A STUDY OF RISK FACTORS AND SOME FACTS ABOUT GASTROENTERITIS IN CHILDREN

Mohammed Hamid M. Al-Sabawi, MD

ABSTRACT

Objective: The aim of this study is to identify some risk factors and facts related to gastroenteritis in Mosul city of Iraq, and to design preventive measures that can decrease these factors as much as possible.

Methods: This case-series study was performed over 8 months (from 1st April till 30th November of 2013) in three Pediatric Hospitals of Mosul. A prospective study was done on 214 infants and children below 5 years of age with diarrhea by questionnaire. History and physical examination were made and the following information have been addressed: patient's age, sex, type of diarrhea, therapy before admission, type of feeding, type of drinking water, associated illnesses, residence, family background, socioeconomic status, mother education, presence of animals in house, and signs of infant/child neglect as well as the weight

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and height to assess the nutritional status of the child.

Results: The study shows an association between diarrhea and male gender (62.6%), infants <1 year old (60.7%), bottle feeding (whether alone or mixed) (91.2% in infants <4 months and 65.6% in infants >4 months), drinking of tap water (without boiling, especially for infants) (73.4%), inside city residence (67.3%), rural background (even if the family reside in the city) (80%), illiterate and low educated mother (84%), signs of infant/child neglect (75.7%) and malnutrition (65.3% for all degrees).

Conclusions: The results show that there is an association between diarrhea and the following variables; male gender, infants <1 year of age, bottle feeding (whether alone or mixed), drinking of tap water (without boiling, especially for infants), inside city residence, rural background (even if the family reside inside city), illiterate or low educated mother, signs of baby neglect, and malnutrition. These results are similar to those studies done in several developing countries.

INTRODUCTION

The World Health Organization (WHO) and UNICEF estimate that almost 2.5 billion episodes of diarrhea occur annually in children under 5 years of age in developing countries, with more than 80% of the episodes occurring in Africa (46%) and South Asia (38%).

Gastroenteritis in childhood accounts for a large proportion (~18%) of childhood deaths annually, with an estimated 1.5 million deaths per year globally, making it the second most common cause of child deaths worldwide (after pneumonia).

In Iraq, the diarrhea constitutes about 13% of all causes of mortality in children <5 years of age in 2008. In Mosul city, the diarrhea constituted about 48% of all causes of admission to the pediatric hospital for children under 5 years of age during 2010, but the mortality rate due to diarrhea in our hospitals was only about 11% in regard to all causes of death.

The global mortality may be declining, but the overall incidence of diarrhea remains unchanged at about 3.6 episodes per child per year, and it is estimated to account for 13% of all childhood disability-adjusted life years (DALYs).

Many children (especially infants and toddlers) in developing countries have frequent episodes of acute diarrhea. Although few individual episodes persist beyond 14 days, frequent episodes of acute diarrhea can result in nutritional compromise and can predispose these children to develop persistent diarrhea, protein-calorie malnutrition, and secondary infections. In addition, increasing attention is being focused on prolonged episodes of diarrhea that last 7-13 days and are associated with significant nutritional penalties.

Risk factors for gastroenteritis: Major risk factors for gastroenteritis are environmental contamination and increased exposure to enteropathogens. Additional risk factors include young age, immune-deficiency, measles, malnutrition, and lack of exclusive or predominant breast-feeding. Gastroenteritis is also associated with poverty, poor environmental hygiene, and development indices of the country. Strikingly, an estimated 88% of all diarrheal deaths worldwide can be attributed to unsafe water, inadequate sanitation, and poor hygiene.

Malnutrition increases the risk of diarrhea and associated mortality, and moderate to severe stunting increases the odds of diarrhea-associated mortality 1.6- to 4.6-fold. The fraction of such infectious diarrhea deaths that are attributable to nutritional deficiencies varies with the prevalence of deficiencies; the highest attributable fractions are in sub-Saharan Africa, south Asia, and Andean Latin America. The risks are particularly higher with micronutrient malnutrition; for example: in children with vitamin A deficiency, the risk of dying from diarrhea, measles, and malaria is increased by 20-24%. Zinc deficiency is estimated to increase the risk of mortality from diarrhea, pneumonia, and malaria by 13-21%.

Aims of study: Identification of some risk factors for gastroenteritis in our locality (Mosul city), in order to design preventive measures that can decrease these factors as much as possible. Determination of some
facts that have been associated with gastroenteritis which may be considered as potential risk factors.

METHODS

This case-series study was performed over 8 months period, from the 1st April to 30th November of 2013, and it is not restricted on one hospital but include three major pediatric hospitals in Mosul; Al-Khansa, Ibn-Sena and Ibn-Alatheer hospitals to cover the whole city as much as possible.

During this study, 214 infants and children with diarrhea were studied by questionnaire, i.e., through questioning of their mothers strictly (not other relatives). The patients included were present in the ward (not in the casualty), and the age range of patients is distributed between 1 month and 5 years of age. Neonates <1 month have been excluded from this study, because their bowel habit sometimes normally is frequent and watery (especially if breast fed), thus it may be confused with diarrhea by the mother.2

The diarrhea included in study is acute (watery and/or bloody) and persistent diarrhea that are presumed to be caused by infective etiologies, whereas chronic diarrhea due to other causes e.g. malabsorption syndromes (cystic fibrosis, celiac disease...etc) have been excluded from this study.

History and physical examination were made and the following information have been addressed: patient’s age, sex, type of diarrhea, therapy before admission, type of feeding, type of drinking water, associated illnesses, residence, family background, socioeconomic status, mother education, presence of animals in house, and signs of infant/child neglect as well as the weight and height to assess the nutritional status of the child.

The materials used in study are a balance for measuring the weight of patient (after rehydration), and a tape measure for measuring the length (or height). To assess the degree of malnutrition, the researcher took the ideal body weight (IBW) for each patient from the growth charts (according to age and sex), then calculate the percentage of the real weight of patient in regard to his/her ideal weight.

Investigations used are general stool examination, which requested for all patients in the study. Stool culture was only restricted for patients with persistent diarrhea, whereas patients with acute bloody diarrhea (although it also an indication for stool culture), it has not been done in this study because most of patients have improved on the initial antibiotic therapy on the second day of admission which may make the result of stool culture falsely negative.

Statistical analysis: Because the study is descriptive, the results have been expressed as percentages (%) of the total, with approximation of the smaller fractions to the nearest value. After collection of data, the researcher had make two methods of analyses for interpretation of these data:
- Quantitative analysis: That makes a relationship between each variable of the patient in relation to the whole number of patients in study. For example; the age variable is made as percentage of infants <1 year versus children >1 year from the total number.
- Qualitative analysis: The researcher tried to find a relationship between some variables which are common in a specific group of patients with other variables in the same group. For example; the association between persistent diarrhea and other variables e.g. age, sex, residence...etc within the same group of patients with persistent diarrhea. However; this has been applied only on the some risk factors (not all) as well as variables with no significant difference between them has not been mentioned.

RESULTS

After studying of 214 infants and children with diarrhea, the results can be illustrated as in the following:

Note: The total number of data is not necessarily correspond with the total number of cases, because some cases have more than one variable in the same time.
- Sex: Male (62.6%), female (37.8%).
- **Age:** <1 year (60.7%), >1 year (39.3%).  
  **Note:** Infants <1 year of age with diarrhea were more frequent with male gender (64%), acute diarrhea (77%), bottle or mixed feeding (92%), drinking of tap water (58%), poor to medium socioeconomic status (90%) and mild malnutrition (67%).

**Type of diarrhea:**

<table>
<thead>
<tr>
<th>Type of diarrhea</th>
<th>%</th>
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<tbody>
<tr>
<td>Bloody diarrhea</td>
<td>14.4%</td>
</tr>
<tr>
<td>Acute watery diarrhea (&lt;2 weeks)</td>
<td>69%</td>
</tr>
<tr>
<td>Persistent diarrhea (&gt;2 weeks)</td>
<td>16.3%</td>
</tr>
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</table>

**Therapy before admission to hospital:** Antibiotic administration (oral or injectable) before admission was more frequent with urban background (73%), medium socio-economic status (82%) and educated mother (whether employed or not) (93%).

**Therapy %**

- Home remedies (e.g. saqua, soup…etc.) 15.8%
- Oral rehydration solution 10.2%
- Antibiotics* 80.3%
- No therapy 10.7%

**Type of feeding in infants below 4 months of age:** Their number was 34 of the total 214.

The three women with exclusive breast feeding were from urban background, educated but not employed and belong to medium socioeconomic status.

**Type of feeding**

<table>
<thead>
<tr>
<th>Type of feeding</th>
<th>%</th>
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<tbody>
<tr>
<td>Exclusive (or predominant) breast feeding*</td>
<td>6.8%</td>
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<tr>
<td>Bottle feeding only**</td>
<td>38.2%</td>
</tr>
<tr>
<td>Mixed feeding (breast and bottle)</td>
<td>53%</td>
</tr>
</tbody>
</table>

Bottle feeding was more frequent with age >1 year (66%), urban background (60%), medium to good socioeconomic status (91%), educated mother (whether employed or not) (92%) and malnutrition (all degrees) (70%).

**Type of feeding for infants and children between 4 months and 2 years of age:** (in addition to the supplementary foods): Their number was 131 of the total 214.

- **Type of feeding**
  - Breast feeding 21.3%
  - Bottle feeding 41.2%
  - Mixed feeding (breast and bottle) 24.4%
  - Weaning foods only 12.9%

**Drinking water supply:** excluding those with exclusive (or predominant) breast feeding.

- **Drinking water supply %**
  - Boiled 14.7%
  - Bottled 11.8%
  - Tap* 73.4%

Drinking of tap water was more frequent with age >1 yr (65%), rural background (80%), poor socioeconomic status (76%), illiterate mother (55%) & malnutrition (all degrees) (78%).

**Associated illnesses:** (e.g. RTI, UTI, CHD & others): Present (21.9%), not present (78.1%).

**Residence:** Inside city (67.3%), outside city (32.7%).

**Family background:** (depending on the language, as well as the general appearance and attitude, regardless the residence): Rural (80%), urban (20%).

**Note:** Rural background was more frequent with infants <1 year (70%), persistent diarrhea (88%), saqua (herbal material contain anti-diarrheal agents) administration (100%), mixed feeding (77%), drinking of tap water (85%), poor socioeconomic status (66%), illiterate mother (92%) and moderate to severe malnutrition (95%).

**Socioeconomic status:** (depending on the income/salary of family, job of parents, owned or rented house):

- **Socioeconomic status %**
  - Poor 26.6%
  - Medium 68.7%
  - Good 4.6%
*Degree of mother education: Highly educated mothers was not restricted to those with high academic achievement, but also for those mothers with lower education but are aware of the basic health principles (e.g. the meaning of bacteria, contamination, importance of breast feeding, ...etc) through discussion of these issues during the interview.

<table>
<thead>
<tr>
<th>Mother education</th>
<th>%</th>
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<tbody>
<tr>
<td>Illiterate</td>
<td>30.3%</td>
</tr>
<tr>
<td>Low educated</td>
<td>53.7%</td>
</tr>
<tr>
<td>Highly educated</td>
<td>15.8%</td>
</tr>
</tbody>
</table>

*Presence of animals in house: (e.g. cattle, cats, dogs, ...etc): Yes (13%), no (87%).

*Signs of infant/child neglect: (e.g. dirty clothes, bad odor, not trimmed fingernails): Present (75.7%), absent (24.3%).

*State of nutrition: Percentage between 90-80% of the IBW were considered as mild malnutrition, 80-70% as moderate malnutrition and <70% as severe malnutrition\(^1\). Height below 3th percentile on the appropriate growth chart was considered as stunting.\(^1\)

<table>
<thead>
<tr>
<th>State of nutrition</th>
<th>%</th>
</tr>
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<tbody>
<tr>
<td>Normal</td>
<td>34.5%</td>
</tr>
<tr>
<td>Mild malnutrition</td>
<td>41.1%</td>
</tr>
<tr>
<td>Moderate malnutrition</td>
<td>11.6%</td>
</tr>
<tr>
<td>Severe malnutrition and/or stunting*</td>
<td>12.6%</td>
</tr>
</tbody>
</table>

Severe malnutrition and/or stunting: was more frequent with age >1 year (60%), rural background (76%), poor socioeconomic status (72%) and illiterate mother (84%).

<table>
<thead>
<tr>
<th>General stool examination</th>
<th>%</th>
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<tbody>
<tr>
<td>Pus cells</td>
<td>48.5%</td>
</tr>
<tr>
<td>RBC</td>
<td>38.3%</td>
</tr>
<tr>
<td>Parasites</td>
<td>15.4%</td>
</tr>
<tr>
<td>Fat globules</td>
<td>98%</td>
</tr>
<tr>
<td>Negative for pus cells, RBS and parasites</td>
<td>51.4%</td>
</tr>
</tbody>
</table>

*General Stool Examination: Pus cells (>5/hpf was significant), it is mainly associated with bacterial rather than viral diarrhea. It was more frequent with bloody diarrhea (100%), bottle feeding (84%) and drinking of tap water (90%). RBC (>5/hpf was significant), it was more frequent with variables similar to those of bloody diarrhea. Parasites was mainly include Entamoeba histolytica and Giardia intestinalis. It was more frequent with male gender (67%), age >1 year (95%), rural background (62%), bottle and weaning feeding (90%), drinking of tap water (97%). Fat globules was nearly universal (98%) of cases.

GSE with negative finding of pus cells, RBS and parasites was more frequent with acute watery diarrhea (86%), as well as (77%) was associated with persistent diarrhea which may represent post-gastroenteritis malabsorption rather than infective origin.

Note: It is sometimes important to know the etiologic agents for every case of diarrhea in order to know the risk factors for acquisition of these infections;\(^2\) but this require a specific tests (e.g. special culture media of stool, serology, PCR, ... etc) which are either unavailable or very expensive in our locality.

DISCUSSION

After studying of 214 infants and children with gastroenteritis in Mosul hospitals, the results of the present study shows an association between diarrhea and male gender (62.6%), infants <1 year (60.7%), bottle feeding, alone or mixed (91.2% in infants <4 months and 65.6% in infants >4 months), drinking of tap water (73.4%), inside city residence (67.3%), rural background (80%), illiterate and low educated mother (84%), signs of infant/child neglect (75.7%) and malnutrition (65.3% for all degrees). These results are similar to those studies performed in many developing countries.

In Iraq/Mosul city, a large prospective study was done on 1000 below 1 year infants with gastroenteritis admitted to Iben Al-Atheer hospital between June, 1990 and May, 1991. It revealed an association between diarrhea in one hand and urban residence, and low educated mother in the other hand, whereas breast-fed infants were found to be less susceptible to develop persistent diarrhea and multiple hospitalization.\(^20\)
Giving a tap water to infant without boiling was found to be a risk factor in this study (73.4%), because the tap water of Mosul city is potentially contaminated by various bacteria and parasites as revealed by a study in our city, which correlates between contamination of tap water with E. Coli and increase incidence of diarrhea in children <5 years of age.  

Mother education has an important role in the occurrence of or protection from diarrhea, as shown by many studies. This study shows that illiterate and low educated mothers were associated with (84%) of cases of diarrhea, whereas highly educated mother show a low percentage because they are more oriented about the causes of diarrhea and their protective measures.

Consequently, the signs of baby neglect is also considered as a risk factor for diarrhea as shown by this study (75.7%), because it reflects the mother attitude and the degree of hygiene of the environment the baby live, which especially important when the baby is bottle-fed. 

Nutritional status plays a major role in the pathogenesis of diarrhea, thus malnutrition significantly increases the susceptibility of diarrhea in these infants and children by many mechanisms including the adverse effect on the immune system. Therefore malnutrition is considered a risk factor of diarrhea, as shown by this study (65.3%).

This study fails to find an association between diarrhea and poor socioeconomic status (26.6%) in our locality, which is contrast to other studies although it has been associated with increase incidence of persistent diarrhea as well as moderate to severe malnutrition and stunting among this group of patients.

The study also shows that there is no significant association between diarrhea and other associated illnesses (21.9%), although some patients develop diarrhea after few days of discharge from hospital after recovery from a previous disease other than diarrhea, i.e., nosocomial infection.

It also shows that there is little association between diarrhea and the presence of animals in house (13%), which means that other factors are playing a more significant role in the etiology of diarrhea in our locality, in contrast to other studies.

The use of antibiotics for diarrhea before admission has not been associated with change in the course of diarrhea in (80.3%) of cases in this study, as there are certain indications of antibiotics in diarrhea as well as they are not recommended in simple acute diarrhea because it increase the bacterial resistance and may prolong excretion of some organisms (e.g. non-typhoidal Salmonellae). ORS is strongly recommended by WHO as an initial therapy of diarrhea, but however it was poorly administered (only 10.2%) of cases in this study.

The results of general stool examination reveals that pus cells (which mainly associated with bacterial diarrhea) was present in (48.5%) of cases, and was mainly associated with bottle feeding and drinking of tap water. RBC was present in (38.3%) of cases and was mainly associated with age <1 year, urban residence, bottle and weaning feeding. Parasites was present in only (15.4%) of cases and was mainly include Entamoeba histolytica and Giardia intestinalis. They also were associated mainly with bottle feeding, weaning foods and drinking of tap water.

The results of stool culture in cases of persistent diarrhea were positive in (67.6%), and were associated with growth of E. coli in about two thirds of cases. The rest of the culture results was negative which may represent either insensitive culture technique (because some organisms require special culture media) or due to post-enteritis syndrome (which is a clinical-pathologic condition in which small intestinal mucosal damage persists after acute gastroenteritis that may be attributed to the sensitization to food antigens, secondary disaccharidase deficiency, or an infection or reinfection with an enteric pathogen).

**CONCLUSIONS**

After studying of 214 infants and children with gastroenteritis in Mosul hospitals, the results show that there is an association between diarrhea and the
following variables; male gender, infants <1 year of age, bottle feeding (whether alone or mixed), drinking of tap water (without boiling, especially for infants), inside city residence, rural background (even if the family reside inside city), illiterate or low educated mother, signs of baby neglect, and malnutrition. These results are similar to many studies performed in several developing countries, whereas in developed countries, the risk factors of diarrhea are not well characterized.

The results also did not show an association between childhood diarrhea in Mosul city and the poor socioeconomic status, other associated illnesses, and the presence of animals in house, which is in contrast to other studies.

This study also shows that a large number of cases had use antibiotics prior to admission which had not change the course of diarrhea, whereas few cases had use ORS prior to admission. The results of general stool examination shows that pus cells was present in about half of cases, less with RBC, whereas parasites was present in only few cases. All were associated with bottle feeding, weaning foods and drinking of tap water more than other variables.

The results of stool culture in cases of persistent diarrhea were positive in and were associated with growth of E. coli in about two thirds of cases.

RECOMMENDATIONS

1. Breast feeding in the first 2 years of life (exclusively in the first 4-6 months) is the most effective method to prevent diarrhea in this age, especially in developing countries like Iraq.
2. Mothers of infants on bottle feeding should prevent contamination of milk by washing the bottle with boiled water for at least 5 minutes and the milk should be consumed within 1 hour, the residual should be discarded and not used again, because milk is a good culture media for pathogenic organisms that can cause diarrhea.
3. Drinking water should be sterilized by boiling before giving to children (especially the infants) because the tap water of our city (Mosul) is often contaminated by pathogenic bacteria e.g. E. coli.
4. Aggressive therapy of malnutrition that may follow persistent diarrhea because it may cause a vicious cycle with diarrhea.
5. ORS should be given instead of antibiotics as an initial treatment of acute gastroenteritis.
6. Educational programs to the mothers about basic health principles and preventive measures that protect their babies from diarrhea through health personnel, pamphlets as well as the media e.g. T.V., radio...etc.

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