# Factors Predisposing Infants To Gastroenteritis Among Poor, Urban, Filipino Families

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## Citation

## Abstract

A cross-sectional study was undertaken between November 1989 and January 1990 to assess the relationship between nutritional status, water quality, feeding practices and diarrhoeal diseases in 50 infants who had gastroenteritis, and 50 healthy infants from poor urban families in Metropolitan Manila. Information was obtained from mothers in a hospital setting concerning feeding practices, age and sex of the infant, quality of the water supply, and whether water used for feeding was boiled. Infants were weighed and examined to determine the degree of malnutrition. Better nutrition and supplementation of water in addition to feeds were inversely associated with the occurrence of gastroenteritis. Breast-fed infants were better nourished than formula-fed infants. These findings underscore the importance of adequate nutrition and hygiene in reducing rates of infant morbidity.

## INTRODUCTION

Diarrhoeal illnesses account for a large proportion of childhood morbidity and mortality in the developing world where the levels of hygiene and nutrition may be poor[1][2]. Infants have proven to be particularly vulnerable[3]. Factors associated with infant diarrhoeal illnesses can be divided into exposure and resistance factors. The former includes water quality, availability, and household sanitation, and the latter includes infant feeding methods and nutritional status. These, together with other variables, have been collectively referred to as "intermediate," or "proximate" determinants in the epidemiology of diarrhoeal diseases[4].

The infant mortality rate in the Philippines in 1990 was 43 per 100[5] with diarrhoeal diseases accounting for 17% of all deaths for children under two[6]. These causes are not, however, mutually exclusive as undernutrition can severely increase the risks of respiratory and gastrointestinal illnesses for infants while episodes of diarrhoea, in turn, exacerbate nutritional ill health. Simpson-Hebert and Makil[7] speculated that rates for diarrhoeal diseases were relatively low in Metropolitan Manila because the water supply is of better quality than in other areas, although the rates are in fact comparable to those in other areas of the Philippines. The present study examines three of the critical intermediate variables predisposing infants to gastroenteritis in a poor, urban sector of Metropolitan Manila in an attempt to isolate some of the factors that may be governing the lower rates of

infant morbidity in this region of the Philippines. These variables are: water sources available to families, nutritional status, and feeding practices. The study was implemented at the end of 1989 in the Dr. Jose Fabella Memorial (JFM) Hospital, and the Lower Bicutan Health Center, both situated in Metropolitan Manila. The JFM Hospital, which is a government institution housed in an old converted prison, is a maternal and child hospital serving women of low socioeconomic status who live in one of the poor urban sectors of Manila. The Lower Bicutan Health Center is in one of the suburbs of Manila. Most of the families attending this clinic subsist by manual labour in Metropolitan Manila. The socioeconomic level of patient catchment areas served by both health services are similar; both used government health care, while people of even limited financial resources are under social pressure to pay for health care services. There are no significant differences between the two areas in access to piped water among the families sampled for this study.

## METHODS

Fifty infants admitted with symptoms of gastroenteritis to the JFM Hospital were studied between November 1989 and January 1990. All of these infants had one or more of the following symptoms or signs: diarrhoea, vomiting, pyrexia and dehydration. Diagnoses upon admission included acute infectious diarrhoea, enterotoxic Escherichia coli [ETEC], enteropathic Escerichia coli [EPEC], acute ileocolitis, acute

gastroenteritis and ameobiasis. Nearly all the infants suffered from an estimated 5-10% dehydration, and were treated with an oral rehydration solution, or with intravenous fluids. Antibiotics were occasionally administered to the infants, but only when satisfying WHO criteria to treat selected pathogenic organisms[8][9]. Infants were weighed upon admission and prior to rehydration treatment using Salter Scales. Weights were corrected for dehydration by adding 10% to the figures (assuming a maximum proportion for dehydration). Percentiles of standard weight for age were calculated using the Harvard Growth standards[10], and the degrees of malnutrition were calculated using the classifications established by Gomez et al[11]. Fifty healthy babies were simultaneously recruited from the Lower Bicutan Health Center, from among those arriving for free routine immunizations. Infants were weighed at the clinic prior to immunization using the same scale as the hospital.

A questionnaire in the local language of Tagalog was verbally administered to both sets of mothers prior to immunization in the Clinic, and after admission of the sick infants to Hospital. The information was collected by CRF (Table 1). Backward stepwise logistic regression was used to model our expectations that infant health would depend upon: a) nutritional status, b) the quality of drinking water available to households; c) whether mothers supplemented their infants with water; d) whether mothers boiled the water that was used; e) the feeding method used by the mother, and; f) age of the infant. Nutritional status of the infants was numerically coded from zero to three, reflecting the degrees of malnutrition, while the other four factors were treated as binary variables. For feeding method, mixed feeding regimens and breastfeeding were counted together as one code; quality of the drinking water was divided into piped or well water; and water supplementation and boiling of water were "yes/no" binary variables. SPSS Version 10 was used for the statistical analyses.

**Figure 1**

Table 1: Information elicited from Filipino women in a questionnaire translated into Tagalog



1. Age of the infant
2. Sex of the infant
3. Method of feeding:
    breast
    formula (name of brand)
    both
4. Water source to the home:
    piped
    well
5. Whether water is boiled or not

## RESULTS

The results of the logistic regression are presented in Table 2.

**Figure 2**

Table 2: Results from the stepwise logistic regression where infant health is the dependent variable. The significant independent variables are nutritional status and supplementation with water.*

|  | B | S.E. | Wald | p |
|---|---|---|---|---|
| Nutritional status | 1.514 | 0.489 | 9.585 | 0.002 |
| Supplementation with water | -2.103 | 0.695 | 9.157 | 0.003 |

*Statistics for all variables from a logistic regression that forced all the variables into the model* *

|  | B | S.E. | Wald | p |
|---|---|---|---|---|
| Nutritional status | 1.392 | 0.526 | 6.998 | 0.008 |
| Supplementation with water | -2.254 | 0.772 | 8.521 | 0.004 |
| Feeding method | 0.356 | 0.502 | 0.503 | 0.478 |
| Water source | 0.087 | 0.485 | 0.033 | 0.857 |
| Boiling of water | -6.96 | 16.44 | 0.179 | 0.672 |
| Sex of infant | 0.775 | 0.553 | 1.966 | 0.161 |
| Age of infant | -0.012 | 0.068 | 0.03 | 0.864 |

* The Wald statistic is the square of the ratio of the coefficient value (B) to its standard error (S.E.)

Poor nutritional status and not supplementing with water made infants more susceptible to gastroenteritis. The majority of mothers (96%) stated that they boiled the water that was used for both infant formulas and as a supplement. Ninety four percent of healthy infants were supplemented with water that was always boiled irrespective of source. However, only 62% of unhealthy infants were given additional water that was always boiled (96%).

With regard to infant feeding, more mothers of healthy babies breastfed exclusively (34%) compared to those mothers with unhealthy infants (24%). More informatively, when we examine the distribution of infants with malnutrition in the healthy and unhealthy groups by infant feeding method, significantly fewer exclusively breast-fed infants (28%) suffer from malnutrition compared to formula-fed infants (66%) (Pearson's Chi-Square, p = 0.058, Figure 1). When comparing water source in formula-fed infants a majority (63%) of the healthy infants came from homes with piped water compared to only 41% in the unhealthy infants.

Age was not a significant independent variable in the logistic regression. However, examination of the distributions by age of healthy and of malnourished infants shows that there is a clear demarcation in infant health and level of nutrition during the first six months of life, and particularly during the first two months (Figure 2). Infants under six months of age appear to be less healthy and well-nourished. Accordingly, we repeated the logistic regression using two sub samples: the first included infants aged up to six months, and the second was restricted to infants between seven and twelve months. In the first sample, age was a significant variable together with degree of malnutrition and whether infants were supplemented with water. No variable was significant in the second sample of infants over six months of age.

**Figure 3**

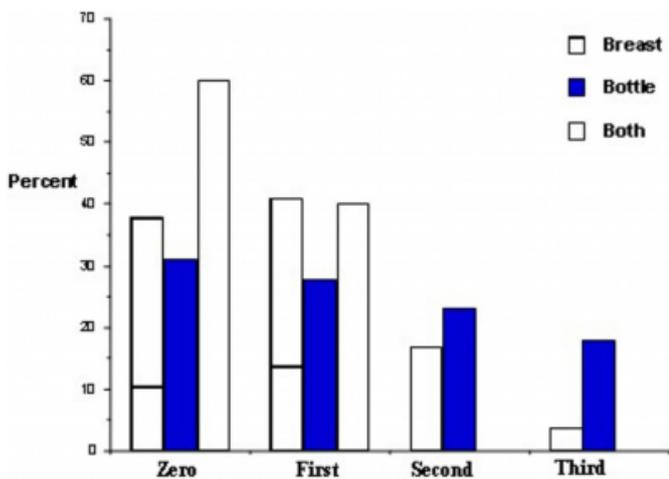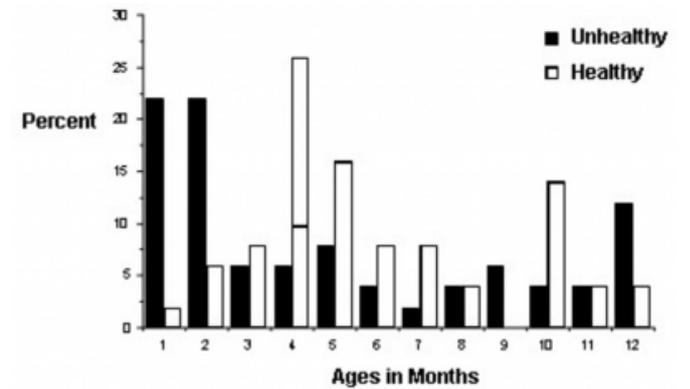Figure 1: Degree of malnutrition in relation to method of infant feeding



**Figure 4**

Figure 2: Age distributions of healthy and unhealthy Filipino infants



## DISCUSSION

This study has examined three of the most critical intermediate variables predisposing infants from a poor urban area in Manila to gastroenteritis, namely water quality, infant feeding methods and nutritional status. Such risk factors are likely to be more prevalent in deprived urban areas.

## NUTRITION

The most important factor contributing to infant gastroenteritis was their nutritional status (Table 2). Nutritional adequacy may be partly determined by the feeding method employed, but also interacts synergistically with diarrhoeal episodes[12]. Diarrhoeal diseases result in anorexia and the rapid transit time of food[13]. This in turn leads to reduced absorption[14] and utilization of nutrients[15] with alteration of the intestinal epithelial cells[16]. Current studies focus on early refeeding and continuation of breast feeding to counteract these changes8 [17]. Malnutrition independently raises risks of morbidity by decreasing nutrient absorption, lowering the body's natural immunity through alterations in the integrity of body surfaces, decreasing the ability to repair the epithelium, and reducing gastric acid secretion. In addition, malnutrition entails welldocumented immunological abnormalities. The synergism between nutrition and diarrhoeal infections may have prolonged effects on the trajectory of normal infant growth and development.

## WATER SUPPLEMENTATION, SANITATION, AND SOURCES

The finding that not supplementing an infant with water is the other significant factor predisposing infants to diarrhoeal episodes is surprising since we would expect supplemented

infants to be more exposed to water-borne pathogens. Our findings are in opposition to the results of Popkin et al[18], where, in a contemporaneous study of over 3000 babies from Cebu, Philippines, the addition of any fluids to breastfeeding increased the risk of diarrhoea up to threefold. This difference between these two studies may be due to two factors: the higher quality of the water supply in Manila, and the high proportion of mothers who boiled the water in our study. Water quality and availability play an important part in determining risks for diarrhoeal diseases; the incidence of diarrhoeal diseases in infants in Cebu correlated with the density of bacteria in drinking waters supplying the homes where these infants lived. Moe et al[6] have shown that a large proportion of open dug wells (of the same kind as in our study) had high densities of faecal coliform, enterococci and faecal streptococci compared to piped water. The quality of the water supply in Manila is relatively good compared to other urban and rural areas of the Philippines although a more formal analysis of this variable at the time of the study was not undertaken.

Water quality is particularly important when infants are fed commercial formula instead of breastmilk, and may determine the higher morbidity rates in most studies of formula-fed infants, especially among women of low socioeconomic status in developing countries[19]. Boiling water prior to preparing formulas can significantly help in reducing bacterial levels in otherwise untreated drinking water irrespective of the water source and quality; and is currently recommended as a standard procedure in preparing infant formulae by the American Federal Drug Administration in the USA (http://www.fda.gov/opacom/lowlit/feedbby.html).

Water supplementation also has implications for infant hydration status. The majority of infants in the unsupplemented group were formula-fed. Breast-fed infants who receive sufficient milk to fulfill their energy requirements are generally not at risk for dehydration. It is possible, however, that the formula-fed infants in our study were not given sufficient liquids, and were therefore more prone to dehydration. This alone could exacerbate their health risk for diarrhoeal diseases. Formula-fed children are particularly at risk of hypernatraemic dehydration compared to breast-fed infants[20].

## FEEDING METHOD

Despite the considerable nutritional and immunological benefits associated with breastfeeding

(http://www.aap.org/policy/re9729.html)[21], feeding practices were not found to protect significantly against gastroenteritis in our study. This is in contrast to the concurrent Cebu Study18 which showed feeding method was the most significant variable determining incidences of diarrhoea. Our contradictory results may be related to the small sample size and, perhaps, also to confounding factors, such as the kinds of food supplementations given to infants in addition to breast milk or formula for which we have no information.

That infants who are formula-fed are significantly more likely to suffer from second and third degree malnutrition may be explained by the fact that mothers using formulas may have been preparing them incorrectly[22]. An earlier study at the same hospital showed that only two in 152 new mothers correctly prepared formula7. The incorrect preparation of formula milk, and the use of contaminated water are, in fact, two of the major problems associated with the use of breast-milk substitutes in the developing world. There has been a general reduction in both the initiation and duration of lactation in the developing world which has been duplicated in the Philippines since the 1970s[23], and is most noticeable among women living in urban areas where sanitation and nutrition are most likely to be inadequate for families with low socioeconomic status. Breastfeeding rates are lowest (65%) in Metro Manila compared to other areas (87%) of the Philippines[24].

## CONCLUSION

The importance of our study is that, unlike similar analyses undertaken in other parts of the Philippines, supplemented infants were healthier than unsupplemented ones. There appear to be two factors involved here: first, the water supply in Manila is relatively good compared to other areas, and secondly, mothers consistently boiled the water that was used as a supplement. Water sanitation is therefore a critical variable determining infants' risks for gastroenteritis. This factor should therefore be given increased attention in future efforts to improve infant health.

Educational programs in concert with those already initiated in the hospital setting would be of benefit in reducing infant morbidity in urban Philippines[25]. Such programs should be designed to improve maternal understanding of adequate infant nutrition, with particular emphasis on the importance of breastfeeding and clean water.

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