Factors mediating the relationship between poverty and diarrhea among children less than 5 years old in rural Bangladesh

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Global deaths among children under 5 years old, 2010*

% of childhood mortality

- Pneumonia: 18%
- Diarrhea: 11%
- Malaria: 7%
- Sepsis: 5%
- HIV/AIDS: 2%
- Meningitis: 2%
- Tetanus: 1%
- Measles: 1%

*The Lancet; vol 379: 2151-61; July 9, 2012
Childhood diarrhea by wealth category, Bangladesh BDHS, 2004-2011

Diarrhea cases = 6498
- 2004: Poorest 25%, Second 21%, Middle 19%, Fourth 18%, Richest 17%

Diarrhea cases = 5719
- 2007: Poorest 22%, Second 22%, Middle 19%, Fourth 19%, Richest 18%

Diarrhea cases = 388
- 2011: Poorest 28%, Second 19%, Middle 25%, Fourth 13%, Richest 15%

* Bangladesh Demographic and Health Survey
Known childhood diarrheal risk factors

- Poverty
- Lack of environmental infrastructure
- Poor hygiene standard
- Inadequate safe water
- Malnutrition
Study objectives

• To characterize the relationship between poverty and diarrhea among children < five years old in rural Bangladesh

• To explore the factors that mediate the effect of poverty on the prevalence of childhood diarrhea
Study population and period

Sanitation, Hygiene Education and Water supply in Bangladesh (SHEWA-B) project:

- Baseline survey period:
  October - December in 2007
- 68 rural sub-districts in 19 districts
- Children < five years old
Sampling design

- Using probability proportionate to size (PPS) of population
- One village per union was randomly selected from the available list
- Ten households per village were systematically selected
- Households had at least one child age 0-60 months
Data collection

• Cross-sectional study:
  - Demographic characteristics of caregivers and child
  - Household assets
  - Household environmental infrastructure
  - Handwashing practice indicators
  - Child nutritional status

• Sentinel surveillance:
  - Recall of diarrhea episodes collected monthly from caregivers for three months
Case definition of childhood diarrhea

Caregiver reported:

- Three or more loose stools in a 24 hour period
- Within 48 hours prior to interview
Conceptual framework for childhood diarrhea

Distal determinants

Intermediate determinants

Proximate determinants

Childhood Diarrhea

Confounders:
Age of Children
Model 1: Relationship between poverty and childhood diarrhea

**Distal determinants**
- Wealth/Poverty
- Parental education
- Parental occupational status

**Intermediate determinants**

**Proximate determinants**

**Childhood diarrhea**

**Confounders:** Age of Children
Model 2a: Relationship between household environmental infrastructure and childhood diarrhea

Distal determinants:
- Wealth/Poverty
- Parental education and occupational status

Confounders:
- Age of Children

Intermediate determinants 1
Household environmental infrastructure
- Water present at the most convenient place to wash hands
- Soap present at the most convenient place to wash hands
- Hand washing location
- Household living condition
- Cooking fuel
- Number of people per room (crowding)
- Sanitation facility
- Waste disposal

Intermediate determinants 2
Nutritional status

Proximate determinants

Childhood diarrhea
Model 2b: Relationship between nutritional status and childhood diarrhea

Distal determinants:
- Wealth/Poverty
- Parental education and occupational status

Confounders:
- Age of Children

Household environmental infrastructure

Intermediate determinants 2
- Anthropometrics status
  - Length for age
  - Weight for age
  - Length for weight

Proximate determinants

Childhood diarrhea
Model 3: Relationship between hygiene practices and childhood diarrhea

Distal determinants: 
- Wealth/Poverty
- Parental education and occupational status

Confounders: 
- Age of Children

Intermediate determinants 1
- Household environmental infrastructure

Intermediate determinants 2
- Nutritional status

Proximate determinants
- Hygiene practices:
  - Usual hand washing practices
  - Cleanliness of children and caregivers
  - Covered stored drinking water

Childhood diarrhea
Model 1: Association between poverty and childhood diarrhea in rural Bangladesh, 2007

<table>
<thead>
<tr>
<th>Wealth index</th>
<th>N=1098</th>
<th>Diarrhea prevalence</th>
<th>95% (CI)†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>Adjusted prevalence ratio*</td>
<td></td>
</tr>
<tr>
<td>Poorest</td>
<td>308 (28)</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Middle</td>
<td>379 (35)</td>
<td>1.01</td>
<td>0.78-1.32</td>
</tr>
<tr>
<td>Wealthiest</td>
<td>411 (37)</td>
<td>0.73</td>
<td>0.53-1.00</td>
</tr>
</tbody>
</table>

*Adjusted for age of children, parental education and occupation
†Controlling for intra-cluster correlation in same household using random effect poisson regression.
Model 2a: Association between intermediate determinants and childhood diarrhea in rural Bangladesh, 2007

<table>
<thead>
<tr>
<th>Household environmental infrastructure</th>
<th>Children N=1098</th>
<th>Diarrhea prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n  (%)</td>
<td>Adjusted prevalence ratio*</td>
</tr>
<tr>
<td>Handwashing location near toilet</td>
<td>482 (44)</td>
<td>0.77</td>
</tr>
<tr>
<td>Handwashing location near food</td>
<td>597 (54)</td>
<td>0.74</td>
</tr>
<tr>
<td>preparation and feeding areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed waste disposal site</td>
<td>698 (64)</td>
<td>0.75</td>
</tr>
</tbody>
</table>

* Adjusted for age of children plus distal variables
† Controlling for intra-cluster correlation in same household using random effect poisson regression
### Model 2b: Association between intermediate determinants 2 and childhood diarrhea in rural Bangladesh, 2007

<table>
<thead>
<tr>
<th>Nutritional status</th>
<th>N=2874</th>
<th>Diarrhea prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>Adjusted prevalence ratio*</td>
</tr>
<tr>
<td><strong>Height for age (≥-2 (normal))</strong></td>
<td>1519</td>
<td>1.01</td>
</tr>
<tr>
<td><strong>Weight for age (≥-2 (normal))</strong></td>
<td>1776</td>
<td>0.98</td>
</tr>
<tr>
<td><strong>Height for weight (≥-2 (normal))</strong></td>
<td>2433</td>
<td>0.93</td>
</tr>
</tbody>
</table>

* Adjusted for age of children plus intermediate determinants 1 and distal variables
† Controlling for intra-cluster correlation in same household using random effect poisson regression
### Model 3: Association between proximate determinants and childhood diarrhea in rural Bangladesh, 2007

<table>
<thead>
<tr>
<th>Hygiene practices</th>
<th>Children N=1098</th>
<th>Diarrhea prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstrated handwashing with soap and water</td>
<td>665 (61)</td>
<td>0.82</td>
</tr>
<tr>
<td>Observed drinking water in covered container</td>
<td>350 (32)</td>
<td>0.72</td>
</tr>
</tbody>
</table>

* Adjusted for age, plus distal and intermediate variables
† Controlling for intra-cluster correlation in same household using random effect poisson regression
Definition of mediating proportion

Mediating proportion (MP) =

\[
\frac{(\text{Adjusted prevalence ratio} - \text{unadjusted prevalence ratio}) \times 100}{(1 - \text{unadjusted prevalence ratio})}
\]

Unadjusted model included distal variables and confounders
Adjusted for mediating variables
Mediating the effect of poverty on childhood diarrhea in rural Bangladesh, 2007

<table>
<thead>
<tr>
<th>Household environmental infrastructure</th>
<th>Mediating Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handwashing location near food and feeding area</td>
<td>28</td>
</tr>
<tr>
<td>Handwashing location near toilet</td>
<td>16</td>
</tr>
<tr>
<td>Fixed waste disposal site</td>
<td>11</td>
</tr>
<tr>
<td><strong>Households environmental infrastructure</strong></td>
<td><strong>55</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hygiene practices</th>
<th>Mediating Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handwashing with soap and water</td>
<td>7</td>
</tr>
<tr>
<td>Drinking water from covered container</td>
<td>1</td>
</tr>
<tr>
<td><strong>Hygiene practices</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>
Mediating proportion: contribution of poverty on childhood diarrhea

MP=37%

Poverty

MP=8%

Household environmental infrastructure

MP=55%

Hygiene practices

MP=0%

Nutritional status

Confounders

Childhood diarrhea

MP=Mediating Proportion
Conclusions

Determinants of childhood diarrhea in poor households were mostly associated with:

- Elements of the household environment, particularly handwashing facilities near food preparation areas
- Hygiene practices
Recommendations

Promising low cost interventions targeted at the poor that can reduce diarrhea:

- Handwashing facilities at the sanitation areas
- Handwashing facilities at food preparation areas
- Promoting waste disposal practices
- Handwashing with soap and water after defecation
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\textsuperscript{2} Centre for Communicable disease, International Centre for Diarrhoeal Disease Research, Bangladesh