

## Effect of Early Solid Food Feeding and the Absence of Colostrum Feeding on Neonatal Mortality and Its Possible Intervention Strategy

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**ABSTRACT** The provision of banana as early solid food feeding together with the absence of colostrum feeding in neonates proven to be the cause of symptoms of intestinal obstruction (SIO). More than 64% of mothers in West Nusa Tenggara (WNT) and 76% in East Java (EJ) fed their newborn babies with chewed banana and 83% of those in WNT and 78% in EJ had a custom of discarding their colostrum. We suggest the same condition in other provinces in Indonesia; 8.49% neonates died with the sign of SIO (see 1), and 23.07% died of diarrhea. Totally, more than 30% of neonatal mortality is caused by banana as early solid food feeding and the absence of colostrum feeding. The application of the health intervention module was proven to be very effective in reducing the custom of provision of banana as early feeding. Therefore, the application of the health intervention module, as a model, based on a previous ethnographic study, and spreading the message community by formal and informal leader with their active organization, is an appropriate method that can be applied to eliminate disadvantageous custom in a community in a relatively short period of time. [Paediatr Indones 1999; 39:251-258]

### Background

In 1985, the infant mortality rate (IMR) in Indonesia was 96 out of 1000 live births, and decreased to 57 out of 1000 live births in 1994. This still represented the highest figures of IMR among other ASEAN countries. In 1985, the IMR in West Nusa Tenggara (WNT) province was 123.90 out of 1000 live births and decreased to 109.8 out of 1000 live births in 1994, but was still the highest IMR among all provinces in Indonesia.<sup>1-3</sup>

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Further, in Indonesia the proportion of neonatal mortality due to perinatal distress was 8.95% in 1980. This number rose to 16.42% in 1985, and 30.8% of IMR in 1992. This means that Indonesia has succeeded in decreasing post-neonatal mortality, but not in decreasing neonatal mortality.<sup>1</sup> The high perinatal distress is caused by two important factors, i.e. first, the perinatal distress which is caused by mother's health condition and nutrition during pregnancy; second, the disorder in neonates after their period of adjustment in the new environment, which includes the disorder caused by the method of delivery, care and early feeding to neonates.

## Review of the Literature

### Early solid food feeding and absence of colostrum feeding studies in Indonesia

A study on the NMR using verbal autopsy i.e. interviewing mothers whose neonates had just died in Kediri subdistrict, West Lombok, during 1986 revealed 414 neonates died. From 414 neonates died, 124 (29.95%) died of acute respiratory tract infection; 101 (24.39%) of diarrhea; 35 (8.45%) of neonatal tetanus; and 42 (10.14%) with vomiting and abdominal distention known as the symptoms of intestinal obstruction (SIO). The proportion of neonatal deaths due to the SIO was higher than that of neonatal tetanus. From 42 infants who died with the SIO 40 (95.23%) died at less than 28 days, where as 2 (4.76%) died between 28 until 60 days. From 40 neonates died less than 28 days, 29 (72.5%) died in less than 7 days. All neonates died SIO had previously been fed with early solid food especially bananas, and were not fed with colostrum.<sup>4</sup>

The Weaning Project sponsored by the United States Agency for International Development (USAID) between 1985-1989 revealed that 64% of mothers in West Nusa Tenggara (WNT) and 76% of mothers in East Java (EJ) fed their newborn neonates with crushed or chewed bananas, whereas 83% of those in WNT and 78% in EJ had a custom of discarding their colostrum.<sup>5</sup>

A qualitative ethnographic study conducted in Labuapi district, Lombok, WNT in 1991 showed that 86% of mothers gave early feeding to their neonates in the forms of banana or rice and 93% discarded their colostrum. Those who advocated the provision of early feeding were as follows: in-laws (11.7%), midwife (61.4%); mothers (20%), spiritual leaders (1.4%), and mothers' experiences (5.5%).<sup>6</sup>

### Early solid food feeding study developing countries

In Nigeria and Zaire, especially in urban areas, early feeding is given to infants of two months of age. Due to the fact that in this area mothers are usually workers as well,

the breast feeding period is relatively shorter. The typical food given to the babies is corn and millet porridge.<sup>7</sup> In Thailand, the typical early food given to neonates is a mixture of rice and banana.<sup>8</sup> In Africa (in Havu and Ntumba) the early food given to neonates is chewed banana,<sup>9</sup> whereas in Malaysia, it is in the form of porridge made of rice and given at one-month-old infants, and some of these infants got diarrhea and malnutrition.<sup>10</sup>

### Early solid food feeding studies in European countries

In Europe, based on the recommendation of European Society for Pediatric Gastroenterology and Nutrition (ESPGAN) in 1982, early feeding is delayed until at least four months old. Feeding should be given when infants are six months old. In reality, in some European countries early feeding is given earlier. For example: in France, wheat porridge is given to two-month old infants; in Greece and Hungary vegetables are given to three-month old infants; and in the upper-middle class in Barcelona (Spain), early food in the form of wheat porridge and vegetables are given to one-month old infants, whereas fruit juice is already given to two week old infants.<sup>11</sup> No banana or rice is given as early solid food feeding in European Country.

### The capacity of carbohydrate digestion and absorption in newborn

The digestion of carbohydrate on neonates are influenced by: (1) Type of crystalline patterns, crystal pattern B type, as found in bananas, is more difficult to digest; while in rice, the type of crystalline pattern is A type, easy to be digested; (2) The method of carbohydrate preparation prior to feeding; (3) Alpha amylase activities; (4) stomach emptying time; and (5) the rapid of intestinal motility; etc.<sup>12</sup> In the large intestine, the undigested carbohydrate undergoes a fermentation process producing short chain fatty acids, hydrogen, and methane.<sup>11</sup>

Neonates are endowed with a good ability digest carbohydrate. The digestion of carbohydrate in neonates is mainly done by glucoamylase produced by duodenal mucosa cells, because pancreatic alpha amylase is not produced well yet.<sup>14</sup>

### Gastrointestinal diseases with symptoms of vomiting and abdominal distention

Gastrointestinal diseases in neonates with vomiting and abdominal distention, are congenital intestinal disorder, bezoar, neonatal necrotizing enterocolitis (NNEC), and SIO. Congenital diseases of the intestine which have vomiting and abdominal distention symptoms are ileal atresia, meconium ileus, meconium plug syndrome, meconium peritonitis, and Hirschsprung disease.<sup>15,16</sup>

In Indonesia phytobezoar with perforation of gastrointestinal tract caused by Siamese banana and followed by NNEC in the duodenum has been reported by

Darmawan in 1984.<sup>17</sup> Bezoar is a mass found in the upper of gastrointestinal tract, especially gaster consists of undigestible material. If the material comes from milk, it is called lactobezoar; if it comes from hair, it is called trichobezoar; and if it comes from indigestible vegetables, it is called phytobezoar. Bezoar can cause symptoms like: abdominal distention, vomiting, and regurgitation.<sup>18</sup> Bezoar is visible in the X-ray of abdomen or it looks like echogenic dense area in ultrasonography (USG).<sup>19</sup>

Neonatal necrotizing enterocolitis (NNEC) is a disease of unknown cause. This disease is mostly found in infants with perinatal distress. Some factors that may influence the appearance of NNEC are intestinal ischemia, bacterial colonization and invasion, the presence of substrate in the lumen of gastrointestinal tract, hyperosmolar food that can damage intestinal lumen, a huge amount of food given too early, and the absence of immunological protection for infants who are not breastfed.<sup>20-22</sup> The incidence of NNEC case is between 1-7.5% out of 1000 live birth, in European and American maternity hospitals.<sup>23,24</sup> Neonatal mortality from NNEC in the neonatal intensive care unit centers is between 40-70%.<sup>20,25</sup>

A cohort study was performed to prove the causal relationship between banana feeding and the absence of colostrum feeding and the appearance of the SIO.<sup>26</sup> The method of conducting this research was surveillance. Sample size needed in this research was 4080 neonates, 3670 as exposed group (group which given banana as early solid food feeding and the absence of colostrum feeding), and 408 as unexposed group.<sup>27</sup> The logistic regression analysis was used in this study.<sup>28</sup> After adjustment of confounding variables, the causal relationship between banana as early solid food feeding and the absence of colostrum feeding and the appearance of the SIO was proven. The causal association was strengthened by almost complete Trout<sup>29</sup> and Sackett<sup>30</sup> criteria used in this study. To reduce the custom of early solid food feeding and discarding the colostrum in community, application of intervention modules based on previous ethnographic study was also performed. By this model, in relatively short period of time (one year), 28.9% of the custom of early solid food feeding and 42.7% discarding the colostrum could be decreased.

The SIO is not only a common vomiting and abdominal distention. This symptom is usually followed by other symptoms such as, the painful look of the infant, continuous crying, abdominal pain when palpated. Symptoms depend on the level of obstruction. The symptoms of proximal obstruction are abdominal cramps, vomiting, and abdominal distention. In distal obstruction, abdominal distention occurs prior to vomiting. The results of this research were as follows:

1. The provision of banana as early solid food feeding to neonates proven to be the cause of SIO (5.1%, with the relative risk (RR)=9.15 and 95% confidence interval (95% CI) 1.96 to 42.58.
2. The absence of colostrum feeding in neonates proven to be the cause of SIO (2.39%, with RR=1.80, and 95% CI 1.09 to 2.97).
3. The provision of banana as early solid food feeding together with the absence of

colostrum feeding in neonates proven to be the cause of SIO (3.3% with RR=5.80 and 95% CI 2.25 to 15.00.

4. With the decrease of the custom of giving banana as early solid food feeding and the increase in the provision of colostrum feeding in neonates, the incidence of SIO in community is also decreasing.
5. About nine percent of neonates in this study died with the SIO and 23.1% with diarrhea. Neonates died with diarrhea is suspected due to the preparation early solid food feeding and the absence of colostrum feeding.
6. The application of the health intervention module was proven to be very effective in reducing the custom of provision of banana as early feeding together with the absence of colostrum feeding in community. Therefore, the application of health intervention module, as a model, based on a previous ethnographic study, and spreading the message by formal and informal leaders with their active organization into community, is an appropriate method that can be applied to eliminate disadvantageous custom in a community, in a relatively short period of time.

#### Colostrum and breastmilk

Colostrum is breastmilk that comes out for the first time, with yellowish color and thick consistency. Colostrum usually comes on the first through third day after birth.<sup>30</sup> Colostrum and breastmilk contain immunological substances, both cellular (lymphocyte, neutrophil, macrophage, and epithelial cells), and humoral (immunoglobulin especially SIgA, lactoferrin, lysosyme and bifido factor).<sup>31,32</sup> Macrophages can do phagocytosis and produce lysosyme, lactoferin, and other components of the complements of the complement system. Macrophage also contains pler' u IgA. Lactoferin binds of Fe, so that there will be no Fe left for the development of microorganism.<sup>33,34</sup> Bifido factors of the breastmilk can trigger the development of bifido bacteria which are dominant in intestinal flora of neonates.<sup>35</sup> Colostrum and breastmilk also contain some type of hormone responsible for the growth and development of the intestine. Two of them are epidermal growth factor (EGF) and prostaglandin.<sup>36</sup> Apart from those, colostrum and breastmilk also contain alpha amylase, higher in colostrum than in breastmilk.<sup>20</sup>

#### Banana (*Musa Paradisiaca*)

Most bananas given to the neonates in the research sites in WNT province are green banana variety (Lacatan Jamaica=Dwarf cavendish). Every 100 g of the green banana has the following composition: calorie 68 kcal; protein 1.3 g; fat 0.2 g; carbohydrate 17.2 g; calcium 10 mg; phosphorus 26 mg; iron 0.6 mg; vitamin A 76 IU; vitamin B 0.08 IU; vitamin C 60 mg; and water 80.3 g.<sup>37</sup> Polysaccharide found in bananas

consists of starch polysaccharide (SP) and non starch polysaccharide (NSP). NSP consists of algine, pectin, and hemicellulose which is hard to digest by alpha amylase. The amount of NSP is 3.6-4.3% of bananas total weight.<sup>38</sup> When banana is ripe, SP will decrease from 80-83% to 1-2%, at the same time the monosaccharide and disaccharide will increase from 1% to 80%. Bananas also contain other substances like dopamine, noradrenaline, and serotonin. The amount of dopamine in banana is 10 µg per g of banana. The amount of noradrenaline in banana depends upon its ripeness. In the ripe bananas, the amount of the noradrenaline is 2.5 µg/g, while in the very ripe ones, the amount of noradrenaline reaches 10.1 µg/g. The amount of serotonin in a ripe banana is between 25-40 µg/g.<sup>39</sup>

### Conclusions and Suggestions

1. The provision of banana as early solid food feeding together with the absence of colostrum feeding in neonates proven to be the cause of SIO.
2. More than 64% of mothers in WNT and 76% in EJ fed their newborn babies with chewed banana and 83% of those in WNT and 78% in EJ had a custom of discarding their colostrum. This condition should be searched in other province. We suggest the same condition in other province in Indonesia 8.49% neonates died with the sign of SIO (see 1), and 23.1% died with diarrhea. Totally, more than 30% of neonatal mortality is cause by banana as early solid food feeding and the absence of colostrum feeding. A big epidemiology problem in Indonesia.  
The application of the health intervention module was proven to be very effective in reducing the custom of provision of banana as early feeding together with the absence of colostrum feeding in community. Therefore, the application of the health intervention module, as a model, based on a previous ethnographic study, and spreading the message community by formal and informal leader with their active organization, is an appropriate method that can be applied to eliminate disadvantageous custom in a community in a relatively short period of time.

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