CLEANING PRACTICES AND CONTAMINATION STATUS OF INFANT FEEDING BOTTLE CONTENTS AND TEATS IN RAWALPINDI, PAKISTAN

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ABSTRACT

Objective: To evaluate the cleaning practices and contamination status of contents and teats of feeding bottles used by children admitted in the hospitals of Rawalpindi, Pakistan.

Study Design: Descriptive cross-sectional study.

Place and Duration of Study: Department of Pediatrics, Benazir Bhutto Hospital (BBH), Rawalpindi from December 2015 to January 2016.

Materials and Methods: Mothers and caregivers of the children being bottlefed and admitted in the indoor facility of department of Pediatrics, BBH, were consecutively sampled and interviewed. For the isolation of pathogens, the samples were taken from the teats of feeding bottles and evaluated in the microbiology laboratory of BBH.

Results: Of 198 children (mean age: 8 ± 10 months), majority (61.1%) were males and admitted with respiratory problems. Mothers being the primary caretakers washed their hands before making food (93.4%), and used soap and water (90.9%) to wash the feeding bottles after every use. Boiled water was chiefly used (68.7%) for washing. The bottles were sterilized thorough boiling (100%) for < 10 minutes (76.5%) once every day (60.8%). The bottle leftover contents were discarded by the bulk (92.2%) of the caretakers after feeding. In the majority of cases, the bottle contents were found contaminated (52.1%) largely with Klebsiella (42.9%), followed by Acinobacter Baumini (26.3%), and Escherichia Coli (17.3%).

Conclusion: Most caregivers of children in our study washed their hands before making food, cleaned feeding bottles with soap and water after every use while the left-over contents of the food were discarded rather than stored. Most of them prepared formula milk in boiled water and tried to sterilize the feeding bottles by boiling them in water. Most bottles were contaminated, primarily by Klebsiella, Acinobacter Baumannii, and Escherichia Coli.

Key words: Bottle feeding, Contamination, Infant formula milk.

INTRODUCTION

The history of breastfeeding is as old as the history of mankind. Mothers have been religiously breastfeeding their infants all across the globe and especially in the Muslim countries as per the guidance of the Quranic instructions. However, the trend has been seen to change with the introduction of infant formula milk and feeding bottles. This trend, which originated in the west has globalized, and is now equally prevalent in the affluent as well as developing countries of the world including Pakistan [1,2-4]. Two Pakistani studies have pointed out that the majority of infants are fed with bottles either exclusively or in combination with breastfeeding [5,6]. The limited economic resources, unavailability of clean water, poor hygienic conditions, and maternal illiteracy all put a question mark to the safety of infant formula milk and bottle-feeding [7]. This is reflected in the high rate of morbidity and mortality among the bottlefed infants [8]. The risk of infant mortality in Pakistan has been estimated to be 4.5 times higher in bottlefed babies than in breastfed babies [9]. This is comparable to the statistics from the developed parts of the world e.g. in Spain, bottlefed children were up to five times more likely to be hospitalized in infancy than children who were exclusively breastfed [10]. In USA, the infant mortality is twice higher in bottlefed babies to those who are breastfed [9].

Infant feeding bottles can be easily contaminated through multiple sources [11-13]. Studies in developing countries have found home prepared infant formula feedings frequently contaminated with 10^2–10^6 colonies of bacteria/ml of sample [7,14-17]. A study from a developed country (United Kingdom) showed that contamination was frequently found in screw caps and interior of teats of feeding bottles [18]. Therefore, prevention of microbiological contamination demands meticulous care while preparing and feeding infant formula.

With this background, we designed this study while aiming to evaluate the cleaning practices and contamination status of contents and teats of feeding bottles used by children admitted in the hospitals of Rawalpindi, Pakistan, so that counseling of mothers or caregivers of infants can be advocated regarding maintenance of hygiene of feeding bottles.

MATERIALS AND METHODS

It was a descriptive cross-sectional study, carried out in the Department of Pediatrics, Benazir Bhutto Hospital (BBH), Rawalpindi from December 2015 to January 2016. After approval from the ethical review board of Rawalpindi Medical College Allied Hospitals and institutional research forum, we included mothers and caregivers of children being bottlefed who were admitted to the indoor facility of the pediatrics department of BBH through non-probability consecutive sampling. For the isolation of pathogens, we included only plastic bottles with silicone teats used for feeding children that were termed “clean” by the caregiver [18]. The term “clean” meant that the bottles were, in the parent's/caregiver’s opinion, clean and ready to be filled with a feed [18]. Those children who were fed with uncapped bottles were excluded. All bottles were sampled within six hours of reported use.

A written questionnaire was filled by the researcher after questioning mothers or other attendants accompanying the patients. The questionnaire was slightly modified to accommodate information after few initial interviews. The mothers were asked to continue with their routine care for the feeding bottles and not to change it for the evaluation purpose. The samples were taken from the teats of feeding bottles and transported to the microbiology laboratory of BBH Rawalpindi in a refrigerated container (<5˚C) where they were submitted for culture. All samples were processed in conformity with standard microbiological methods recommended by American Public Health Association [19]. The bacterial growth of one colony forming unit/area sampled, was considered a positive contamination [18].

The mothers or the caregivers were asked about the individual who prepared feeding bottle for the child (mother, grandmother, aunt, others), the educational status of the one who prepared feeding bottle for the child (< grade-10, ≥ grade10 ), occupation of the mother (housewife, working lady), liquid used to clean bottles and teats (tap water only, soap and tap water, boiled, chlorinated or sterilized water, any other liquid) number of times feeding bottles and teats are washed in a day (once, twice, thrice, after every use, do not wash everyday), source of this information about the method used to clean bottles and teats (television and radio, newspaper, parents, grandparents or other relatives, other sources) information about method of sterilization for bottles (sterilizing solution, electric sterilizer or microwave, boiling), washing of hands before preparing feeding bottle (tap water, water and soap, medicated cleansing liquid or medicated soap, not at all), water used for preparing feeding bottle (boiled water, tap water, mineral water, buffalo or cow milk), number of minutes the bottles were boiled (< 10 minute, ≥10 minutes; as boiling for 10 minutes is effective) [20], and number of hospital admissions.
the child had since he or she was bottle fed (not at all, once, twice, thrice, more than three times).

The data were analyzed with the help of Statistical Package for Social Sciences V 20 (IBM Corp., Armonk, NY, USA). For all the sociodemographic factors and the responses of queries, frequencies along with percentages were calculated.

RESULTS

Of 198 children, thus finally enrolled, the mean age was 8 ± 10 months (range 1-84 months). Majority were male (61.6%) and admitted in the hospital for the respiratory problems (61.1%). (Table-1) The mothers were the primary care taker in the majority (93.4%) for the preparation of feeding bottles. Most (96.5%) of them were house wives. Most caretakers (57.1%) preparing the feeding bottles had education less than 10th grade, washed their hands before making food (93.4%), and used soap and water (90.9%) to wash the feeding bottles after every use. Boiled water was primarily used (68.7%) for washing. The bottles were sterilized thorough boiling (100%) for < 10 minutes (76.5%) once every day (60.8%). The primary source of information for the majority of caretakers (65.2%) was parents, grandparents and other relatives. The bottle leftover contents were discarded by the bulk (92.2%) of the caretakers after feeding.

Most of the infants (76.8%) were admitted to the hospitals once after they were started on bottle feeding. In the majority of cases, the bottle contents were found contaminated (52.1%) primarily (58%) with a single organism. The commonest organism cultured was Klebsiella (42.9%) followed by Acinobacter Baumini (26.3%), and Escherichia Coli (17.3%).

Table-1: The demographic and clinical properties of the sample (n=198).

<table>
<thead>
<tr>
<th>Variables</th>
<th>n (%)</th>
<th>Variables</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td><strong>Sterilization practice</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>122 (61.6)</td>
<td>Do sterilize</td>
<td>180 (91.4)</td>
</tr>
<tr>
<td>Female</td>
<td>76 (38.4)</td>
<td>Do not sterilize</td>
<td>17 (8.6)</td>
</tr>
<tr>
<td><strong>Missing</strong></td>
<td>1 (0.5)</td>
<td>Missing</td>
<td>1 (0.5)</td>
</tr>
<tr>
<td><strong>Medical problems for which the children were hospitalized</strong></td>
<td></td>
<td><strong>Method used for sterilization</strong></td>
<td></td>
</tr>
<tr>
<td>Respiratory disorder</td>
<td>121 (61.1)</td>
<td>Sterilizing solution</td>
<td>Nil</td>
</tr>
<tr>
<td>Gastrointestinal disorder</td>
<td>39 (19.7)</td>
<td>Electric sterilizer or microwave</td>
<td>Nil</td>
</tr>
<tr>
<td>Cardiovascular disorder</td>
<td>5 (2.5)</td>
<td>Boiling</td>
<td>190 (100)</td>
</tr>
<tr>
<td>Neurological disorder</td>
<td>30 (15.2)</td>
<td>Missing</td>
<td>8</td>
</tr>
<tr>
<td>Renal disorder</td>
<td>3 (1.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Individual responsible for handling and preparation of feeding bottles</strong></td>
<td></td>
<td><strong>Number of times feeding bottles are sterilized</strong></td>
<td></td>
</tr>
<tr>
<td>Mother</td>
<td>185 (93.4)</td>
<td>Daily</td>
<td>90 (60.8)</td>
</tr>
<tr>
<td>Grandmother</td>
<td>2 (1)</td>
<td>After 1-2 days</td>
<td>36 (24.3)</td>
</tr>
<tr>
<td>Aunt</td>
<td>9 (4.5)</td>
<td>After 3-4 days</td>
<td>9 (6.1)</td>
</tr>
<tr>
<td>Others</td>
<td>2 (1)</td>
<td>After 4-6 days</td>
<td>2 (1.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After a week</td>
<td>11 (7.4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Missing</td>
<td>50</td>
</tr>
<tr>
<td><strong>Educational status of the individual responsible for handling and preparation of feeding bottles</strong></td>
<td></td>
<td><strong>Duration of boiling</strong></td>
<td></td>
</tr>
<tr>
<td>Less than matriculation</td>
<td>113 (57.1)</td>
<td>&lt; 10 minutes</td>
<td>114 (76.5)</td>
</tr>
<tr>
<td>Matriculation or more</td>
<td>85 (42.9)</td>
<td>10 minutes or more</td>
<td>35 (23.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Missing</td>
<td>49</td>
</tr>
</tbody>
</table>
**DISCUSSION**

There are many difficulties in managing safe and uncontaminated water-based foods in the developing countries like Pakistan. Pakistan is facing the challenge of limited water resources and is the third most water-stressed country in the world [21]. Water shortage has led to unsatisfactory hygienic conditions. Low literacy rate, limited resources, and poor planning often overlook the key water and food safety precautions and thus contribute to food and water contamination. Moreover, mothers and caregivers are often unaware of maintaining food safety precautions [22]. Infants need frequent feeding. It is therefore a challenge for mothers and caregivers to maintain cleanliness and freshness of every feed. In most circumstances, they do not have access to refrigeration and ample cooking fuel for boiling water and thoroughly cooking/reheating food [23]. Side by side, the overpopulation of families disturbs the balance between earnings and expenses and provides lesser time to mothers to take adequate care of each child. Finally, beliefs, taboos, practices, customs, and insufficient social set-up can further deprecate water and food safety efforts [24].

Coming back to our study, we have discovered many positive and some negative trends in cleaning practices for feeding bottles among caregivers of children in Rawalpindi. The positive trends were that most caretakers were mothers and they washed their hands before making food. The feeding bottles were washed with soap and water after every use while the left-over contents of the food were discarded rather than stored. Most of them prepared feed of formula milk in boiled water and tried to sterilize the feeding bottles while boiling them in water. These positive trends have been supplemented by the literature. Motarjemi and colleagues abstracted that food safety in the...
developing countries was deteriorated by unsatisfactory cleaning of hands and utensils, inadequate cooking of foods, and lack of refrigeration for storage of unpreserved foods [24]. Infrequent washing of hands before preparing formula feed was also reported by Herbold et al. and Labiner-Wolfe et al. [25,26]. Ma and colleagues found that rinsing bottles with soapy water provided the greatest reduction of contaminating bacterial pathogens [8]. Similarly, by removing much of the organic matter remaining on the feeding equipment after use provided some reduction in bacterial counts [8].

The negative trends were that the caregivers boiled the bottles for a time less than the minimum recommended by WHO for effective boiling [20]. They also paid more attention to the instructions of boiling by parents, grandparents, and other relatives than to the health care providers. Resultantly, the majority of feeding bottles were contaminated. The comparable studies in the developing world have pointed out similar disappointing attitudes among caregivers of children. Studies from Brazil, South Africa, Nigeria, and Ethiopia have shown that feeding bottles were contaminated because the recommended hygienic preparation of infant formula was not followed [14-17]. Even in a study from USA, ineffective cleaning and preparation of feeding apparatuses was found to be a source of contamination [27].

Milk as a complementary food to infants’ diet has been associated with a higher degree and frequency of bacterial contamination. Our study has revealed that 52.1% of the bottles considered clean by the caregivers were contaminated. Morais et al. in a Brazilian study, found that 6-26% of the samples from high and low socioeconomic groups respectively were contaminated [28]. Other investigators have reported proportions of contaminated feeding utensils ranging from 49% to 100% [29-32].

The source of harmful pathogens that make the children ill can be the formula product itself, the containers it is stored in, as well as the process of its reconstitution and subsequent handling prior to feeding. The risk from powdered infant formula milk has received increased attention in recent years due to isolation of Escherichia sakazakii (Cronobacter spp) from 2–12% samples of powdered infant formula milk [33,34]. Similarly, the feeding bottles and other utensils have been a major resource of pathogens. The organisms isolated from cleaned bottles from our study were Klebsiella (42.9%), Acinobacter Baumini (26.3%), Eschericia Coli (17.3%), Pseudomonas (9.8%), and Staph Aureus (3.8%). Two Nigerian Studies from Zaria and Ile-Ife have isolated Escherichia coli and Staphylococcus aureus from teats of feeding bottles [15,35]. The predominant bacterial isolates both from bottle-contents and teat-swabs in a Somalian study were Escherichia coli, Enterobacter spp., Klebsiella spp., and Citrobacter spp. [17]. From Sao Paulo, Brazil, Escherichia coli was isolated from up to 26% of the samples [28]. In a British study, Staphylococcus aureus was detected from 4% of ‘clean’ bottles or bottle components [18].

Breast milk is the perfect food for an infant especially in the first six months of life. Even in the developed countries, studies have found that infants who consume formula milk are at increased risk for acute gastroenteritis, type 1 and 2 diabetes, obesity, atopic dermatitis, eczema, severe lower respiratory tract infections, asthma, sudden infant death syndrome, otitis media, necrotizing enterocolitis, and autism [36]. Therefore, utmost care is crucial for making and managing complementary foods to guarantee safe and healthy nourishment of infants and young children. Because mothers have a central role in food preparation, culturally relevant education in food safety through media, health care providers, and religious scholars is necessary. As water is the key element in making these foods and cleaning the feeding equipment, considerable efforts and political will is needed to educate the mothers and to
formulate effective strategies for making clean water available for drinking and food preparation. Pakistan's leaders and stakeholders need to take ownership of this challenge and declare their intention to tackle it.

CONCLUSION
Most caregivers of children in our study washed their hands before making food, cleaned feeding bottles with soap and water after every use while the left-over contents of the food were discarded rather than stored. Most of them prepared formula milk in boiled water and tried to sterilize the feeding bottles by boiling them in water, however, boiled the bottles for a time less than the minimum recommended by WHO for effective boiling. Most bottles considered clean by the caregivers were contaminated primarily by Klebsiella, Acinobacter Baumini, and Eschericia Coli.

AUTHORS CONTRIBUTION
Fatima Ayaz: Conception, planning of research, arrangement of reagent kits, sample collection, and overall supervision.
Saeed Bin Ayaz: Literature review, write-up, data analysis, and data interpretation.
Muhammad Furrukh: Conception, and sample collection.
Sumeera Matee: Write-up.

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