Diarrhoea and acute respiratory infections among under-five children in slums: Evidence from India

Background: In the wake of burgeoning slum population, a substantial reduction in the prevalence of diarrhea and acute respiratory infections (ARI) is necessary for to achieve necessary reduction in child mortality in urban India. To achieve this, we need evidence based public health interventions and programs. However, a review of previous studies indicate that national level studies focused on slum population are very few. Therefore, the present study aims to study differentials and determinants of diarrhea and ARI in urban slums of India. Methodology: Using data obtained from the third round of National Family Health Survey conducted in 2005-06, we analyzed information on 2687 under-5 children living in urban slums located in eight selected India cities. Apart from bivariate analysis, logistic regression analysis was performed to identify factor associated with diarrhea and ARI among slum children. Results: The prevalence diarrhea and ARI is about 8% and 8.5%, respectively. Age, birth weight, access to safe water and improved toilet and region emerge as main factors affecting prevalence of diarrhea among slum children. Safe drinking water reduces the likelihood of getting diarrhea by about 19% compared to unsafe water [CI=0.563-1.151]. Children with normal birth are about 51% less likely to suffer from diarrhea compared to those with unknown birth weight [CI=0.368-0.814]. Older children are about 63% less likely to suffer from diarrhea [CI=0.274-0.502]. Children from Southern cities are about half as likely to have diarrhea as children from slums in Northern cities. ARI is associated with age, birth weight, religion, caste, education, family type, safe water, improved toilet, mass-media exposure, region and separate kitchen. Older children and children with normal birth weight are less likely to suffer from ARI. Children from 'Other' religions and OBC are 39% [CI=1.000-1.924] and 49% [CI=1.008-2.190], respectively, more likely to suffer from ARI. Parents' education is strongly associated with prevalence of ARI. Exposure to mass media reduces the likelihood of ARI to 50% compared to the situation when mother of the child did not have any exposure to mass-media [CI=0.324-0.819]. Non-flush toilet and lack of separate kitchen

PeerJ PrePrints | http://dx.doi.org/10.7287/peerj.preprints.208v1 | CC-BY 3.0 Open Access | received: 19 Jan 2014, published: 19 Jan 2014

increase the likelihood of ARI. Children from slums located in Southern region are less likely to suffer from ARI. Conclusion: The findings call for dedicated programs and policies, in line with those already existing ones such as RAY, IHSDP, NUHM, ICDS and JNNURM, for the development of urban slums through provision of affordable housing, improved sanitation, safe water and clean fuel. Adequate nutrition to mothers and their children should be ensured and vulnerable groups identified in the analysis should be the focus of future public health intervention and strategies. The use of mass-media to change health behavior should also be considered.

Original Research

Diarrhoea and acute respiratory infections among under-five children in slums: Evidence from India

Aditya Singh, MPhil.
PhD Candidate
University of Portsmouth, United Kingdom
Email: Aditya.Singh@port.ac.uk

Mahesh Nath Singh, PhD
Assistant Professor
Tata Institute of Social Sciences, India
Email: maheshnsingh@gmail.com

Address for correspondence:
Aditya Singh
School of Health Sciences and Social Work,
University of Portsmouth,
0.302, James Watson West,
2 King Richard 1st Road,
Portsmouth
PO1 2FR
Email: Aditya.Singh@port.ac.uk

Conflict of interest: Authors declare that no competing interests exist.
Funding: This study did not receive any kind of external or internal funding/support for this study from any source.

Diarrhoea and acute respiratory infections among under-five children in slums: Evidence from India

Introduction

Slums have long been part of cities in developing countries, and the basic features of life in these urban spaces have observed little change over time [Jorgenson and Rice 2012]. However, what has changed in recent decades is the size of slum population. As per the available estimates for 2005, 31% of the world's urban dwellers lives in slums, a proportion that has not changed significantly since 1990. There are approximately 998 million slum dwellers in the world, and if the trends continue, the size of slum population is expected to cross 1.4 billion by 2020. [UN-Habitat 2006]. Slum population in India, being no exception to this worldwide trend, has also grown 5-6% during 1991-2001, which is double the average growth rate of urban population during the same period [Agarwal et al. 2007]. Although the estimates of slum population in India vary according to the source [Gupta et al. 2009], the Census of India, 2011 officially puts the figure around 65 million [Census of India 2011].

The growth of urban slums is often considered a reflection of the urbanization of poverty and misery [Jorgenson and Rice 2012]. Slum populations often suffer multiple deprivations such as inadequate water supply, poor environmental sanitation, poor air quality and lack of waste disposal system, inadequate housing causing overcrowding and poor ventilation, overburdened healthcare services and public transport systems, and erratic electricity supply [UNHABITAT 2006]. Together these deprivations pose a significant threat to the health and well-being of people, especially of children, living in slums [Barlett 2003; Kundu and Kanitkar 2002; Karn et al. 2003]. For instance, higher under-5 mortality in slums compared to non-slum urban areas is mainly attributed to poor living conditions and hazardous environment prevalent in slums [Günther and Harttgen, 2012; Moore et al. 2003; Vaid et al. 2007]. Thus, slums may prove to be an important entry point in the effort to achieve Millennium Development Goals-4 (MDG-4) in cities [UNHABITAT 2006].

However, the achievement of targets such as MDG-4 and recently announced GAPPD (Global Action Plan for Pneumonia and Diarrhoea) will require sizeable decreases in child mortality particularly from acute respiratory infections (ARI) and diarrhoea – the top two major killers of under-5 children [WHO/UNICEF 2013; Walker et al. 2013]. Together, they account for 30% of all under-5 deaths, which amounts to roughly 2.2 million deaths each year [UN IGME 2012; Lopez et al. 2006; Parashar et al. 2003]. Africa and South Asia together are home to about 90% of all deaths due to pneumonia and diarrhoea and India tops the list with about 609,000 child deaths, i.e. about 28% of all deaths due to pneumonia and diarrhoea in 2010 [Black et al. 2010]. Although India has succeeded in reducing child mortality to a considerable extent [Gupta et al 2009], a considerable number of children are still dying of these two diseases because of piecemeal approach to service provision and those at greatest risk are not being identified and reached [WHO/UNICEF 2013]. Identifying those at greatest risk, hardest to reach and most neglected, and targeting them with effective interventions will help to close the gap, eventually

PeerJ PrePrints | http://dx.doi.org/10.7287/peerj.preprints.208v1 | CC-BY 3.0 Open Access | received: 19 Jan 2014, published: 19 Jan 2014

ending the heavy toll of preventable child deaths [Awasthi and Agarwal 2003; Agarwal and Taneja 2005].

Many studies in India and abroad have already studied prevalence and determinants of diarrhoea [Sarkar et al. 2013; Khan et al. 2013; Luke and McPike 2012; Gladstone 2010; Jadhav 2009; Sakdapolrak et al. 2011; Melo et al 2008] and ARI [Islam 2013; Srivastava et al. 2012; Wadgave and Godale 2011; Prajapati 2011; Prietsch 2008; Savitha 2007; Gupta et al. 2007; Acharya 2003; Broor 2001; Biswas 1999]. However, the scope of most of the previous studies is geographically restricted. In other words, previous studies have examined only a small population located in a particular city. Hence, the results are often relevant for a small population and a particular place, making generalization at national level a difficult task. Therefore, using data from a large nationally representative survey, the present study takes into account eight large cities of India including four second-order metros (regional metros), which unlike Mumbai, Delhi, Kolkata, and Chennai generally do not get a great deal of attention from policymakers, planners, and researchers [Gupta et al. 2009]. Thus, the study has two objectives: (1) to investigate differentials in the prevalence of diarrhoea and ARI; (2) to tests the association between socio-demographic, economic, household environment, and behavioural factors and prevalence of diarrhoea and ARI among under-5 children from urban slums of these selected Indian cities.

Data and Methods

Data

The study is a cross-sectional study that uses data from the third round of National Family Health Survey (NFHS III) conducted in 2005-06 covering 29 states of India i.e., about 99% of total population. The NFHS III survey is suitably designed to provide estimates of important indicators on the family welfare, fertility, mortality, child health and nutrition. For the first time in 2005-06, NFHS has provided separate estimates of population, health, and nutrition indicators for slum and non-slum population of eight mega cities namely, Delhi, Mumbai, Kolkata, Chennai, Meerut, Indore, Hyderabad, and Nagpur [IIPS and ORC Macro 2007].

International Institute for Population Sciences (IIPS), Mumbai was designated as the nodal agency for carrying out the survey. Technical assistance for NFHS-3 was provided by ICF Macro, Calverton, Maryland, USA. The survey used a uniform sample design, questionnaires, and field procedures in all the cities to facilitate comparability and to ensure the highest possible data quality. Fieldwork for NFHS-3 was conducted in two phases from November 2005 to August 2006 [IIPS and ORC Macro 2007].

The survey used two-stage sampling design to select its sample households in the cities. Census of India 2001, which provides information on Census Enumeration Blocks (CEB) – [*A ward in a township is a large area comprising a large number of households. Each ward comprises several enumeration blocks (CEB) created for the census*], provided the necessary sampling frame. In each city, slum and non-slum CEBs were selected independently from the respective lists of slum and non-slum CEBs. The house listing carried out in each of the selected CEBs served as the sampling frame for the selection of households. The response rate was 95.5% [IIPS and ORC Macro 2007]. More on sampling of this survey can be found be found at www.rchiips.org.

The survey provides the information about those children under age five years who suffered from diarrhoea and ARI during two weeks preceding the survey date. Out of total 6680 children in the sample of these eight cities, 2803 lived in slums. Since information on diarrhoea and ARI was missing for some children, only 2687 under-five children have been included in the analysis.

Ethics statement

This study uses data with no identifiable information on the survey participants. Data collection procedures were approved by the ORC Macro institutional review board. A formal written consent was obtained and ethical issues were taken care of before interviewing respondents [IIPS and ORC Macro 2007]. The data set is available for academic use to all and hence any ethical approval is not required. The survey data used in this study can be obtained by making a formal request on the official website (http://www.rchiips.org/) of the IIPS.

Dependent variables

Acute respiratory infection: The prevalence of ARI is estimated based on its symptoms as reported by mothers. In the survey, mothers were asked whether their children under age five years had been ill with a cough accompanied by short, rapid breathing which was chest related in the two weeks preceding the survey [IIPS and ORC Macro 2007]. These symptoms are compatible with ARI. It is a binary variable coded '1' if the child suffered from ARI and '0' otherwise.

Diarrhoea: It is defined as having loose or watery stools at least three times per day, or more frequently than normal for a child in the two weeks before the survey. Though most episodes of childhood diarrhoea are mild, acute cases can lead to significant fluid loss and dehydration, which may result in death or other severe consequences if fluids are not replaced at the first sign of diarrhoea [IIPS and ORC Macro 2007]. It is also a binary variable coded '1' if the child suffered from diarrhoea and '0' otherwise.

Independent variables

Using Mosley and Chen's (1984) analytical framework for examining child health, we have chosen a variety of maternal, socioeconomic, demographic and environmental indicators as key determinants of childhood diarrhoea and ARI (Mosley and Chen 1984). Many of these variables have been found to be associated with these two childhood illnesses in previous studies conducted in India and abroad as well [Sarkar et al. 2013; Khan et al. 2013; Luke and McPike 2012; Gladstone 2010; Jadhav 2009; Wadgave and Godale 2011; Prajapati 2011; Prietsch 2008; Savitha 2007; Gupta et al. 2007; Acharya 2003; Broor 2001].

The variables used in the analysis are – child's age (0-11 months, 12-23 months, 24-35 months, 36-47 months, 48-59 months); birth order (1^{st}, 2^{nd}, 3^{rd} and above); place of residence (urban, rural); mother's age at birth (15-24 years, 25-29 years, and ≥30 years); child's weight at birth (up to 2500 grams, >2500 grams, not reported/do not know); wealth index (poor middle, rich); parents education (both literate, one literate, both illiterate); mother's exposure to media (no exposure, partial exposure, full exposure); working status of mother (not worked, worked); caste/tribe (SC/ST – Scheduled Castes and Scheduled Tribes, OBC – Other Backward Castes, Others); religion (Hindu, Others – includes Muslims, Sikhs, Christians, Buddhists, Jains, Zoroastrians and others); family type (nuclear and non-nuclear); cooking place (separate kitchen, no separate kitchen, cooking outside house); fuel used for cooking (safe, semi-safe, unsafe); availability of mattress (yes, no); availability of glass window (yes, no); type of toilet (flush, non-flush, no toilet facility); drinking water (safe, unsafe); stool disposal (latrine/diaper, others); substance/tobacco smoking use (yes, no); family member with tuberculosis/asthma (yes, no) and geographic region of residence (the cities were combined into three regions – North region-

Delhi, Meerut and Kolkata, West region- Indore, Mumbai and Nagpur, South region - Chennai and Hyderabad). Region as a variable has been included to adjust regional variations in achievement of health programs and development. Wealth Index is generally used as a proxy for the economic status of the household [Montgomery 2000, Filmer and Pritchett 2001]. It is a composite index of household amenities and assets having three categories – poor, middle and rich.

The mainstream social system in India is characterised by numerous castes. The castes that were deemed elite by the Indian society in the past are now officially classified as "General" or "Others". Other socioeconomically deprived communities are collectively termed as 'lower castes'. They are further divided into two – OBC and SC. SCs are at the lowest rung of caste hierarchy, often known as 'untouchables' while OBCs can be placed somewhere in between the two extremes - Others and SCs, as mentioned above. STs are those groups that do not practice caste system and in the past, primarily lived in hilly, forested and remote areas secluded from mainstream society of India [Nandan et al. 2007]. STs and SCs make up around 7% and 16% of the total population of India, respectively. The estimates of OBC population vary according to the source. The Government of India follows the report submitted in 1980 by the Second Backward Classes Commission, which puts the figure as high as 52% of the total population. Rest of the people of India, who are officially categorised as 'General' (we call them here 'Others'), make up around 25% of the total population of India [Jha et al. 2013].

Statistical Analysis

We have generated the proportion of children who suffered from diarrhoea and ARI by selected background characteristics and other probable risk factors. Simple binary logistic regression has been applied to understand the net effect of predictor variables on two selected outcomes. Logistic regression is applied when the response variable is dichotomous (i.e., binary or 0–1). We also examine for evidence of multicollinearity by the means of calculating variance inflation factor (VIF) associated with individual variables in statistical software Stata 12. Low VIFs confirms that there exists no significant multicollinearity existing in final models. The results of logistic regression have been presented in the form of odds ratios with p-values and 95% confidence intervals (CI). We use SPSS 20 and Stata 12 for data analysis.

Results

Sample characteristics

Table 1 presents the descriptive statistics of the sample characteristics of children considered in the study. Around 53.9% of children in the study sample are male and 38.1% belong to mothers aged less than 25 years. About two thirds of all children are Hindus and one fourth belong to SC/ST. About 48% and 47.8% slum children do not have access to water and flush toilets, respectively. Mothers of about 9.9% children are not at all exposed to mass media. Only 20% children belong to working mothers. About 3-6% children lived in those households where at least one of its members smoke tobacco or have tuberculosis/asthma.

Diarrhoea

The results reveal that about 8.3% of under-five slum children suffer from diarrhoea during two weeks preceding the survey (Table 2). About 14.6% infants suffer from diarrhoea compared to 12% among those who are aged 12-23 months. About 10.5% of children with unknown birth

weight suffer from diarrhoea. There is very little difference in the prevalence of diarrhoea across different categories of birth order, sex of the child, parents' education, caste, mother's age, wealth index, family type and religion. Only 6.7% children of those mothers who had full mass media exposure suffered from diarrhoea compared to 8.9% children of mothers who had only partial exposure. The prevalence of diarrhoea also varies according to the type of toilet used. Only 6% children suffered diarrhoea where flush toilets are used compared to 11.2% in the households where some other type of toilet is used. Similarly, proportion of children from households that use latrine or diaper for disposing the stools suffer less from diarrhoea compared to those that do not. The prevalence of diarrhoea is comparatively higher (13.3%) in those families where a member of the household smokes tobacco. The prevalence of diarrhoea among cities from Southern region is comparatively lower (See Fig.1).

Table 3 presents the results of logistic regression results in the form of odds ratios. Current age of the child, birth weight, type of toilets, quality of water, and region of slum emerge out to be significant predictors of diarrhoea. Children aged two or more years are about 63% less likely to suffer from diarrhoea compared to the children aged less than two years [95% CI=0.274-0.502]. Children, whose birth weight is 2500 grams or more, are about 51% less likely to suffer from diarrhoea compared to those whose birth weight is either unknown to the mother or it is not reported [95% CI=0.368-0.814]. Safe drinking water reduces the likelihood of getting diarrhoea by about 19% compared to unsafe water [95% CI=0.563-1.151]. Another indicator of household environment, type of toilet, shows that in the houses with non-flush toilets, the likelihood of suffering from diarrhoea is twice compared to those houses with flush toilet [OR=2.045, 95% CI=1.443-2.898]. Children from the slums of Southern cities are about half as likely to have diarrhoea as children from slums in Northern cities [OR=0.504, 95% CI=0.320-0.796)].

Acute Respiratory Infections

The prevalence of ARI among children aged below five years is estimated to be 8.5%. Table 2 shows that there are only marginal differences in the prevalence of ARI by most of the background characteristics included in the table. ARI is somewhat less prevalent among older children, children in households belonging to the highest wealth quintile, Hindu children, and children of mothers with full mass media exposure. ARI is also found to be lower among children from the households with safe drinking water, flush toilets, safe practices for stool disposal, clean fuel for cooking, no tobacco among members, and separate kitchen for cooking. The small variation in the prevalence of ARI by most socioeconomic characteristics indicates that, in India, ARI affects children from all strata, irrespective of their socioeconomic background. However, the prevalence of ARI among slums in Southern cities is considerably lower (See Fig.1).

Table 4 reports the results of logistic regression in the form of odds ratios. Children aged two or more years are about 48% less likely to suffer from ARI compared to the children aged less than two years [95% CI=0.382-0.696]. Children, whose birth weight is 2500 grams or more, are about 51% less likely to suffer from ARI compared to those whose birth weight is either unknown to the mother or it is not reported [95% CI=0.372-0.868]. Children from 'Other' religious category and OBC castes are 39% [95% CI=1.000-1.924] and 49% [95% CI=1.008-2.190], respectively, more likely to suffer from ARI compared to Hindu and SC/ST children. Parents' education is strongly associated with prevalence of ARI. If one of the parents is illiterate, the odds ARI is about twice compared to the situation where both parents are literate [OR=2.198, 95% CI=1.230-3.926]. Even partial exposure to mass media reduces the likelihood of suffering from ARI to 50% compared to the situation when mother of the child did not have any exposure to mass-media

[95% CI=0.324-0.819]. Children from the households with non-flush toilet are 54% more likely to get infected with ARI [95% CI=1.088-2.190]. Cooking inside the house because of unavailability of separate kitchen also increases the likelihood of a children getting infected with ARI by 40%. Children from slums located in Southern region are about 76% less likely to suffer from ARI [95% CI=0.146-0.395].

Discussion

Using data from a nationally representative survey, we find that about 8.3% and 8.5% of under-5 children in urban slums of India suffer from diarrhoea and ARI, respectively. Results from logistic regression analysis suggest that the odds of diarrhoea among children aged more than two years are significantly lower than the odds of children aged two years or less. The result is in line with many previous studies conducted in developing countries including India [Calistus and Alessio, 2009; Mohammed et al. 2013; Lal 1994; Melo et al. 2008]. This pattern could be due to exogenous factors such as an increased exposure to contaminated weaning and food in the first or second year of life, an age when the immune system is weaker in younger children than in older children. Results also reveal that children with normal birth weight are significantly less at the risk of diarrhoea [Sur et al. 2001].

Birth weight and age of the child are also significantly associated with the prevalence of ARI. Many other studies have also observed similar results [Prajapati et al. 2012; Islam 2013; Acharya 2003]. Low birth weight is a surrogate marker of intrauterine growth restriction, which causes impaired immunocompetence and poor lung anatomy and function among infants [Roth et al. 2008; Rice et al. 2000]. Nutritional interventions for children and pregnant mothers can significantly reduce the incidence of low birth weight [Roth et al. 2008; Victoria et al. 1999]. Hence, a coordinated action under the Integrated Child Development Scheme (ICDS) focusing on children below one year in general and pregnant women in particular is the need of hour. According to the Department of Women and Child Development, Government of India (2005), there are only 360 urban ICDS projects catering to a huge population of about 90 million urban poor. ICDS, therefore, needs rapid expansion of its coverage [NIPCCD 2009]. However, its expansion alone is not adequate to bring about any significant change as smooth functioning of the scheme is seriously crippled by widespread corruption (Gill and Taylor 2013).

About 88% of diarrheal deaths worldwide are attributable to unsafe water, inadequate sanitation, and poor hygiene (WHO/UNICEF 2004). Our study, confirming the same, finds that type of toilet facility and quality of drinking water are significantly associated with diarrhoea (Palit et al. 2012). Children belonging to households equipped with separate flush toilet are about 50% less likely to suffer from diarrhoea than the children with access to 'Other' type of toilets (includes pit latrine, dry toilet and toilet shared by other households). Toilets covered under 'Other' type are generally unhygienic and pose a higher risk of getting diarrhoea to the children. The quality of drinking water is also significantly associated with the odds of suffering from diarrhoea (Jalan et al. 2003; Sarkar et al. 2007; Alam 2007; Jadhav 2009). In our study, the children with access to safe drinking water are almost 20% less likely to suffer from diarrhoea than those who use water from unsafe sources such as unprotected dug well or springs, tanker truck/cart and surface water. It indicates that water and sanitation interventions in urban slums can play an important role in combating the incidence of this disease among children (Palit et al. 2012; Roushdy et al. 2012; Waddington et al. 2009).

The positive association between parental schooling and child health is largely undisputed. Similar to many previous studies, we find that parental schooling is associated with ARI among slum children (Siziya et al 2009; Kristensen and Olson 2006; Kandalaa et al 2009; Etiler et al. 2002; Ghosh 2005). Mother's schooling is argued to be an effective means of achieving greater autonomy in the family and getting an employment, thereby achieving economic independence [Celik 2000]. Education also makes mothers confident; brings a feeling of self-worth and self-confidence; enhances communication with their husbands and other family members on different issues including her child's health [Chanana 1999]. The resultant improved decision making power helps a mother achieve better health for her children through day-to-day health enhancing behaviour, child-centered intra-household resource allocation and access to emergency care [Desai and Johnson 2005]. Husband's education is often argued to contribute to child's health through his ability to gather financial resources for his children's nutrition and healthcare [Singh and Ram 2007].

It is argued that exposure to mass media results in to higher awareness and dissemination of knowledge about the existing program and policies related to health care which may in turn result into behavioural change [Wakefield et al. 2010]. Similar to many previous studies, the result from this study confirms that children of mothers with even partial mass-media exposure are less likely to suffer from ARI compared to children of mothers with no mass-media exposure.

Caste and religion emerge as important variables associated with the prevalence of ARI among slum children. Results show that children belonging to 'Other' religions and OBC are more likely to suffer from ARI. In this regard, it must be noted that majority of OBCs and Muslim households run their business and small-scale industries within the four walls of their slum houses [NSSO, 2002]. Due to lack of space in high-density areas such as these slums, they are bound to run their small-scale household industries in filthy, small, congested and non-ventilated environment [GOI 2009] that may have severe health hazards not only for adults but also for children [Kjellstrom el al. 2007]. Muslims also 'exhibit deficits and deprivation in practically all dimensions of development' and 'the deficits are particularly salient in the areas of female schooling and economic status' [Sachar et al. 2006]. As of 2012, about 22.7% Muslim households in urban areas are below poverty line compared to meagre 12.1% Hindu households [Pangariya and More 2013]. A study conducted in the city of Lucknow have found that a Hindu dominated urban slum has better quality roads, drainage system, sanitation, water supply and sewage disposal compared to another slum inhabited mainly by Muslims [Sachar et al. 2006]. Therefore, the fact that Muslim children are more prone to ARI than their Hindu counterparts should not come as a surprise.

It is often argued that the children who belong to a non-nuclear family are healthier than those who belong to nuclear families [McLanahan & Booth, 1989; Dawson, 1991; McLanahan & Sandefur, 1994; Gage 1997]. In this study too, children belonging to nuclear households have higher odds of ARI than children belonging to non-nuclear households. The findings are in line with a recent study in India (Kumar and Ram 2013). This could possibly be due to the fact that mothers in nuclear families often have to work to avoid financial difficulties and do not have enough time for proper child care [McLanahan & Sandefur, 1994]. On the contrary, in the extended families, many adult caregivers are available for a child when parents are engaged in some other activities (Griffiths et al. 2002). In the absence of any additional caretaker, mothers in nuclear families have to carry their children to the hazardous sites such as cooking, washing and disposal of garbage and outside work. To minimize the exposure to such hazardous conditions, municipal bodies may promote subsidized crèches at a relatively safer place and motivate parents

to send their children during day hours. In 2011, the Government of India through budgetary allocation has increased subsides significantly to run crèches (GOI 2006). Scaling up such simple interventions could overcome some very common obstacles to increasing child survival in urban India and help provide every child a fair chance to live, grow and thrive.

Similar to many previous studies, in this study as well [Sikolia et al. 2002; Mishra et al. 2005; Kilabuko and Nakai 2007]. A separate kitchen provides an opportunity to keep children away from harmful exposure of household air pollution (HAP). HAP increases the incidence of intrauterine growth retardation, preterm birth (births before 37 weeks of gestation), and low birth weight (an infant born weighing <2500 grams at any gestational age), the conditions associated with increased risk of ARI among children [Stillerman et al., 2008; Currie and Schmieder, 2009].

Although use of unsafe fuels do not emerge out to be significant in this study unlike many other studies [Rehfuess et al. 2009; Ezzati and Kammen 2001; Smith et al. 2000], it must be noted that in slums, a significant proportion of households still use unclean fuels which release smoke containing harmful particles that adversely affect the functioning of lungs (Gupta et al. 2009; Bassani et al. 2010). It is a daunting task for the government to provide access to clean fuel to every household in slums. Although subsidy on clean fuels could help poor people access the clean fuels, there have been studies showing that it is not the only way out. A study in Hyderabad showed that collective action (self-help) from the community through household resource pooling itself can bring significant changes the situation without putting any further financial burden on government exchequer (Prasad et. al 2012). There are other policy issues as well for example the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), a mega program for urban renewal and development of urban infrastructure, does not embrace energy as one of its thrust areas (TERI 2008).

This study shows that region has a significant impact on the odds of children suffering from diarrhoea. Children from the southern region are less likely to suffer from diarrhoea and ARI. It may be due to improved water, sanitation facilities, greater access to quality public healthcare and overall better socio-economic and living conditions prevailing in urban slums of Southern cities (Sundar and Sharma 2002; Gupta et al. 2009). According to NFHS-3 (2005-06), about 20% of slums dwellers in Northern cities such as Delhi and Meerut do not own any toilet facility compared to Southern cities such Chennai and Hyderabad where the proportion of such households range from 2% to 3%. Similarly, the proportion of households with a separate kitchen is only 31%, 34% and 43% in Delhi, Kolkata and Meerut, respectively, compared to 56% and 62% in Chennai and Hyderabad. These facts from NFHS-3 report clearly show the advantage that these Southern cities have in terms of basic amenities [Gupta et al. 2009]. It also reflects in the levels of ARI and diarrhoea prevalence in slums of Southern cities.

In addition to factors above discussed, living with a family member who either smokes or suffers from tuberculosis/asthma is also anticipated to have influence on child's ARI status (Armstrong 1991; Sikolia et al. 2002; Agnihotram 2005; Savitha et al. 2007). However, studies in India and abroad have also noted that passive smoking or parental smoking habit does not have any statistically significant association with the prevalence of ARI (Durate and Botelho 2000; Kristensen and Olson 2006; Prajapati et al. 2011). Similarly in this study, we fail to find any association between prevalence of ARI among children and above mentioned characteristics of family members.

Conclusions

Using data from third wave of NFHS conducted in 2005-06, this study makes an attempt to examine the factors affecting diarrhoea and ARI among children from urban slum in selected cities of India. The prevalence of diarrhoea and ARI is about 8.3% and 8.5%, respectively. Age, birth weight, safe water, improved toilet and region of residence emerge as main factors associated with prevalence of diarrhoea among slum children. On the other hand, the prevalence of ARI is associated with age, birth weight, religion, caste, education of parents, type of family, safe water, improved toilet, mass media exposure, region of residence, and cooking place.

Low birth weight is an important public health problem in India. Undernutrition amongst women is one of the prime reasons behind low birth-weight babies. In this regard, it can be suggested that health department should ensure proper implementation of ICDS scheme and devise specific strategies to improving antenatal care and diet for pregnant women in slums. Public education campaigns, intended to promote behaviours conducive to the prevention and appropriate treatment of Diarrhoea and ARI, should consider using mass media as an effective health communication strategy [Banerjee et al. 2004]. Apart from woman's education, the education among male partners should also be encouraged as in a traditional society like India, it is the male in the family who generally has an upper hand in decision-making. It may lead to their greater involvement in child care [Chattopadyay 2013]. However, the focus of policy should also be on vulnerable groups in slums such as children aged less than two years or non-Hindus and OBC children need special attention. Apart from that, policymakers also needs to devise strategies to reduce regional disparities in Diarrhoea and ARI in Indian slums.

Improvements in water quality and sanitation are vital for the reduction of diarrhoeal diseases, and therefore, municipal bodies in cities should ensure that these basic services are easily available and accessible to all. Running hazardous industries within the house and not having a separate room for kitchen makes children even more vulnerable. Therefore, the parents and caretakers must be informed and educated about the possible health hazards due to children's exposure to such living conditions. Although the Government of India provides financial assistance to the States through programs such as Rajiv Awas Yojana (Rajiv Housing Program), Integrated Housing & Slum Development Programme (IHSDP) and JNNURM for development of urban slums, it has been observed that the lack of effective coordination among different departments leads to inefficiency and poor delivery of services [Mohanty and Mohanty 2005]. It is hoped that recently launched National Urban Health Mission, which aspires to work towards a public health bill that sets standards for basic entitlements such as safe water, improved sanitation, housing and healthcare, will be able to facilitate effective coordination among different departments and municipal bodies in order to improve health and living conditions of slum dwellers in India [GOI 2013].

Limitations of the study

The study although provides a bigger picture of factors affecting diarrhoea and ARI in urban slums of selected cities in India, the results must be read/used with a caution. The information collected in NFHS-3 on diarrhoea and ARI is based on mothers' perceptions of illness and is not validated by any qualified medical personnel. The accuracy of these measures is also affected by the reliability of the mother's recall of when the disease episode occurred. However, two weeks recall period, as also followed in NFHS-3, is generally considered the most suitable.

References:

1. Agarwal A., and S. Taneja (2005) All Slums are Not Equal: Child Health Conditions among the Urban Poor, *Indian Pediatrics,* **42**, pp. 233-244.
2. Agarwal S, Satyadev A, Kaushik S, Kumar R (2007) Urbanization, Urban Poverty and Health of the Urban Poor: Status, Challenges and the Way Forward. *Demography India*, 36(1):121-134
3. Acharya D, Prasanna KS, Nair S, Rao RS. Acute respiratory infections in children: A community based longitudinal study in south India. *Indian Journal of Public Health*. 2003; 47:7–13.
4. Agnihotram, VR (2005) Reviewing Respiratory Burden in Rural India: Household Envrionment Matters, *Rural and Remote Health* **5**, pp.357. Online: http://rrh.deakin.edu.au.
5. Alam, M. J. (2007) Water Quality Tests and Behavioural Factors of Child Diarrhoea in Dhaka Slums, *BRAC University Journal*, 5, no.1, pp.103-106.
6. Armstrong, J.R.; Campbell, H. (1991) Indoor Air Pollution Exposure and Lower Respiratory Infections in Young Gambian Children*, International Journal of Epidemiology*,**20**,no.2, pp.424-429.
7. Awasthi S and Agarwal S (2003) Determinants of Childhood Mortality and Morbidity in Urban Slums in India. *Indian Paediatrics*. 40:1145-1161
8. Banerjee, B., S. Hazra and D. Bandhopadhyay (2004) Diarrhoea Management among under Five', *Indian Pediatrics,* **41,** pp. 255-260.
9. Bassani, D. G., Jha, P., Dhingra, N., & Kumar, R. (2010). Child mortality from solid-fuel use in India: a nationally-representative case-control study. *BMC public health*, 10, 491.
10. Biswas A, Biswas R, Dutta K, Manna B (1999) Risk factors of acute respiratory infections in underfives of urban slum community. *Indian Journal Public Health*. 43: 73-75.
11. Black, Robert E., Simon Cousens, Hope L. Johnson, Igor Rudan, Diego G. Bassani, Prabhat Jha, Harry Campbell, Christa Fischer Walker, Richard Cibulskis, Thomas Eisele, Li Liu, Colin Mathers, for the Child Health Epidemiology Reference Group of WHO and UNICEF, (2010) Global, Regional,, and National Causes of Child Mortality in 2008: A Systematic Analysis, *www.thelancet.com,* Published Online, May 12, DOI: 10.1016/S0140-6736(10)60549-1.
12. Botelho C, Correia AL, da Silva AM, Macedo AG, Silva CO. Environmental factors and hospitalization of under-five children with acute respiratory infection. Cad Saude Publica. 2003;19:1771–80.
13. Broor S, Pandey RM, Ghosh M, Maitreyi RS, Lodha R, Singhal T, et al. Risk factors for severe acute lower respiratory tract infection in under-five children. Indian Pediatr.2001;38:1361–9.
14. Calistus W, Alessio P. (2009) Factors associated with diarrhoea among children less than 5 years old in Thailand: a secondary analysis of Thailand multiple indicator cluster survey. J Health Res, 23: 17-22.

15. Celik, Y. & Hotchkiss, D. R. (2000) The socioeconomic determinants of maternal health care utilization in Turkey. Social Science & Medicine 50(12), 1797–1806.

16. Chanana K (1996) Education attainment, status production and women's autonomy: a study of two generations of Punjabi women in New Delhi. In: Jeffery R, Basu AM, editors. Girls' Schooling, Women's Autonomy and Fertility Change in South Asia (pp. 107–132). New Delhi: Sage Publications.

17. Chattopadhyay A (2013) Men in Maternal Care: Evidence from India. Journal of Biosocial Science. 44(02):129 – 153. doi: 10.1017/S0021932011000502.

18. Curtis V., Sandy Cairncross and Raymond Yonil (2000) Domestic Hygiene and Diarrhoea–Pinpointing the Problem, *Tropical Medicine and International Health,* **5**, No.1, pp. 22-32.

19. Currie, J., Schmieder, J.F., (2009) Fetal exposures to toxic releases and infant health. Am. Econ. Rev. 99 (2), 177–183.

20. Dawson, D. A. (1991) Households structure and children's health and well-being: data from the 1988 national health interview survey on child health. Journal of Marriage and the Family 53, 573–586

21. Duarte DM, Botelho C. (2000) Clinical profile in children under five year old with acute respiratory tract infections. J Pediatr (Rio J) 76:207–12.

22. Desai S, Johnson K. Women's Decision Making and Child Health: Familial and Social Hierarchies. In: Kishor S, editor. A Focus on Gender: Collected Papers on Gender Using DHS Data. Calverton, MD: ORC Macro; 2005. Accessed on 22nd November 2013. Available on http://www.measuredhs.com/pubs/pdf/OD32/4.pdf .

23. Ezzati, M., & Kammen, M D. (2001). Indoor air pollution from biomass combustion and acute respiratory infections in Kenya: an exposure-response study. Lancet, 358:619-624.

24. Filmer, D. & Pritchett, L. H. (2001) Estimating wealth effects without expenditure data or tears: an application to educational enrolments in states of India. Demography 38(1), 115–132.

25. Gage, A. J. (1997) Familial and socioeconomic influences on children's well-being: an examination of pre-school children in Kenya. Social Science & Medicine 65(12), 1811–1828

26. Ghosh, Saswata (2005) Does Economic Inequality Matter in Cases of Infectious Childhood Diseases An Analysis for India, *Asia-Pacific Journal*,**20**, no. 2, 37-62.

27. Gill J, Taylor D. 2013. Health and health care in India, national opportunities, global impacts. UCL School of Pharmacy.

28. Gladstone, BP; Das, AR; Rehman, AM; Jaffar, S; Estes, MK; Muliyil, J; Kang, G; Bose, A; (2010) Burden of Illness in the First 3 Years of Life in an Indian Slum. Journal of Tropical Pediatrics, 56 (4). pp. 221-6. DOI: 10.1093/tropej/fmp116

29. Government of India (GOI) (2009) Mumbai Human Development Report, 2009, *Ministry of Housing and Urban Poverty Alleviation, Government of India.* New Delhi: Oxford University Press. Accessed on 27th December 2013. Available at http://mhupa.gov.in/W_new/Mumbai%20HDR%20Complete.pdf

30. Government of India (GOI) (2006) Rajiv Gandhi National Crèche Scheme for the Children of Working Mothers. *Department of Women & Child Development, Ministry of Human Resource Development, New Delhi*. Accessed on 25th December 2013. Available at http://wcd.nic.in/SchemeChildren/RajivGandhiCrecheScheme.pdf

31. Government of India (GOI) (2013) National Urban Health Mission – Framework for Implementation. Ministry of Health & Family Welfare, Government of India, New Delhi. Accessed on 22nd December 2013. Available at http://www.pbnrhm.org/docs/nuhm_framework_implementation.pdf

32. Gupta N., S.K. Jain, Ratnesh, Uma Chawla, Shah Hossain and S. Venkatesh (2007): An Evaluation of Diarrhoeal Disease and Acute Respiratory Infections Control Programmes in a Delhi Slum, *The Indian Journal of Pediatrics,* **74,** no.5, pp. 471-476.

33. Griffiths, P.L., Matthews, Z., Hinde, P.R.A., 2002. Gender, family and the nutritional status of children in three culturally contrasting states of India. Social Science and Medicine 55, 775–790

34. Günther, I. and Harttgen, K. (2012), Deadly Cities? Spatial Inequalities in Mortality in sub-Saharan Africa. Population and Development Review, 38: 469–486. doi: 10.1111/j.1728-4457.2012.00512.x

35. International Institute for Population Sciences (IIPS) and Macro International. 2007. National Family Health Survey (NFHS-3), 2005–06: India: Volume I. Mumbai: IIPS.

36. Islam F, Sarma R, Debroy A, Kar S, Pal R. Profiling acute respiratory tract infections in children from Assam, India. J Global Infect Dis [serial online] 2013 [cited 2013 Dec 29];5:8-14. Available from: http://www.jgid.org/text.asp?2013/5/1/8/107167

37. Jadhav J, Ravish K.S, Gopinath D. (2009) A Study of Socio-Cultural Factors, Water Quality And Diarrhea In Bangalore. The Internet Journal of Public Health. 1(1).

38. Jalan, Jyotsana, Martin Ravallion (2003) Does Piped Water Reduce Diarrhoea for Children in Rural India? *Journal of Econometrics*,**112**, pp. 153-173.

39. Jha G. M., Trehan S., Rao G., Vishwanath B., Sarin R. and Monga A. (2013) Mandal Commission: Equality and Liberty, International Research Journal of Social Sciences, 2(6): 35-38. Available at: http://www.isca.in/IJSS/Archive/v2/i6/7.ISCA-IRJSS-2013-070.pdf

40. Kamla Gupta, Fred Arnold, H. Lhungdim (2009) *Health and Living Conditions in Eight Indian Cities*. National Family Health Survey (NFHS-3), India, 2005-06. Mumbai: International Institute for Population Sciences; Calverton, Maryland, USA: ICF Macro.

41. Kandala, N.-B., Emina, J. B., Nzita, P. D. K., and Cappuccio, F. P. (2009). Diarrhoea, acute respiratory infection, and fever among children in the Democratic Republic of Congo. Social Science & Medicine (1982) 68, 1728-36.

42. Kundu, N., and Tara Kanitkar (2002) Primary Health Care in Urban Slums, *Economic and Political Weekly,***51,** pp.5086-9.

43. Karn, S.K., S. Shikura, and H. Harada (2003) Living Environment and Health of Urban Poor: A Study in Mumbai, *Economic and Political Weekly,***34**, pp. 3575-86

44. Kjellstrom, T., Friel, S., Dixon, J., Corvalan, C., Rehfuess, E., Campbell-Lendrum, D., Gore, F., et al. (2007). Urban environmental health hazards and health equity. Journal of Urban Health, 84 (3) Supplement 1), 86-97.

45. Khan, M., Zanuzdana, A., Burkart, K. and Krämer, A. (2013), Determinants of Diarrhoea in 'Urban' Slums of Dhaka and Adjacent Rural Areas: a Household-level Analysis. Population Space and Place. doi: 10.1002/psp.1777

46. Kristensen, I. A., and Olsen, J. (2006). Determinants of acute respiratory infections in Soweto--a population-based birth cohort. South African Medical Journal 96, 633-640.

47. Kilabuko, James H. and Satoshi Nakai (2007) Effects of Cooking Fuels on Acute Respiratory Infection in Children in Tanzania*, Intl. J. Environ. Res. and Public Health*, **4**, no.4, pp.283-288.

48. Kumar A and Ram F (2013). Influence of Family Structure on Child Health: Evidence from India. Journal of Biosocial Science, 45, pp 577-599. doi:10.1017/S0021932012000764.

49. Lal S. 1994. Surveillance of acute diarrhoeal diseases at village level for effective home management of diarrhoea. Indian J Public Health. 38(2):65-8

50. Lopez, A D., Mathers, C D., Ezzati, M., Jamison, D T., & Murray, C J L. (2006). Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. Lancet, 367, 1747-1757.

51. Luke N and McPike J (2012) Rethinking the 'Urban Advantage:' Differences in Child Diarrhea across Rural, Urban Non-Slum and Urban Slum Locations in India. Presented at Population Association of America Annual Meeting 2012. Accessed on 22nd December 2012. Available on http://paa2012.princeton.edu/papers/122308

52. McLanahan, S. & Booth, K. (1989) Mother-only families: problems, reproductions and politics. Journal of Marriage and the Family 51, 557–580.

53. McLanahan, S. & Sandefur, G. (1994) Growing up with a single parent: what hurts, what helps. Master's thesis, Harvard University Press, Cambridge, MA.

54. Melo, M. C. N. de, Taddei, J. A. A. C., Diniz-Santos, D. R., Vieira, C., Carneiro, N. B., Melo, R. F., & Silva, L. R. (2008). Incidence of diarrhea in children living in urban slums in Salvador, Brazil. The Brazilian journal of infectious diseases: an official publication of the Brazilian Society of Infectious Diseases, 12(1), 89-93.

55. Mishra, V., Smith, K.R., Retherford, R.D. (2005) Effect of Cooking Smoke and Environmental Tobacco Smoke on Acute Respiratory Infection in Young Indian Children, *Population and Environment*, **26**, no. 5, pp. 375-396.

56. Mohanty, LNP and Mohanty S (2005) Slums in India. New Delhi: APH Publishing Corporation. ISBN: 81-7648-892-5

57. Moore, M., Gould, P., & Keary, B. S. (2003). Global urbanization and impact on health. International journal of hygiene and environmental health, 206(4-5), 269-278.

58. Montgomery MR, Gragnolati M, Burke KA, Paredes E (2000) Measuring living standards with proxy variables. Demography 37(2), 155–174.

59. Mosley, Henry and Lincoln Chen. 1984. Child Survival: Strategies for Research. Population and Development Review 10:25-25.

60. National Commission on Urbanisation (1988) *Report of the National Commission on Urbanisation,* **2,** Ministry of Urban Affairs, Government of India.

61. National Sample Survey Organization (2002) Housing conditions India*, Report No.489*, MOSPI. New Delhi.

62. National Institute of Public Cooperation and Child Development (NIPCCD) (2009) Research on ICDS: An Overview (1996-2008). Accessed on 22nd December 2013. Available on http://nipccd.nic.in/reports/icdsvol3.pdf

63. Nandan D, Mathiyazhagan T, Meshram MP, Ramesh C and Meena LL (2007) Knowledge, perceptions and sources of information for tribals about common diseases prevailing in Mandla district of M.P., Health and Population – Perspectives and Issues, 30 (2): 94-106

64. Etiler, N., Velipasaoglu, S., and Aktekin, M. (2002). Incidence of acute respiratory infections and the relationship with some factors in infancy in Antalya, Turkey. Pediatrics International: Official journal of the Japan Pediatric Society 44, 64-69.

65. Palit A, Batabyal P, Kanungo S, Sur D: In-house contamination of potable water in urban slum of Kolkata, India: a possible transmission route of diarrhea. Water Sci Technol 2012, 66(2):299–303

66. Pathak et al. (2011) Adherence to treatment guidelines for acute diarrhoea in children up to 12 years in Ujjain, India - a cross-sectional prescription analysis. BMC Infectious Diseases, 11:32. doi:10.1186/1471-2334-11-32

67. Parashar, D U., Bresee, S J., & Glass, R I. (2003). The global burden of diarrhoeal disease in children. Bulletin of the World Health Organization, 81 (4)

68. Pangariya, A and More V. (2013) Poverty by Social, Religious & Economic Groups in India and Its Largest States 1993-94 to 2011-12. Program on Indian Economic Policies, Columbia University. Working Paper No. 2013-02. Accessed on 24th December 2013. Available on http://indianeconomy.columbia.edu/sites/default/files/working_papers/working_paper_2013-02-final.pdf

69. Prasad, B. N. Aggarwal, V., Werthmann, C. (2012). Collective Action for Transition towards Clean Cooking Fuel: Trust and Cooperation in the Slums of Hyderabad, India. Department of Cooperative Responses to Global Challenges. Berlin, Germany. 21-

23.03.2012. Accessed on 17-09-2013 from http://future-megacities.org/fileadmin/documents/forschungsergebnisse/aktuell/HYD-AB8.pdf .

70. Prajapati, B., Talsania, N. J., Lala, M. K. & Sonalia, K. N. (2012) Epidemiological profile of acute respiratory infections (ARI) in under five age group of children in urban and rural communities of Ahmedabad district, Gujarat. Int J Med Sci Public Health, 1 (2), 52-58. doi:10.5455/ijmsph.2012.1.52-58

71. Prietsch, S. O. M., Fischer, G. B., César, J. A., Lempek, B. S., Barbosa, L. V., Zogbi, L., Cardoso, O. C., et al. (2008). Acute lower respiratory illness in under-five children in Rio Grande, Rio Grande do Sul State, Brazil: prevalence and risk factors. Cadernos de saúde pública / Ministério da Saúde, Fundação Oswaldo Cruz, Escola Nacional de Saúde Pública, 24(6), 1429-38. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/18545768

72. Rathor, A., (2003) *Slum Dwellers Curse on Development,* Sarup and Sons Publishing House Pvt. Ltd., New Delhi.

73. Rao, K. V., Vinod K. Mishra, and Robert D. Retherford (1998): "Mass Media Can Help Improve Treatment of Childhood Diarrhoea", *National Family Health Survey Bulletin, Number 11, August*, International Institute for Population Sciences, Mumbai, East-West Center Program on Population, Honolulu.

74. Rehfuess, E. A., Tzala, L., Best, N., Briggs, D. J., & Joffe, M. (2009). Solid fuel use and cooking practices as a major risk factor for ALRI mortality among African children. Journal of epidemiology and community health, 63(11), 887-892.

75. Roth, D. E., Caulfield, L. E., Ezzati, M., & Black, R. E. (2008). Acute lower respiratory infections in childhood: opportunities for reducing the global burden through nutritional interventions. Bulletin of the World Health Organization, 86(5), 356-364.

76. Rice AL, Sacco L, Hyder A, Black RE. (2000) Malnutrition as an underlying cause of childhood deaths associated with infectious diseases in developing countries. Bulletin of World Health Organization, 78: 1207-21 pmid: 11100616.

77. Sarkar R., A. T. Prabhakar, S. Manickam, D. Selvapandian, M. V. Raghava, G. kang and V. Balraj (2007) Epidemiological Investigation of an Outbreak of Acute Diarrhoeal Disease Using Geographic Information System, *Royal Society of Tropical Medicine and Hygiene,* **101**, pp. 587-593.

78. Sarkar et al. (2013) Burden of childhood diseases and malnutrition in a semi-urban slum in southern India. BMC Public Health, 13:87. doi:10.1186/1471-2458-13-87

79. Sharma, Sangeeta, G. R. Sethi, A. Rohtagi, A. Choudhary, R. Shankar, J. S. Bapna, V. Joshi and D. G. Sapir (1998) Indoor Air Quality and Acute Lower Respiratory Infection in Indian Urban Slums, *Environmental Health Perspective,***106**, no.5,pp.291-297.

80. Sikolia D.N., Mwololo K., Cherop H., Hussein A., Juma M., Kurui J., Bwika A., Seki, I. and Osaki Y. (2002) The Prevalence of Acute Respiratory infections and Associated Risk Factors: A Study of Children under Five Years of Age in Kibera Lindi Village, Nairobi, Kenya*, Journal of National Institute of Public Health*, **51**, no.1,pp.67-72.

81. Sundar R. and A. Sharma (2002) Morbidity and Utilisation of Healthcare Services: A Survey of Urban Poor in Delhi and Chennai, Economic and Political Weekly, **37**, no.47, pp.4729-40.

82. Sachar RS, Hamid TK, Ooman MA, Basith R, Basant AM, Majeed A, Shariff A. (2006) Social, economic and educational status of the Muslim community of India. Prime Minister's High Level Committee Cabinet Secretariat, Government of India, New Delhi. Accessed on 22nd November 2013. Available at http://www.minorityaffairs.gov.in/sites/upload_files/moma/files/pdfs/sachar_comm.pdf
83. Shikur Mohammed, Marelign Tilahun, Dessalegn Tamiru (2013) Morbidity and Associated Factors of Diarrheal Diseases Among Under Five Children in Arba-Minch District, Southern Ethiopia, 2012. Science Journal of Public Health. 1(2):102-106. doi: 10.11648/j.sjph.20130102.19
84. Sakdapolrak P, Seyler T, Prasad S (2011) Measuring the local burden of diarrhoeal disease among slum dwellers in megacity Chennai, South India. In Kramer A, Khan MH, Krass Faruke (2011) Health in Megacities and Urban Areas. Phyisa-Verlag – A Springer Company. Heidelberg, Germany. ISSN: 978-3-7908-2733-0. Available at http://www.springer.com/medicine/book/978-3-7908-2732-3
85. Savitha, M. R., Nandeeshwara, S. B., Pradeep Kumar, M. J., ul-Haque, F., & Raju, C. K. (2007). Modifiable risk factors for acute lower respiratory tract infections. Indian Journal of Pediatrics, 74(5), 477-482.
86. Smith KR, Samet JM, Romieu I, Bruce N: Indoor air pollution in developing countries and acute lower respiratory infections in children. Thorax 2000, 55(6):518-532.
87. Srivastava DK, Tripathi D, Gour N, Jain PK, Singh CM, Srivastava AK, Kumar S, Rani V (2012) Indian Journal of Community Health, 24 (2): 153-157 Available at http://iapsmupuk.org/journal/index.php/IJCH/article/viewFile/211/pdf
88. Stillerman, K.P., Mattison, D.R., et al., 2008. Environmental exposures and adverse pregnancy outcomes: a review of the science. Reprod. Sci. 15 (7), 631–650.
89. Sur D, Mondal SK, Gupta DN, Ghosh S, Manna B, Sengupta PG (2001) Impact of Breastfeeding on Weight Gain and Incidence of Diarrhoea Among Low Birth Weight Infants of an Urban Slum of Calcutta. Indian Pediatrics 38: 381-384
90. Taffa, N. and G. Chepngeno (2005) Determinant of Health Care Seeking for Childhood Illnesses in Nairobi Slum, *Tropical Medicine and International Health,* **10**, no.3, pp.240-245.
91. TERI (2008) Supply of clean energy services for urban and peri-urban poor. New Delhi: The Energy and Resources Institute. [Project Report No. 2007UD21]. Accessed on 16-08-2013 from http://www.gnesd.org/upload/gnesd/pdfs/upea%20technical%20reports/teri%20final.pdf
92. UN-Habitat (2006) *The State of the World's Cities* Report 2006/07, Earthscan, London.
93. Vaid, A., A. Mammen, B. Primrose, and G. Kang (2007) Infant Mortality in an Urban Slum, *Indian Journal of Pediatrics,* **74**, no.5, pp.449-453.
94. Victora CG, Kirkwood BR, Ashworth A, Black RE, Rogers S, Sazawal S, et al. (1999) Potential interventions for the prevention of childhood pneumonia in developing countries: improving nutrition. American Journal of Clinical Nutrition, 70: 309-20 pmid:10479192.
95. Wakefield, M. A., Loken, B., & Hornik, R. C. (2010). Use of mass media campaigns to change health behaviour. Lancet, 376(9748), 1261-1271.

96. Waddington, H., Snilstveit, B., White, H. and Fewtrell, L. (2009) Water, sanitation and hygiene interventions to combat childhood diarrhoea in developing countries. New Delhi, India: 3ie.

97. Walker CL, Rudan I, Liu L, Nair H, Theodoratou E, Bhutta ZA, O'Brien KL, Campbell H, Black RE (2013) Global burden of childhood pneumonia and diarrhoea. Lancet. 381(9875):1405-16. doi: 10.1016/S0140-6736(13)60222-6

98. WHO/UNICEF (2013) Ending preventable child deaths from pneumonia and diarrhoea by 2025: The integrated Global Action Plan for Pneumonia and Diarrhoea (GAPPD), WHO Press, World Health Organization, Geneva. ISBN: 9789241505239. Accessed on 23rd December 2013. Available at http://apps.who.int/iris/bitstream/10665/79200/1/9789241505239_eng.pdf

99. UNHABITAT (2006) Cities, Slums and the Millennium Development Goals. *Asia Pacific Ministerial on Housing and Human Settlements 13-16 December 2006,* New Delhi, India. Accessed on 22nd December 2013. Available on http://www.unhabitat.org/documents/media_centre/APMC/Cities,%20Slums%20and%20the%20Millennium%20Development%20Goals.pdf

100. UN Inter-agency Group for Child Mortality Estimation (UN IGME) (2012) Levels and trends in child mortality: Report 2013. New York: United Nations International Children's Emergency Fund, New York. Accessed on 22nd December 2013. Available at http://www.childinfo.org/files/Child_Mortality_Report_2013.pdf

101. Yohannes, A. G., K. Streatfield, and L. Bost (1992) Child Morbidity Patterns in Ethiopia. *Journal of Biosocial Science* 24:2 143–155.

Table 1(on next page)

Percentage distribution of under-5 children by background characteristics in slums of selected Indian cities

PeerJ PrePrints | http://dx.doi.org/10.7287/peerj.preprints.208v1 | CC-BY 3.0 Open Access | received: 19 Jan 2014, published: 19 Jan 2014

Table 1: Percentage distribution of under-5 children by background characteristics in slums of selected Indian cities, 2005–06.

Background Characteristics	n	%	Background Characteristics	n	%
Child's age (in months)			**Mass media exposure**		
0-11	491	18.27	No exposure	266	9.90
12-23	530	19.72	Partial exposure	1,804	67.14
24-35	561	20.88	Full exposure	617	22.96
36-47	560	20.84			
48-59	545	20.28	**Family type**		
			Nuclear	1,316	48.98
Birth order			Non-nuclear	1,371	51.02
1	914	34.02			
2	843	31.37	**Cooking place**		
3+	930	34.61	Kitchen only	696	25.90
			No kitchen	1,595	59.36
Sex of the child			Outside house	396	14.74
Male	1,449	53.93			
Female	1,238	46.07	**Fuel used for cooking**		
			Safe	1,244	46.30
Mother's age (in years)			Semi safe	424	15.78
15-24	1026	38.18	Unsafe	1,019	37.92
25-29	1,065	39.64			
30+	596	22.1	**Availability of mattress**		

		8			
			No	1,748	65.05
Birth weight			Yes	939	34.95
Do not know®	715	26.61			
Up to 2500 grams	993	36.96	**Availability of glass window**		
≥2500 grams	979	36.43	No	431	16.04
			Yes	2,256	83.96
Parents' education					
Both literate	350	13.03	**Type of toilet**		
One literate	678	25.23	Flush	1,285	47.82
Both illiterate	1,659	61.74	Non-flush	1,158	43.1
			No toilet facility	244	9.08
Caste/Tribe					
SC/ST	693	25.79	**Quality of drinking water**		
OBC	814	30.29	Unsafe	1,291	48.05
Others	1,180	43.92	Safe	1,396	51.95
Religion			**Stool disposal**		
Hindu	1,734	64.53	Latrine/Diaper	1,288	47.93
Others	953	35.47	Others	1,399	52.07
Wealth index			**Use of tobacco**		
Poor	198	7.37	No	2,537	94.42

PeerJ PrePrints | http://dx.doi.org/10.7287/peerj.preprints.208v1 | CC-BY 3.0 Open Access | received: 19 Jan 2014, published: 19 Jan 2014

Middle	557	20.73	Yes	150	5.58
Rich	1,932	71.90			
			Tuberculosis/Asthma		
Mother's work status			No	2,501	96.90
Not worked	2,154	80.16	Yes	80	3.10
Worked	533	19.84	**Total**	**2687**	**100.0**

Notes: In 'Others' category of variable 'Stool Disposal' includes putting/rinsing into drain or ditch, throwing into garbage, burying/disposing/leaving it in the open and any other way of disposing it. In 'Cooking fuel', category 'Safe' includes the use of electricity, Liquefied Petroleum Gas, Natural Gas, Bio Gas; 'Unsafe' includes the use of Kerosene, Coal, Charcoal, straw/shrubs/grass, agricultural crop, animal dung and others.

Table 2(on next page)

Prevalence of diarrhoea and acute respiratory infections among under-five children by background characteristics in urban slums of selected Indian cities

PeerJ PrePrints | http://dx.doi.org/10.7287/peerj.preprints.208v1 | CC-BY 3.0 Open Access | received: 19 Jan 2014, published: 19 Jan 2014

Table 2: Prevalence of diarrhoea and acute respiratory infections among under-five children by background characteristics in urban slums of selected Indian cities, 2005-06.

Background Characteristics	Diarrhoea (in %)	ARI (in %)	Background Characteristics	Diarrhoea (in %)	ARI (in %)
Child's age (in months)			**Mass media exposure**		
0-11	14.6	12.4	No exposure	8.4	11.8
12-23	12.1	11.9	Partial exposure	8.9	7.6
24-35	6.4	8.6	Full exposure	6.7	9.9
36-47	4.5	6.7			
48-59	5.3	3.8	**Family type**		
			Nuclear	8.2	9.3
Birth order			Non-nuclear	8.5	7.7
1	9.2	9.5			
2	7.3	8.3	**Cooking place**		
3+	8.4	7.9	Kitchen only		7.6
			No kitchen		8.1
Sex of the child			Outside house		11.8
Male	9.1	8.6			
Female	7.5	8.4	**Fuel used for cooking**		
			Safe		7.8
Mother's age			Semi safe		9.9
15-24 years	8.5	9.7	Unsafe		8.8
25-29 years	8.2	7.5			
30+ years	8.3	8.3	**Availability of mattress**		
			No		7.6
Birth weight			Yes		8.1
Do not know	10.5	9.1			
Up to 2500 grams	7.5	8.8	**Availability of glass window**		
≥2500 grams	7.6	7.9	No		8.8
			Yes		7.2
Parents' education					
Both literate	7.8	5.7	**Type of toilet**		
One literate	7.6	8.9	Flush	6.0	6.6

PeerJ PrePrints | http://dx.doi.org/10.7287/peerj.preprints.208v1 | CC-BY 3.0 Open Access | received: 19 Jan 2014, published: 19 Jan 2014

Both illiterate	8.8	9.0	Non-flush	11.2	10.7
			No toilet facility	8.2	9
Caste/Tribe					
SC/ST	8.7	7.8	**Drinking water quality**		
OBC	9.5	10.5	Unsafe	9.3	9.8
Others	7.3	7.6	Safe	7.5	7.5
Religion			**Stool disposal**		
Hindu	8.9	8	Latrine/Diaper	6.9	6.8
Others	7.2	9.4	Others	9.7	10.2
Wealth index			**Use of tobacco**		
Poor	8.7	9.7	No	8.0	8.5
Middle	9.3	10.1	Yes	13.3	9.1
Rich	8	8			
			Tuberculosis/Asthma		
Mother's work status			No	8.3	8.4
Not worked	8.8	8.3	Yes	8.9	14
Worked	6.5	9.2	**Total**	**8.3**	**8.5**

Notes: In 'Others' category of variable 'Stool Disposal' includes putting/rinsing into drain or ditch, throwing into garbage, burying/disposing/leaving it in the open and any other way of disposing it. In 'Cooking fuel', category 'Safe' includes the use of electricity, Liquefied Petroleum Gas, Natural Gas, Bio Gas; 'Unsafe' includes the use of Kerosene, Coal, Charcoal, straw/shrubs/grass, agricultural crop, animal dung and others.

Table 3(on next page)

Factors associated with diarrhoea among under-five children in urban slums of selected Indian cities

PeerJ PrePrints | http://dx.doi.org/10.7287/peerj.preprints.208v1 | CC-BY 3.0 Open Access | received: 19 Jan 2014, published: 19 Jan 2014

Table 3: Factors associated with diarrhoea among under-five children in urban slums of selected Indian cities, 2005-06

Background characteristics	Unadjusted Odds (n=2680)		Adjusted Odds(n=2680)	
	Exp (β)	***CI 95%***	***Exp (β)***	***CI 95%***
Child's age				
Less than 2 years®	1.000		1.000	
2 or more years	0.392***	(0.368,0.417)	0.371***	(0.274, 0.502)
Birth weight				
Do not know®	1.000		1.000	
Up to 2500 grams	0.666**	(0.475, 0.932)	0.778	(0.543, 1.114)
≥2500 grams	0.731*	(0.525,1.019)	0.490**	(0.368, 0.814)
Type of toilet				
Flush®	1.000		1.000	
Non-flush	1.268***	(1.133,1.418)	2.045***	(1.443, 2.898)
No facility	1.265***	(1.129, 1.417)	1.207	(0.608, 2.163)
Quality of water				
Unsafe®	1.000		1.000	
Safe	1.004	(0.935,1.078)	0.810*	(0.563, 1.151)
Regions of slums				
North®	1.000		1.000	
West	0.910**	(0.838,0.988)	1.126	(0.761, 1.667)
South	0.866***	(0.797,0.940)	0.504***	(0.320, 0.796)

Note: p-values: *<0.05; **<0.01; ***<0.001; Confidence Intervals (CI) at 95% level of significance for Exp (β) are given in brackets; Variables such as caste religion, family type, parents' education, mother's age, exposure to mass media, household wealth index, mother's work status, family structure, child's stool disposal, any family member smokes tobacco, and any member suffer from tuberculosis were also controlled but did not appear statistically significant neither in unadjusted model nor in adjusted model. The exponential beta for these variables has not been shown in the table above.

Table 4(on next page)

Factors associated with acute respiratory infections among under-five children in slums of selected Indian cities

PeerJ PrePrints | http://dx.doi.org/10.7287/peerj.preprints.208v1 | CC-BY 3.0 Open Access | received: 19 Jan 2014, published: 19 Jan 2014

Table 4: Factors associated with acute respiratory infections among under-five children in slums of selected Indian cities, 2005-06

Background characteristics	Unadjusted Odds (n=2687)		Adjusted Odds (n=2687)	
	Exp (β)	***CI 95%***	***Exp (β)***	***CI 95%***
Child's age				
Less than 2 years®	1.000		1.000	
2 or more years	0.664***	(0.623, 0.707)	0.516***	(0.382, 0.696)
Birth weight				
Do not know®	1.000		1.000	
Up to 2500 grams	0.873***	(0.788, 0.967)	1.148	(0.800, 1.647)
≥2500 grams	0.969	(0.887, 1.059)	0.568**	(0.372, 0.868)
Caste/tribe				
SC/ST®	1.000		1.000	
OBC	1.087**	(1.004, 1.176)	1.485*	(1.008, 2.190)
Others	1.238***	(1.146, 1.337)	0.866	(0.575, 1.304)
Religion				
Hindu®	1.000		1.000	
Others	1.114***	(1.041, 1.191)	1.387*	(1.000, 1.924)
Family type				
Nuclear®	1.000		1.000	
Non-nuclear	0.999	(0.937, 1.065)	0.662**	(0.487, 0.902)
Parents' education				
Both literate®	1.000		1.000	
One literate	1.202***	(1.093, 1.322)	2.198*	(1.230, 3.926)
Both illiterate	1.026	(0.942, 1.118)	2.609**	(1.469, 4.635)
Mother's mass-media exposure				
No exposure®	1.000		1.000	
Partial exposure	0.854***	(0.772, 0.944)	0.515**	(0.324, 0.819)
Full exposure	0.964	(0.894, 1.039)	0.703	(0.410, 1.207)
Type of toilet				
Flush®	1.000		1.000	
Non-flush	1.328***	(1.181, 1.493)	1.544*	(1.088, 2.190)

No toilet	1.263***	(1.122, 1.421)	1.061	(0.570, 1.978)
Place of cooking				
Kitchen only®	1.000		1.000	
No kitchen	1.185	(1.091, 1.287)	1.401*	(0.992, 2.008)
Outside house	1.454	(1.331, 1.589)	1.201	(0.877, 2.233)
Regions of slums				
North®	1.000		1.000	
West	1.059	(0.974, 1.152)	0.706	(0.477, 1.044)
South	0.853***	(0.782, 0.930)	0.240***	(0.146, 0.395)

Note: p-values: *<0.05; **<0.01; ***<0.001; Confidence intervals (CI) at 95% level of significance for Exp (β) are given in brackets; Mother's age, household wealth index, mother's work status, family structure, access to safe water, child's stool disposal, any family member using substance use, suffering from tuberculosis, fuel used for cooking, possession of mattress, and windows with glasses were also controlled but did not appear statistically significant neither in unadjusted model nor in adjusted model. The exponential beta for these variables has not been shown in the table above.

Figure 1

Prevalence of diarrhoea and acute respiratory infections among under-five children by region of residence