding factors

Other factors, such as mother's health status, child's health status at birth, health care, cultural practices, environmental, and socio-economic and demographic factors, may confound the effect of infant feeding on child growth and survival. These factors should be carefully examined when the statistical effect of infant feeding on child growth and survival is examined. Confounding factors should be operationalized as statistical variables but problems such as the data availability, and measurement flaws, may hamper such operationalization. The problems, however, should not restrain the conduct of statistical analysis as there are several ways of appropriately inferring statistics into substantive meanings (Schlesselman, 1982: 7-26; Babbie, 1989). While there are obviously so many conceptually confounding factors (De Garine, 1972; Seward and Serdula, 1984), not all are included because of the data availability. In many cases, because of the measurement problem, variables used in the analysis are proxies rather than direct measures of confounding factors. Since confounding factors are generally inter-related (Seward and Serdula, 1984), one single statistic variable may also be a proxy measure of several confounding factors. Mother's health status, child's health status at birth, health care, socio-economic status, mother's education, mother's working status, and mother's and child's...
demographic variables were noted to be the significant confounders of the effect of infant feeding on child health (Chapter 8 in Utomo, 1996). The following discussion of confounding factors, however, is focused on mother’s health status and child’s health status at birth identified in the analyses to be the most important confounding factors on the effect of infant feeding on child health (see Utomo, 1996).

5.1 Mother’s health status

Maternal nutrition and health status affect child growth and survival through the mother’s biological and social readiness to take care of the child, including readiness to be pregnant, to breastfeed, to provide food and health care, and to interact with and stimulate the child (Satoto, 1990: 336). To bear healthy, well-nourished, and well-developed infants, the mother must have laid down adequate nutritional reserves during pregnancy, including subcutaneous fat, and must stay well-fed throughout lactation (Villar and Belizan, 1981). The effect of maternal nutritional status on the adequacy of lactation, for example, is well recognized as an important issue. Although milk of poorly nourished women has an amino-acid content similar to that of well-nourished women (Ismaiil et al., 1975: 19), methionine and lysine levels are lower (Popkin et al., 1986: 104). Most studies indicate that milk volume, and in some cases milk composition, particularly fat levels, decrease with severe maternal undernutrition (Seward and Serdula, 1984: 734; Popkin et al., 1986: 104). The mother’s ability to lactate may depend on her nutritional status before and during pregnancy, as well as during lactation (Seward and Serdula, 1984: 734; Popkin et al., 1986: 105). More recent studies indicate that while well-nourished mothers have greater lactational capacity and breastmilk production than the amount ingested by the infant, the infants of marginally nourished mothers, by contrast, need frequent feeding to obtain the same amount recorded, suggesting that milk output is not limited by food intake but is also controlled by the characteristics of the mother-infant pair (cited in Van Steenbergen et al., 1994: 116).

Results of this study suggest that mother’s health status, as measured by mother’s MUAC and mother’s height, is associated with child growth. The bivariate analysis shows that mothers with left MUAC of less than 23.5 centimetres tend to bear lower weight-for-age, lower height-for-age, lower MUAC, and lower weight-for-

height children than mothers with left MUAC of 23.5 centimetres or more; and mothers with height less than 150 centimetres tend to bear lower weight-for-age, lower MUAC, and lower height-for-age, but not lower weight-for-height children, than mothers with height of 150 centimetres or more (Utomo, 1996: 320). Multiple linear regression analysis of child growth controlling for the effects of infant feeding, child’s health status at birth, and socio-economic and demographic variables confirm the significant association between mother’s health status and child growth; mother’s left MUAC is positively related to all child anthropometric measures, weight-for-age, height-for-age, weight-for-height, and MUAC, in both age groups of children, under 18 months and under 36 months of age, suggesting that mother’s MUAC is a good predictor of child’s nutritional status. On average, children aged under 36 months with mother’s left MUAC of 23.5 centimetres or more will have weight-for-age Z-scores of 0.33 SD, height-for-age Z-scores of 0.21 SD, weight-for-age of 0.27 SD, and MUAC of 0.26 centimetres higher than children of the same age group with mother’s left MUAC of less than 23.5 centimetres (Table 5).

While the statistical relation between mother’s MUAC and child growth is consistent across child growth measures, the same is not true of mother’s height and child growth. Logistic regression analysis of child growth controlling for the effects of infant feeding, mother’s MUAC, child’s health status at birth, and socio-economic and demographic variables indicate a positive relation between mother’s height and child’s weight-for-age and between mother’s height and child’s height-for-age, but a negative relation between mother’s height and child’s weight-for-height and no relation between mother’s height and child’s MUAC (Table A.8.4 in Utomo, 1996: 323). This relation-pattern implies that mother’s height is more closely related to child’s height-for-age than to child’s weight-for-age; hence, the final logistic regression models also show that the ratio of the odds of being low weight-for-age for a child whose mother’s height is less than 150 centimetres to that for a child whose mother’s height is 150 centimetres or more is also lower than the ratio of the odds of being low height-for-age. For children under 36 months, for example, while the ratio of the odds of being low weight-for-age, below -2 SD, is 1.44, the ratio of the odds of being low height-for-age, below -2 SD, is 1.87 (Table A.8.4 in Utomo, 1996: 323).
The risk of having weight-for-age Z-score below -2 SD is 44 per cent higher and the risk of having height-for-age Z-score below -2 SD is 87 per cent higher for a child whose mother's height is less than 150 centimetres than that for a child whose mother's height is 150 centimetres or more. When logistic regression models are compared between children under 36 months and children under 18 months, it is clear that mother's height is positively associated with child's weight-for-age and child's height-for-age, especially after 18 months of age, but it is negatively associated with child's weight-for-height, especially before 18 months of age. This negative relation between mother's height and child's weight-for-height could be related to the constraints of using weight-for-height as the indicator of nutritional status during the first 12 months of age (see Seward and Serduka, 1984: 729).

5.2 Child's health status at birth

The notion that child's health status at birth affects child growth and survival is well known (Popkin et al., 1986: 111; Millman and Cooksey, 1987: 210). Few studies, however, have examined in detail the relation between child's health status at birth and child growth and survival, in part because of the paucity of data on measures of child's health status at birth for developing countries. Among these, birthweight and gestational age were usually used as indicators of child's health status at birth (Seward and Serduka, 1984: 756; Popkin et al., 1986: 111; Elo and Miller, 1991: 1). Although birthweight and gestational age alone are imprecise controls for attributes of health that influence child growth and survival (Elo and Miller, 1991: 15), birthweight and gestational age have been empirically shown to be potential confounders of the effect of infant feeding on child growth and survival (Popkin et al., 1986: 111-112; Elo and Miller, 1991). Nevertheless, a review by McCormack (1985: 84) of the relative effects of birthweight and gestational age suggests that birthweight is the dominant factor. Moreover, gestational age assessment in many studies has been clinical or hospital rather than community based (Popkin et al., 1986: 112).

This study uses only birthweight as the indicator of child's health status at birth. However, not all children under the surveillance have birthweight information, and even among those with birthweight information, the 'birthweight' was generally obtained several days after birth. Moreover, only birthweights obtained within the first seven days after birth are included in the analysis. It has been shown that weight of the infant during the first six days does not change very much (Husaini, Husaini, and Karyadi, 1990: 81). To increase the birthweight variance, the cut-off point of 3000 grams is used instead of 2500 grams, the conventional cut-off point for estimating the prevalence of low birthweight. Even with these limitations of measurement, this study demonstrates that birthweight is the most important variable strongly associated with all measures of child growth and survival. Ratios of the odds of being low weight-for-age, below -2 SD or -3 SD, being low height-for-age, below -2 SD, or being low MUAC, below 13.5 centimetres, for a child with birthweight of less than 3000 grams to that for a child with weight of 3000 grams or more are between 2.00 and 3.00. These odds ratios, as expected, are higher for children under 18 months than for children under 36 months (Table A.8.4 in Utomo, 1996: 323), suggesting that the effect of birthweight on child growth is greater during the early than during the late period of the child's life. On the other hand, the effect of birthweight on weight-for-height status seems to be smaller than the effect of birthweight on other child growth measures.

The ratio of the odds of being low weight-for-height, below -2 SD, for a child with birthweight of less than 3000 grams to that for a child with weight of 3000 grams or more is only 1.70 for both age groups of children, under 36 months and under 18 months of age. These findings are in line with the previously mentioned notion that at ages less than 12 months, at a given height the older infant tends to be heavier (Seward and Serduka, 1984: 729). That, birthweight, controlling for the effects of infant feeding, mother's health status, and socio-economic and demographic variables, continues to affect child growth even after 18 months of age. One study among Black term neonates in the United States by Garn (1985) also shows that there is a direct, positive relationship between birthweight and long-term weight gain, even over a seven-year period.

Birthweight is the important predictor not only for child growth, but also for child survival. The observation that small babies are at increased risk of dying is not

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13 This approach may create biased statistical results; but the exercise showed no significant differentials in socio-economic and demographic characteristics between those children included and those excluded from the analyses.
new (McCormick, 1985; Millman and Cooksey, 1987; Elo and Miller, 1991). This study also demonstrates that low-birthweight children have higher risk of mortality than normal-birthweight children. Cox regression of survival duration and logistic regression of infant death, controlling for the effects of infant feeding, mother’s health status, and socio-economic and demographic variables, show that the ratio of the probability of dying during the first one to two-and-a-half years and the ratio of the odds of infant death for a child with birthweight of less than 3000 grams to that for a child with birthweight of 3000 grams or more are 1.78 and 1.90 respectively (Table 6). McCormick (1985) indicates that the risk of mortality of infants born weighing 2500 grams or less increases rapidly with decreasing weight. Compared with normal-birthweight infants, those with low weight at birth are almost 40 times as likely to die in the neonatal period (McCormick, 1985: 84). After the neonatal period, low-birthweight infants remain at increased risk of death, but postneonatal mortality is not as closely related to birthweight as neonatal mortality is. Socio-economic factors modify the effect of birthweight on postneonatal mortality (McCormick, 1985).

6. Effect of infant feeding on child health

Most studies on the effect of infant feeding on child health contrast the health effects of breastfeeding to those of other methods of infant feeding (Forman et al., 1984; Jason, Nieburg, and Marks, 1984; Kovar et al., 1984; Popkin et al., 1986; Seward and Serdula, 1984; Uusi and Richard, 1988). Nearly all studies show that breastfed infants have lower morbidity and mortality from various causes than non-breastfed infants, and that the protective effect of breastfeeding is greater with younger age of infant and with poorer environmental sanitary conditions. Studies examining feeding practices and infant growth in low-income populations, however, present inconsistent findings; some studies show breastfed infants heavier and taller than non-breastfed infants, but others are inconclusive (Popkin et al., 1986: 113). But, for the first six months of life, almost all studies show that breastfed infants have better growth than bottle-fed infants (Seward and Serdula, 1984: 749). In developed countries, where food supply and mother’s health do not limit infant growth, growth of artificially fed infants appears to be comparable to or greater than that of breastfed infants (Hitchcock, Owles, and Gracey, 1981; Hitchcock, McGuinness, and Gracey, 1982; Seward and Serdula, 1984; Popkin et al., 1986: 113).

There are not many studies examining the effect of early supplementary feeding on child health, but all show that early supplementary feeding has an adverse effect (Plunk and Milanesi, 1973; Seward and Serdula, 1984: 749-750; Habicht et al., 1986; Shahidullah, 1994). There have been a few historical, but not epidemiological, reviews of the adverse effect of ‘improper’ early feeding practices, such as delayed initiation of breastfeeding, discarding colostrum, and prelacteal feeding, on the health of infants (Fikdes, 1980, 1986; Corsini, 1991; Grieco, 1991).

Using the Indramayu data, this study employs multivariate statistical models to estimate the effect of certain practices of infant feeding, such as early supplementary feeding and improper early feeding practices, on child growth and mortality. Multiple linear regression and logistic regression models are used to estimate the effect of the practices on child growth, and Cox regression and logistic regression models are used to estimate the effect on child mortality. The statistical models of child growth are made separately for children aged under 35 months and under 18 months to see whether the effect of the practices of infant feeding on child growth continues beyond the infant’s life. Initially, the statistical models are based on the availability of variables from the Socio-Economic Anthropometric Survey conducted in October-December 1993. Other logistic regression models of child growth incorporating additional important variables derived from other data sets, such as delayed initiation of breastfeeding, discarding colostrum, prelacteal feeding, birthweight, mother’s height, and child’s immunization status, are also estimated, but obviously gave a much reduced number of observations. For survival duration and infant death, the statistical models are initially based on children born during the four-year period of demographic surveillance, from 1990 to 1993, but many of the independent variables are also derived from various data sets.

Although some of the statistical models are characterized by a much reduced number of observations, the statistical results presented are in general complementary

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14 One study by Forman et al. (1990) also used multiple regression and logistic regression analyses to examine the effect of infant feeding practices on child growth.
and consistent, indicating that the results are not only statistically, but also substantively significant (Schleselman, 1982: 22-25). The appropriateness of the models can be statistically evaluated from the adjusted R² for multiple linear regression, which ranges from five to 30 per cent, and the percentage of goodness-of-fit for the logistic regression, which ranges from 65 to 90 per cent.

6.1 Early supplementary feeding

Like other studies (Plank and Milanese, 1973; Seward and Serdula, 1984: 749-750; Habicht et al., 1986; Shahidullah, 1994), data from this study also indicate that early supplementary feeding or giving other foods, including fluids, within the first three months after birth, is negatively associated with child health, even controlling for the effects of mother’s health status, child’s health status at birth, and socio-economic and demographic variables. As shown by the negative regression coefficients (Table 5), children receiving early supplementary foods are at higher risk of low weight-for-age, low height-for-age, and low weight-for-height, and, as shown by the odds ratios (Table 6), higher risk of mortality than children not receiving early supplementary foods. The adverse health effect of early supplementary feeding may continue beyond the infant period, but, as expected, is greater with younger children; hence, the magnitude of the regression coefficients is always greater for children aged 0-17 months than for children aged 0-24 months (Table 5). The logistic regression analysis of child growth for children aged 12 to 35 months, but also incorporating child’s immunization status, show no effect of early supplementary feeding on child growth, confirming that the notable effect of early supplementary feeding on child growth is particularly evident during the infant period (Table A.8.5 in Utomo, 1996: 324). The β coefficients (the adjusted regression coefficients), which could be used to indicate the relative importance of the variables, show that not only early supplementary feeding, but age of child and mother’s health status are also associated with child growth during the first 18 months after birth (Table 5).

The Cox regression analysis of survival duration and the logistic regression analysis of infant death, controlling for the effects of mother’s health status, child’s health status at birth, other practices of infant feeding, and socio-economic and demographic variables, show the profound effect of early supplementary feeding on mortality. The ratio of the probability of dying and the ratio of the odds of infant death for a child receiving early supplementary foods to that for a child not receiving early supplementary foods range from three to five (Table 6), suggesting that the risk of death is three to five times higher for a child receiving other foods before four months of age than for a child receiving other foods at four months of age or older. Although the net effect of early supplementary feeding on child mortality could be lower than the ones presented in the statistical analysis, as unhealthy newborns are generally more likely than the healthy ones to receive early supplementary foods, the consistent findings suggest that early supplementary feeding has an adverse effect on child health. Thus, in poor living conditions, such as Indramayu, early supplementary feeding exposes the infant to early cumulative increased infections (see Seward and Serdula, 1984). The notion that early supplementary feeding increases the rate of infections is supported by the statistical analyses showing it to be the important predictor of child mortality and low weight-for-height, two indicators of acute illnesses or infections (Table 6; see also Table A.8.2 in Utomo, 1996: 321).

6.2 Delayed initiation of breastfeeding, discardingcolostrum, and prelactal feeding

Reviews and studies have indicated that certain practices within the first few days of birth, notably, delayed initiation of breastfeeding, discardingcolostrum, and prelactal feeding, may reduce the many benefits of breastmilk and breastfeeding (Huffman and Lamphere, 1984; Fields, 1986; Neville, 1989; Soetijingsih and Suraatmaja, 1989; WHO, 1989). While there is no doubt that such practices reduce the many benefits of breastmilk and breastfeeding, there has been no epidemiological study examining their continuing effect on child growth and mortality. Fields (1980), however, is convinced that the fall in infant mortality in England and Wales during the eighteenth century is associated primarily with a radical change in such early feeding practices.

The Indramayu data show that delayed initiation of breastfeeding, controlling for the effects of mother’s health status, child’s health status at birth, other practices of infant feeding, and socio-economic and demographic variables, is associated with child’s weight-for-age and child mortality. For children, delayed initiation of
breastfeeding increases both the risk of being underweight and the risk of death. The multivariate statistical analysis shows that the risk of dying is two times higher for a child with delayed than for a child with not-delayed initiation of breastfeeding (Table 6). The significant effect of delayed initiation of breastfeeding on child’s weight-for-age occurs only for children aged under 18 months and only if the cut-off point of -3 SD is used, suggesting that the effect is limited to the infant period. However, it could possibly be argued that the significant association between delayed initiation of breastfeeding and child’s weight-for-age and mortality is the result of reverse causation, as poor health at birth may cause delayed initiation of breastfeeding, not the other way round (see Elo and Miller, 1991). Although birthweight is included in the analysis, it may not perfectly control for the child’s health status at birth (see Elo and Miller, 1991). Unfortunately, there are no other clinical data available to verify such an argument.

The multivariate analyses suggest no effect or no continuing effect of losing the colostrum and prelacteal feeding on child growth and mortality. On the other hand, there is a statistically significant negative effect of discarding colostrum on child’s weight-for-age and child’s height-for-age, but it occurs for children aged under 36 months, not for children under 18 months (Tables A 8.3, A 8.4 in Utomo, 1996: 322-323). This statistical result implies that the practice of discarding colostrum, as defined by the study, does not reflect the effect of losing the colostrum on child health. If the practice of discarding colostrum is a biological variable measuring the quantity of colostrum discarded, the significant effect of discarding colostrum on child health should logically be stronger for children aged under 18 months than for children aged under 36 months. This statistical result is in accord with the notion that discarding colostrum acts more as a proxy of a behavioural than a biological variable. It is likely that the differing risk of underweight and underheight children between mothers discarding and not discarding colostrum is because of differing cultural practices of infant feeding and care overall, but not because of the exact quantity of colostrum consumed or discarded.

Two reasons may explain why the Indramayu data are not able to show the negative effect of discarding colostrum and prelacteal feeding on child health. One obvious reason relates to the difficulty in measuring the practices of discarding colostrum and prelacteal feeding, in which mothers vary greatly. The act of discarding colostrum could cover less than an hour, a day, or several days, and the quantity of colostrum discarded could be from several drops to a cup or more. Likewise, there is also a large variation in types and quantity of the prelacteal food given to the infant. Hence, simply categorizing mothers as discarding or not discarding colostrum, and practising or not practising prelacteal feeding, is obviously too crude in the context of measuring the biological effects of losing the colostrum and undertaking prelacteal feeding on infant health. Another reason relates to the timing differences between the measurement of improper early feeding practices and the measurement of infant health outcomes. Theoretically, the effect of improper early feeding practices on infant health, if any, will be much stronger during the early period, notably the first six months after birth, than during the later period of the infant’s life. Thus, the study population for examining the effect of improper early feeding practices on infant health should ideally be limited to infants aged under six months. Data for examining this theoretical proposition, however, are not available from this study. The data available are on improper early feeding practices measured for newborns during 1990-1992, and anthropometric data of children born during 1990 to 1993, but cross-sectionally measured at the end of 1993.

6.3 Never breastfeeding

Although the proportion of mothers never breastfeeding in the two study areas is very small, only three per cent (Table 6), the Cox regression analysis of survival duration and logistic regression analysis of infant death, controlling for the effects of mother’s health status, child’s health status at birth, and socio-economic and demographic variables, show the strong effect of never breastfeeding on child mortality (Table 6). Never-breasted children have much higher risk of mortality than breastfed children. The strong effect of never breastfeeding on child mortality may be due to a reverse causation, as never breastfeeding may be the consequence of poor health at birth and not the other way round (Elo and Miller, 1991). However, the final Cox regression models of survival duration show that the ratio of the probability of dying for a never-breasted child to that for a breastfed child is 9 before, and then, 5 after controlling for the effect of birthweight on child mortality. This finding, that
controlling for birthweight reduces, but does not remove, the sizeable excess mortality associated with never-breastfed children, supports the notion that never breastfeeding has a strong independent influence on child mortality; this has also been found in other studies (Habicht et al., 1986; Millman and Cocksley, 1986; Elo and Miller, 1991). Moreover, the fact that more than half of the dead children died after 20 days also favours the independent influence of never breastfeeding on child mortality (see also Elo and Miller, 1991). This finding and also the evidence of progressive growth faltering after six months of age suggest that, in the two study areas, other foods for infants are less nutritious, but more bacterially contaminated, than breastmilk.

7. Summary and conclusion

The relation between infant feeding and child health has been discussed, focusing primarily on the effect of early supplementary feeding, delayed initiation of breastfeeding, discarding colostrum, and prelacteal feeding on growth and mortality of children under 36 months of age. Data used are from the Indramayu Socio-Economic Anthropometric Survey 1993 and the Indramayu SRS 1990-1993. The analysis begins with the description of levels and patterns of child undernutrition using anthropometric indicators involving the measurements of age, weight, height, and mid-upper arm circumference. The conventional anthropometric indicators, weight-for-age, height-for-age, weight-for-height, are expressed in Z-scores for the main statistical analyses. Variables measuring mother’s health status, child’s health status at birth, and socio-economic and demographic factors are included in multivariate statistical analyses. As these variables may affect child growth and mortality directly as well as indirectly through infant feeding, they may confound the effect of infant feeding practices on child growth and mortality. Multiple linear regression and logistic regression models are used to analyze child growth, while the analysis of child mortality relies on Cox regression and logistic regression models.

The level of undernutrition in the two study areas is relatively high, higher than rural provincial and rural national figures reported by the National Socio-Economic Survey 1989 and 1992. As stunting is marked and moderate levels of wasting are observed, the overall community malnutrition problem in Indramayu could be categorized as moderate to severe. There is a relatively acceptable growth during the first four to six months, a progressive faltering till about 24 months followed by a steady growth, parallel to reference curves but at a lower level, afterwards. This age-pattern of child growth is common not only for Indonesian children, but also for children of most contemporary developing societies, suggesting profound problems of supplementary feeding and weaning practices in comparison with a standard population. Thus, in addition to breastfeeding promotion, efforts to improve supplementary feeding practices and weaning are equally important in order to alleviate growth faltering of children after six months of age. Even if all infants are exclusively breastfed for the first four to six months, as recommended by the breastfeeding promotion program, the progressive growth faltering of children after six months of age still remains.

The Indramayu data suggest that growth faltering in infants may begin some time before six months of age, notably after two or three months. The reason for the occurrence of early growth faltering, however, is not yet clear. Theoretically, early growth faltering could occur because of possible inadequacy of breastfeeding, the common practice of early supplementary feeding, or the inclusion of low-birthweight infants in the analysis. Children from poor families tend to have an earlier onset of growth faltering than children of better-off families. This socio-economic differential in the start of growth faltering may relate to differences in the mother’s nutritional status, life style, and environmental conditions.

Even controlling for the effects of infant feeding, mother’s health status, and socio-economic and other demographic variables, a notable consistent sex differential in child’s weight-for-age and MUAC, but not in other anthropometric measures, is noted. Boys are better-off than girls. No clear differential in the prevalence of child undernutrition emerged, but a substantial differential in infant mortality between Garus Wetan and Sliyeg is noted, indicating that anthropometric indicators are not in line with mortality indicators. Ideally both types of indicators should be used together to reflect the health problems that prevail in the community. Among the anthropometric measures analyzed, low weight-for-height or ‘wasting’ is the most powerful predictor of mortality.
The study shows that mother's and child's health status at birth are important confounders of the effect of infant feeding practices on child growth and mortality. Birthweight, particularly, is the most important predictor of child health and survival. Other confounders include health care factors, socio-economic factors, mother's education, mother's working status, and mother's and child's demographic variables. Child's immunization is positively associated with child growth. Low household socio-economic level is associated with the occurrence of child stunting, but not with other measures of child growth. Low level of mother's education is associated with child's low weight-for-age and low MUAC. Children with mothers working outside the home have higher risk of undernutrition or death than children with mothers working as housewives. Children of young mothers, aged below 20 years, have higher risk of death than children of mothers aged 20 years and over, and the higher the mother's parity the higher the risk of infant or child death. The importance of the mother's education in child health, however, is difficult to ascertain, as the vast majority of mothers in the two study areas have little or no education.

The most important implication of the Indramayu results is the adverse effect of early supplementary feeding on child health. Children receiving early supplementary foods have higher risk of low weight-for-age, low height-for-age, low weight-for-height, and mortality than children not receiving early supplementary foods. The adverse health effect of early supplementary feeding may continue beyond the infant period, but, as expected, is greater among younger children. Because of the methodological difficulties, however, the study is unable to show the negative effect of discarding colostrum and prelactal feeding on child health.

The importance of breastfeeding for child survival is clear in Indramayu. The analysis shows that controlling for birthweight reduces, but does not remove, the sizeable excess mortality associated with never-breastfed children. Finally, the study findings imply that efforts to improve the nutritional status of infants and children should include not only the promotion of exclusive breastfeeding during the first four months, but also the promotion of safe supplementary feeding and weaning practices in the fourth and subsequent months when the growing infant's nutritional needs cannot be met by breastmilk alone.

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**Weekend Activities**

- Monday: Visit to the library
- Tuesday: Sports practice
- Wednesday: Science project
- Thursday: Art class
- Friday: Music lesson

**Notes**

- Attendance: 100%
- Homework: Completed by all students
- Upcoming Exam: Next Friday

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**Suggested Readings**

- *Children's Literature* by Jane Doe
- *Science for Kids* by John Smith

**Next Steps**

- Prepare for the upcoming exam
- Review all notes from this week

*Signed*

[Signature]

Date: [Date]
Table 5  Preportion of infant death, oon regression models of several factors, and final logistic regression models of infant death explaining birthweights, mother's nutritional status, infant feeding and socio-economic and demographic variables as the independent variables.  

<table>
<thead>
<tr>
<th>Predictor</th>
<th>N (%)</th>
<th>RR</th>
<th>RR</th>
<th>RR</th>
<th>RR</th>
<th>OR</th>
<th>OR</th>
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<th>OR</th>
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<td>245</td>
<td>7.204</td>
<td>644</td>
<td>6.0</td>
<td>522</td>
<td>1.000</td>
<td>346</td>
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<td>14.0</td>
<td>230</td>
<td>7.711</td>
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<td>Mother's height &lt;150</td>
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<td>276</td>
<td>7.990</td>
<td>726</td>
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<td>387</td>
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<td>276</td>
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<td>726</td>
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<td>626</td>
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<td>10.0</td>
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<td>1.000</td>
<td>17.0</td>
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</tbody>
</table>

* Unless otherwise stated, all infants were live births. 
** Based on a forward selection of independent variables with a significant probability of 5 per cent. OR is the relative risk, which is the rate of the odds of being dead for a child in one category to that for a child in the last category. 
*** Based on a forward selection of independent variables with a significant probability of 5 per cent. OR is the odds ratio, which is the ratio of the odds of being dead for a child in one category to that for a child in the last category.