Pathogenic Bacteria Isolated From Infant Feeding Teats

Contamination of Teats Used by Illiterate and Educated Nursing Mothers in Ile-Ife, Nigeria

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We assessed bacterial contamination of infant feeding teats among nursing mothers and identified pathogenic organisms that might be associated with the incidence of diarrhea. The incidence of diarrhea among the infants of illiterate mothers was fivefold that of infants of educated mothers. The vast majority of the illiterate mothers poorly sterilized their infants’ feeding utensils. The most prevalent pathogenic organism isolated from the teats was enteropathogenic Escherichia coli, followed by Staphylococcus aureus. Unhygienic handling of feeds is an important factor in infantile diarrhea.

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Infant formula per se does not predispose children to infantile diarrhea; rather it is the method of preparation, nonavailability of potable water, ignorance, and the unhygienic conditions of feeding utensils that expose many children to illness. Bottle-feeding aids in bacterial contamination particularly in developing countries where methods of sterilization of feeding utensils are far from satisfactory. Consequently, feeding utensils, especially bottles and teats, can play a part in the development of diarrhea diseases.

The formidable challenge posed by diarrheal diseases in developing countries has been well recognized by several authors. Nigeria, one of the largest countries in Africa, recognized the threat when it listed gastroenteritis as the most important preventable disease to be tackled. Many workers have discussed the risk of bottle-feeding in the health and survival of the infants. Bottle-feeding is quickly becoming more popular in developing countries, and bottle-fed babies in these countries have death rates two to three times greater than their counterparts in developed countries.

One reason babies in developed countries are less apt to be exposed to bacterial contamination is the widespread use of commercially prepared formula with disposable feeding bottles and teats. Babies in developing countries are not as privileged.

Therefore, we undertook this study to investigate bacterial contamination by isolating and specifying the types of colonizing bacteria in the teats collected from nursing mothers.

\[ \text{PATIENTS AND METHODS} \]

Four hundred thirty-two nursing mothers who brought their infants to More Health Center, Ile-Ife, Nigeria, for either minor ailments such as fever, cough, or diarrhea, or regular clinical checkups and routine immunizations between November 1980 and May 1981 were interviewed by questionnaire and interview schedule. The mothers were asked about specific methods of sterilizing the feeding utensils, the duration of sterilization, the number of bottles and teats available, and whether they prepared their babies’ feeds prior to feeding time. The criteria for selection of mothers were based on the following: (1) the child’s age being under 1 year; (2) whether the mother was feeding or bottle feeding her infants; (3) and whether the mother was in possession of a bottle at the time of interviewing for inspection.

The teats of every bottle inspected were collected for bacterial investigation from those nursing mothers who met all the criteria. Demographic data on mothers’ ages, level of education, and socioeconomic background were also obtained. Women with educational backgrounds equivalent to high school or above, who were able to comprehend the questionnaire without any assistance, and who were from a middle socioeconomic class were regarded as literate. Those falling short of these criteria were regarded as illiterate.

\[ \text{Collection of Specimens} \]

The teats collected were those that the mothers considered clean or ready to be used in feeding their babies. Each of the inspected teats was collected aseptically in 5 mL of sterile nutrient broth in a 100-mL widemouthed flask covered with a presterilized stopper. Each flask was shaken vigorously and allowed to stand for at least five to ten minutes before subculturing onto various media.

\[ \text{Processing of Specimens} \]

Broth samples containing each teat were subcultured after five to ten minutes using a precalibrated platinum wire loop that delivered 0.01 mL of the broth to inoculate the entire surface of a 5% defibrinated sheep blood agar (trypticase soy agar base). MacConkey agar, Salmonella and Shigella agar, mannitol salt agar, and phenyl ethyl alcohol agar supplemented with 5% sheep RBCs were also inoculated with...
broth samples containing the teats using a 4-mm platinum wire loop. After the inoculation, all plates were aerobically incubated at 37 °C for 24 hours.

All bacteria recovered in excess of 10^9 colonies per milliliter were biochemically and serologically identified using procedures outlined previously.13,14

As controls, 23 teats washed with detergents and thoroughly rinsed with water before soaking in milton water (1% sodium hypochlorite in water) for at least 90 minutes were cultured using the aforementioned technique.

RESULTS

Of the 432 mothers contacted during the period of the study, only 205 met all the criteria stipulated. The ages of the mothers ranged from 20 to 36 years. Fifty-six percent of the mothers were illiterate and 44% were educated. Seventy-one (78%) of the literate mothers used at least three to four bottles and teats to feed their infants, whereas the vast majority of the uneducated mothers used only one and at most two bottles and teats to feed their infants. The methods of sterilizing feeding utensils are shown in Table 1. Table 2 shows the relationship of bacterial contamination of teats to the educational background and methods of sterilization by nursing mothers. A total of 82 (80%) of the 103 teats were grossly contaminated by bacterial pathogens, which were recovered from the teats for biochemical and serological identifications. In three cases (2.9%) Salmonella and Shigella species were isolated.

Of the 49 species (48%) that showed pure growth of organisms with the morphologic and biochemical characteristics of Escherichia coli,13,14 26 (24.3%) were serologically positive for enteropathogenic strains of E. coli (EPEC) using the polyvalent antisera. The strains of monovalent E. coli were O155:k29, O128:k67, O124:k72, O86:k61, and O44:k74. Other bacteria isolates included 14 (13.6%) Staphylococcus aureus, seven (6.8%) Klebsiella pneumoniae, two (1.9%) Staphylococcus epidermidis, and seven (6.8%) Proteus mirabilis. The distribution of the isolates and the method of sterilizing the teats are shown in Table 3. No bacteria were recovered from the control teats (those soaked in milton water for at least 90 minutes). Table 2 shows that some of the teats from educated mothers were contaminated.

A greater percentage of pathogens recovered were from teats that were washed with detergents and rinsed with water, but that were neither soaked in milton water for at least 90 minutes nor soaked at all. The illiterate mothers possessed the higher number of contaminated teats, especially those mothers who washed the teats without any form of sterilization. Those who used milton water did not presoak the teats for more than 15 minutes, at which time the level of bacterial contaminants is still high. In all, 47.5% of teats sterilized by milton water had less than 10^7 bacteria colonies per milliliter, as compared with 3.1% of teats sterilized by other methods as outlined in Table 2.

COMMENT

That the incidence of diarrheal disease among the infants of illiterate mothers was almost five times that of the educated mothers must not be surprising. This becomes even more understandable when one compares the data in Table 1 with the number of teats and bottles used by mothers in feeding their infants. The vast majority of the illiterate mothers had only two bottles and two teats to feed their infants. Thus, opportunity for thorough washings and sterilization of the utensils to minimize bacterial contamination was greatly reduced.

Although we suggest that the high frequency of diarrhea among the infants of illiterate mothers resulted from their method of sterilizing the teats,
feeding utensils, diarrhea may also be precipitated by contamination from unhygienic methods and the lack of potable water used in reconstituting formula, or contamination from handling the feeds or the feeding utensils.\textsuperscript{1,4,17}

Although many researchers have shown the merits of breast-feeding,\textsuperscript{1,4} the inherent dangers of bottle-feeding with equipment that is heavily colonized by bacteria have not been researched widely in the tropical countries of Africa. Our study has shown that teats used in feeding babies were heavily contaminated with pathogenic bacteria like Salmonella, Shigella, EPEC, and S. aureus, all of which have been implicated previously in infantile gastroenteritis.\textsuperscript{11}

As disclosed by most of the mothers, more than half of the children whose feeding teats were investigated had suffered high episodes of diarrhoea, dysentery, and vomiting within the two to four weeks before the study. The ratio of reported cases of diarrhea among illiterate mothers versus educated mothers was 5:1.

The low count of bacteria in the teats from the educated mothers cannot be unrelated to their longer and more effective methods of sterilization, availability of potable water, influence of education, and high economic and social status. At least they could afford to buy more than two bottles and teats, and more importantly, the mothers could readily follow labeling instructions attached to their sterilizing kits.

Thorough washing of teats and bottles with detergents and salts and adequate and prolonged sterilization in milton water before use will greatly reduce the number of contaminating bacteria and should improve the health of these babies. Advantages of storing bottles and teats in solutions containing hypochlorite has been emphasized.\textsuperscript{1,2,13,14} We have shown that prolonged storage in milton water reduces contamination of infectious bacteria in our country, where safe water supplies are not available in most cities and villages.

The implication that the bottle-fed babies whose teats were grossly contaminated by bacteria are at high risk of gastroenteritis is supported by reports by other researchers.\textsuperscript{19}

There is an urgent need to educate the illiterate mothers in their local dialects on the reasons for ensuring hygienic possession of feeding utensils, and such an education program should also include home visits to observe both feeding utensils and home environment. Above all, the supreme qualities of breast milk with its bacteriostatic, ammnoergic, immunologic, nutritional, and economic advantages should be constantly emphasized to the mothers.

References