# Estimation of Acute Diarrhea and Acute Respiratory Infections among Children under Five Years Who Lived in a Peri-urban Environment of Myanmar

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### Abstract

Exposures to multiple environmental contaminants place children under five years of age at a greater risk to acute diarrhea and acute respiratory tract infections (ARI). To assess this phenomenon, a cross-sectional survey was conducted to examine relationships between environmental conditions and occurrence of acute diarrhea and ARI in peri-urban areas of Yangon Region, Myanmar. Mothers or caretakers of 620 children under five years were interviewed using a structured questionnaire. Of these children, 1% had acute diarrhea only, 45% had ARI only and 3.7% had both conditions during last four weeks. Children suffered from acute diarrhea were 2.1 times more likely to suffer ARI in age group of 24-59 months (stratum-specific odds ratio = 2.1, 95% CI = 0.7-6.5). Multivariate analyses identified that bamboo housing and unsafe method of waste disposal were significantly associated with occurrence of acute diarrhea. However, no significant association was identified between ARI attack rate and environmental factors such as house condition and ventilation. Integrated community-based strategies to improve environmental conditions, water, sanitation and hygiene should be considered to reduce the dual burden of these illnesses in children under five years.

*Keywords*: acute diarrhea, acute respiratory infections, dual burden, under five children, environmental contaminants

## Introduction

Globally, millions of children under five years of age die every year from environmental related diseases such as acute respiratory infections (ARI) and acute diarrhea.[1] Children in developing countries are at the highest risk. In 2012, estimated 6.6 million of children were under five years old in Myanmar. Acute diarrhea and ARI were the leading causes of morbidity and mortality among these children.[2]

Environmental conditions such as contaminated water and inadequate sanitation can contribute to acute diarrhea while poor air quality can be a factor to ARI. Multiple exposures to environmental contaminants may increase occurrence of acute diarrhea and ARI among children under five years of age.[3] Acute diarrhea can lead to acute weight loss, malnutrition and stunting, which are risk factors for ARI in a low income setting. This association has a considerable public health importance.[4] Burden of both diseases can be duly reduced by implementing community-based prevention strategies such as improved water quality, sanitation and hygiene, and

better quality of fuel for cooking.[5] Studies have shown that these interventions could significantly reduce child mortality by more than 25%.[6]

Objectives of this study were to assess occurrence of acute diarrhea and ARI in a 4-week period and determine contribution of exposure to environmental conditions on acute diarrhea and ARI among children under five years of age in peri-urban areas of Yangon Region. These findings would be useful for assessing scope and magnitude of these diseases, and identifying vulnerable households and risk factors that would lead to an integrated approach to reduce burden of these diseases.

## Methods

We conducted a cross-sectional survey in North Dagon Township, Yangon Region from September to November 2012. We interviewed mothers or caretakers of children under five years of age who lived in six randomly selected wards in North Dagon Township. A structured questionnaire was pretested and then administered by six trained interviewers in

face-to-face interview with eligible mothers or caretakers. In household study, mothers or caretakers reported, at most, only one episode of ARI and acute diarrhea within past two weeks. However, when extending the self-reporting period for additional two weeks, one to two additional episodes of morbidity were reported. Thus, the study period was extended to 4-week period.

Cluster sampling method was used as it can increase efficiency and cost effectiveness of the study. Sampling frame from a recently completed research project was used to identify six clusters to be sampled.[7] The selected clusters contained 525 households and 620 children. The number of households was based on the assumption that 20% of households had a child under five years with acute diarrhea and ARI within past four weeks, with 5% precision, design effect of two and 10% non-response rate. All children under five years in these households were included in the study (range 1-2 children).

For this study, acute diarrhea was defined as one of the followings: passage of three or more loose watery motion, more than usual loose watery motion, a single large watery motion in a day, or mother's assessment that her child passed more frequent liquid stools.[8] Other symptoms recorded were bloody stools, vomiting or dehydration. ARI could be an upper or lower respiratory tract infection and was defined as any acute episode of runny nose, cough, ear discharge, hoarseness of voice, difficult or fast breathing with or without fever, or chest indrawing.[7] Environmental conditions were defined as any modifiable condition of indoor or outdoor air pollution, housing infrastructure, source of water supply, water treatment and storage, hand washing facilities, latrines and solid waste disposal, exclusive of meteorological conditions.

Quantitative data were entered in EpiData software after thorough checks. Frequency distributions and cross-tabulations were done for variables of interest such as social and demographic characteristics, and related environmental variables. Attack rates for acute diarrhea and ARI, and 95% CI were computed. For bivariate analyses, chi-square test or Fisher's exact test was used as appropriately to ascertain relationship and p-value of 0.05 or less was considered as statistically significant. Stratum-specific odds ratios (OR) and 95% CI were computed to identify confounding effects of children's age. Logistic regression was also done to identify confounding effects of environmental factors in occurrence of acute diarrhea and ARI within past four weeks.

All participants were informed about objectives and procedures of the study, and steps to protect privacy, anonymity and confidentiality of information collected. Only those who gave their voluntary consent were interviewed.

## Results

In this survey, 46.0% of children were between 12-35 months old and only 17.3% were under 12 months. Mean age and standard deviation of children was 29.0±16.4 months. Boys (51.3%) comprised slightly more than half of the study population. Most respondents (65.6%) were mothers of children and 41% were between 25 to 34 years old. Almost one fourth of respondents had high school level education and one third constituted working mothers.

Monthly per capita income was computed by dividing total monthly family income by total number of people living in that household. Median monthly per capita income was 25,000 Kyat (approximate 25 USD) and 41.6% of the respondents were residing in households with low (1667 to 14,286 Kyat) to middle (14,287 to 20,000 Kyat) monthly per capita income.

### Attack Rates of Acute Diarrhea and ARI

Of 620 children in the surveyed households, 29 (4.7%, 95% CI=3.3-6.9) had an acute diarrhea episode in preceding four weeks of the interview. Attack rates of ARI during the same period was 48.7% (95% CI=46.1-54.2). Attack rates of acute diarrhea and ARI within past four weeks were the highest among age group of 12-23 months (Table 1).

For acute diarrhea, 3.2% of 620 children had one episode within past one month and only 1.5% suffered from two episodes. Regarding to ARI, 26.5% of 620 children had one episode within past one month and 22.3% suffered from two episodes (Table 2).

Simultaneous occurrence of acute diarrhea and ARI in past month was reported in 23 children as 3.7% (95% CI=2.4-5.7), and 312 children (50.3%) were free from morbidity of acute diarrhea or ARI. Findings indicated that children under five years in the study population were nearly 10 times more likely to suffer from one or two episodes of ARI (302/620, 48.7%) compared to acute diarrhea (29/620, 4.7%).

Children suffered from acute diarrhea were 2.1 times more likely to suffer ARI in age group of 24-59 months (95% CI = 0.7-6.5) (Table 3). Although it was not significant, children suffered from acute diarrhea were 1.7 times more likely to suffer ARI in age group of 12-23 months. Older age group had higher risk for simultaneous morbidity of ARI and diarrhea within past month compared to younger children (Table 3).

**Table 1. Attack rates of acute diarrhea and acute respiratory infections (ARI) in children under five years within past four weeks, North Dagon Township, Yangon Region, Myanmar, September to November 2012 (n=620)**

| Age group (month) | Total | Acute diarrhea | | | ARI | | | Both | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Number | Percent | 95% CI | Number | Percent | 95% CI | Number | Percent | 95% CI |
| 1-11 | 107 | 1 | 0.9 | 0-5.0 | 40 | 37.4 | 29.0-47.0 | 4 | 3.7 | 1.0-9.0 |
| 12-23 | 144 | 2 | 1.4 | 0-5.0 | 72 | 50.0 | 42.0-58.0 | 7 | 4.9 | 2.0-10.0 |
| 24-59 | 369 | 3 | 0.8 | 0-2.0 | 167 | 45.3 | 40.0-50.0 | 12 | 3.3 | 2.0-6.0 |

**Table 2. Episodes of acute diarrhea and acute respiratory infections (ARI) in children under five years within past four weeks, North Dagon Township, Yangon Region, Myanmar, September to November 2012 (n=620)**

| Characteristic | Number | Percent |
|---|---|---|
| Episode of acute diarrhea | | |
| None | 591 | 95.3 |
| One | 20 | 3.2 |
| Two | 9 | 1.5 |
| Episode of ARI | | |
| None | 318 | 51.3 |
| One | 164 | 26.5 |
| Two | 138 | 22.3 |
| Both acute diarrhea and ARI | 23 | 3.7 |
| Acute diarrhea only | 6 | 1.0 |
| ARI only | 279 | 45.0 |
| None | 312 | 50.3 |

Bivariate analyses revealed significant associations between attack rate of acute diarrhea and living in a bamboo house, storage of drinking water in a clay pot, using a cloth filter for drinking water and unsafe method of waste disposal. In adjusted model, bamboo housing and unsafe method of waste disposal had statistically significant higher odds in occurrence of acute diarrhea compared to their reference categories (Table 4).

Presence of smoke around the house was associated with chances of having ARI more likely than the reference category. However, when adjusted for other variables, ORs were revealed not significant (Table 5).

## Discussion

This was the first study carried out in Myanmar to identify dual burden of acute diarrhea and ARI in an expanding peri-urban areas. Occurrence of ARI is more predominant than acute diarrhea among children under five years in households during four weeks prior to the survey date. The attack rate of acute diarrhea was found to be 4.7% in past four weeks, which was lower than the rates reported in studies in Asia and Africa.[9-11] This might be due to the fact that this survey took place in late rainy season. Usually, prevalence of acute diarrhea is very high in April to May and also in cool season from December to January in Myanmar.[12]

In this study, children between 12 to 23 months of age had significant higher attack rates of acute diarrhea (6.3%) and ARI (54.9%) in the past month as compared to children 1-11 months and 24-59 months of age. This might be due to higher level of care given to infants, regarding water, sanitation and hygiene compared to older children. Only 3.7% of children under five years suffered from both acute diarrhea and ARI within past four weeks.

There are significant location differentials between rich and poor areas based on per capita income level. Poor areas are particularly vulnerable because many people are living in camp-like setting where overcrowding and poor sanitation increase chance of disease occurrence. In this study area, most people were living in poor housing conditions and ventilation

**Table 3.  Relationship between acute diarrhea and acute respiratory infections (ARI) within past four weeks stratified by age group, North Dagon Township, Yangon Region, Myanmar, September to November 2012**

| Age group (month) | Number of acute diarrhea | | Number of ARI | | Stratum-specific OR | 95% CI |
|---|---|---|---|---|---|---|
| | | | No | Yes | | |
| 1-11 | No | 102 | 45 | 40 | Reference | |
| | Yes | 5 | 1 | 4 | 1.3 | 0.2-7.9 |
| 12-23 | No | 135 | 42 | 72 | Reference | |
| | Yes | 9 | 2 | 7 | 1.7 | 0.4-11.2 |
| 24-59 | No | 354 | 14 | 167 | Reference | |
| | Yes | 15 | 3 | 12 | 2.1 | 0.7-6.5 |

**Table 4. Environmental conditions associated with acute diarrhea reported among children under five years within past four weeks, North Dagon Township, Yangon Region, Myanmar, September to November 2012 (n=620)**

| Characteristic | Total | Number of case | Crude OR | 95% CI | Adjusted OR | 95% CI |
|---|---|---|---|---|---|---|
| Housing material | | | | | | |
| Pucca, semi-pucca, wood | 503 | 24 | Reference | | Reference | |
| Bamboo | 117 | 20 | 4.1 | 2.2-7.7 | 2.1 | 1.0-4.2 |
| Storage of drinking water in a clay pot | | | | | | |
| No | 414 | 21 | Reference | | Reference | |
| Yes | 206 | 23 | 2.4 | 1.3-4.4 | 1.3 | 0.7-2.8 |
| Using cloth filter for drinking water | | | | | | |
| No | 376 | 19 | Reference | | Reference | |
| Yes | 244 | 25 | 2.2 | 1.2-4.0 | 0.8 | 0.4-1.7 |
| Safe disposal of waste | | | | | | |
| Yes | 489 | 17 | Reference | | Reference | |
| No | 131 | 27 | 7.2 | 3.8-13.7 | 5.6 | 2.6-12.2 |

**Table 5. Environmental conditions associated with acute respiratory infections (ARI) reported among children under five years within past four weeks, North Dagon Township, Yangon Region, Myanmar, September to November 2012 (n=620)**

| Characteristic | Total | Number of case | Crude OR | 95% CI | Adjusted OR | 95% CI |
|---|---|---|---|---|---|---|
| Number of room in house | | | | | | |
| >1 rooms | 421 | 275 | Reference | | Reference | |
| 1 room | 199 | 108 | 0.6 | 0.5-0.9 | 1.3 | 0.9-1.9 |
| Cross-ventilation | | | | | | |
| Yes | 567 | 352 | Reference | | Reference | |
| No | 53 | 31 | 0.9 | 0.5-1.5 | 1.4 | 0.8-2.6 |
| Usual cooking place | | | | | | |
| Kitchen and outside the house | 316 | 210 | Reference | | Reference | |
| In the house | 304 | 173 | 0.7 | 0.5-0.9 | 0.9 | 0.7-1.3 |
| Smoke around house | | | | | | |
| No | 546 | 323 | Reference | | Reference | |
| Yes | 73 | 59 | 2.9 | 1.6-5.3 | 0.5 | 0.3-0.9 |

was not adequate in most of the houses. Using unclean cloth filters and keeping drinking water in unclean clay pots might aggravate contamination of drinking water, especially for children under five. However, in this study, significant associations were not detected for ARI probably due to seasonal effect and small sample size. Poor housing and unsafe waste disposal were significant environmental contributors for occurrence of acute diarrhea, leading to higher chance of ARI occurrence within one month. Role of water and waste on children's health had been demonstrated in low income neighborhoods previously. Multiple risk factors for both conditions were widely prevalent in the Southeast Asia Region.[13]

This study addressed alarmingly lack of simple, safe and relatively inexpensive environmental interventions in the study area. Therefore, it was essential to facilitate discussions with stakeholders for high level of community involvement for water,

sanitation and hygiene interventions to mitigate the dual burden in vulnerable sites.

## Limitations

In this study, self-reported answers might subject to recall and reporting bias. Since the study was a cross-sectional one and conducted with small sample size, causality could not be determined. There was a likelihood of unidentified predictors or confounders and effect modifiers concerning with malnutrition, food sanitation and seasonality.

## Conclusions and Recommendations

Findings of this study might help to improve understanding about influence of indoor and outdoor environment on children's health in fast developing peri-urban areas of Yangon Region. Risk factors for acute diarrhea and ARI in this study were linked to socio-economic conditions of household and

community levels. There was a likelihood of ARI occurrence among children if they suffered acute diarrhea within previous four weeks. This was especially true for older children and follow-up studies would be necessary to prove the causal link.

Preventing the dual burden of acute diarrhea and ARI among low and middle income households requires a multi-sectoral strategy beyond bounds of health sector such as provision of safe water supply, sanitation and decent housing. Coping strategies for environmental exposure and health impacts in children might aim to fill up knowledge gaps, and priorities should be redefined after multi-stakeholder discussions. Integrated interventions to augment disease control program by innovative risk communication approaches should cover all children under five years. Integrated community-based strategies to improve indoor and outdoor environmental conditions, water, sanitation and hygiene should be considered to reduce the dual burden of acute diarrhea and ARI in children. Risks and social protection of households in the study area required attention to avoid further implications on inequity in universal health coverage.

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## Suggested Citation

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