

## Modifiable Factors for Prevention of Childhood Mortality

VIDUSHI MAHAJAN, AMARPREET KAUR, AMIT SHARMA, CHANDRIKA AZAD AND VISHAL GUGLANI

From Department of Pediatrics, Government Medical College and Hospital, Sector 32, Chandigarh, India.

Correspondence to:

Dr Vidushi Mahajan,

Assistant Professor, Department of Pediatrics, Government Medical College and Hospital, Sector 32, Chandigarh, India.

vidushimahajan2003@yahoo.co.in

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**Objective:** To know the disease-related causes of child mortality and identify socially modifiable factors affecting child mortality among hospitalized children aged >1 month-18 years in a referral hospital of North India. **Methods:** Causes of death (ICD-10 based) were extracted retrospectively from hospital files ( $n=487$ ) from 17 March 2003 to 30 June 2012. Modifiable factors were prospectively studied in 107 consecutive deaths from 6 October 2011 to 30 June 2012. **Results:** Pneumonia, CNS infections and diarrhea were the most common disease-related causes of child mortality. **Conclusions:** Amongst modifiable factors, administrative issues were most common followed by family-related reasons and medical-personnel related problems.

**Keywords:** Audit, Child deaths, India, Prevention.

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India hosts maximum (24%) number of deaths in under-5 children occurring worldwide [1]. Disease-related or 'biological' factors related to child mortality are studied extensively. Majority of childhood deaths in India are attributed to infections, particularly pneumonia and diarrhea [1- 6]. Certain non-biological causes (*e.g.* administrative, medical personnel, family-related factors) may also contribute towards child mortality [7]. We planned this study to evaluate disease-related causes and modifiable factors of child mortality among hospitalized children aged >1 month-18 years who died in a tertiary care referral teaching hospital of Northern India.

### METHODS

The study had a mixed design; disease-related causes of mortality were analyzed retrospectively (17 March, 2009 to 30 June, 2012) and socially modifiable factors were identified prospectively (6 October, 2011 to 30 June, 2012) in children (age 1 mo-8 y), who died in Pediatric emergency ward (PEW) and Pediatric Intensive care unit (PICU). Ethical approval was obtained.

To study the disease-related causes of mortality, we extracted the relevant clinical details and final diagnosis from hospital files of the study population. We excluded any missing case records. The 'primary cause' of death was the probable cause that finally led to death of the child [8]. The causes of death were ICD-10 based.

To study the modifiable causes of child mortality, we enrolled all critically sick children admitted in PEW and PICU. A list of modifiable factors was developed *a. priori*,

which were defined as events, actions or omissions contributing to death of a child and which, by means of interventions, could be modified [9]. These factors were categorized as: (A) Family/caregiver-related problems which included - (i) delay in getting medical attention (*e.g.* lack of transport, girl child, delayed referral by primary care physician, inability to recognize danger signs, maternal ill health), (ii) treatment by quacks/faith healers, (B) Medical personnel-related factors included - (i) clinical assessment issues (delay in detection of signs, delayed referral by treating team, alternative diagnosis not considered), (ii) monitoring issues, and (iii) case management (prescription error, delay in institution of specific management) at our hospital; and (C) Administrative factors included - (i) shortage of staff (residents, nurses), (ii) shortage/non-functioning of equipment(s), (iii) lack of specialized lifesaving care *e.g.* dialysis, surgical procedure etc, (iv) lack of PICU beds/ ventilators, (v) communication gap between medical staff, (vi) Lack of drugs, blood products, and (vii) lack of policy. Resident doctors recorded these factors during history-taking, which were cross-checked by a consultant pediatrician. The staff was periodically primed to record all study variables.

To identify modifiable factors audit meetings were held fortnightly, using death-audit profoma and patient records. Each meeting was attended by at least three consulting pediatricians (one primary consultant who managed the case and two unrelated consultants), concerned resident doctors and nursing staff, where deemed necessary. Consensus on causes of death, contributing conditions and modifiable factors were reached.

Proportion of disease-related causes of mortality; and proportion of modifiable factors related to child mortality were the two outcome variables. Descriptive statistics was used to describe baseline demographic variables and modifiable factors. Data were analysed by Excel and SPSS V. 17.0.

**RESULTS**

There were 5815 admissions (>1 month) during the study period. Of these, 493 children died (case fatality rate 8.4%). We excluded six cases whose files could not be traced. We therefore analyzed 487 deaths [237 (48.6%) one-month to 1-year, 138 (28.3%) in 1-5 years and 112 (23%) in children >5 years] for disease-related causes of mortality. Pneumonia, CNS infections and diarrhea were leading disease-related causes of mortality (**Fig. 1**). Severe malnutrition (42%) was the major contributing cause [median z-score: -1.94 (IQR -3.37 to -0.68)].

We studied modifiable factors amongst 107 (5% males) consecutive deaths. Their median (IQR) age was 12 (5, 60) months and weight was 8 (5, 15) kg. 43% had shock at presentation, as defined by AHA [10,11], and 6% had a cardiac arrest either before or at presentation to PEW. Seventy one percent required mechanical ventila-tion

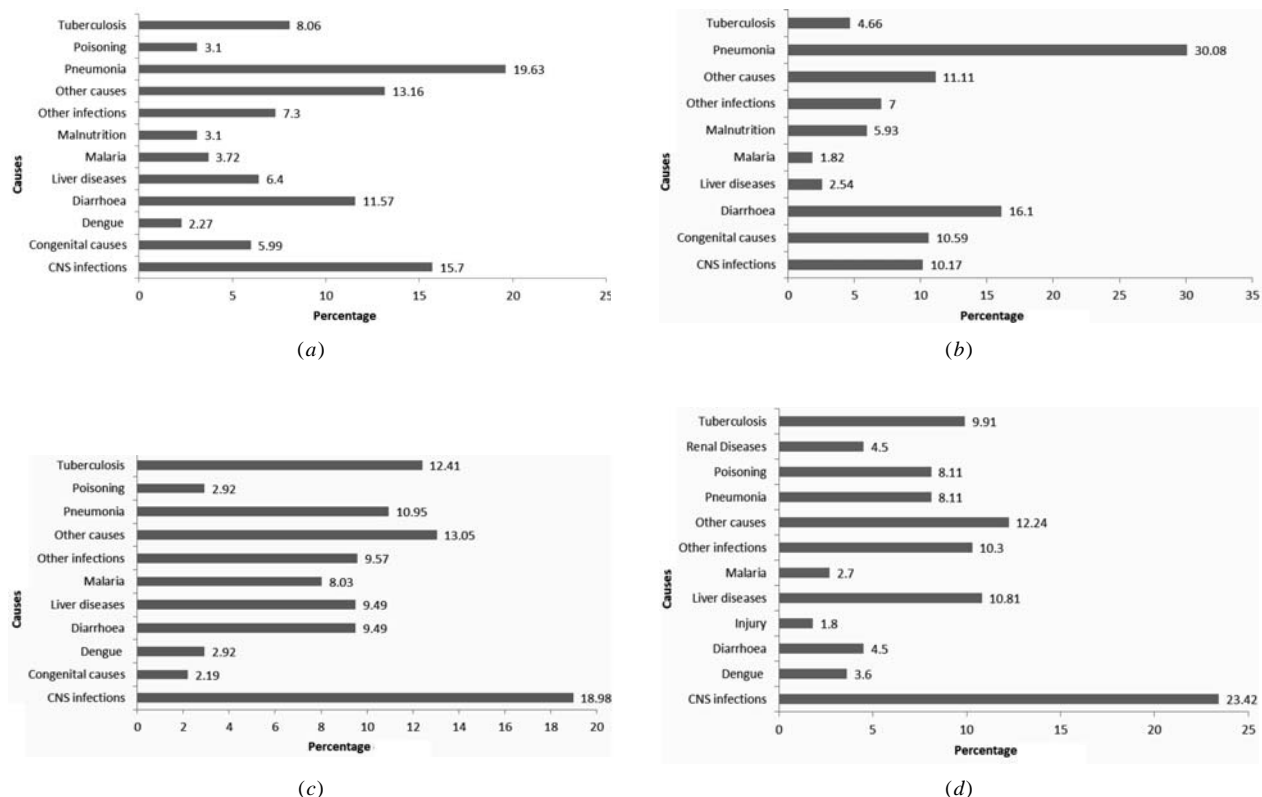
within one hour of presentation. Median hospital stay was 32 (IQR-10, 101) hours. Majority (64%) of the parents of study children lived in villages, were illiterate (mothers-46%, fathers-29%) and worked as manual labourers/ daily wagers (61%).

Amongst modifiable factors, administrative issues were most common (universal) followed by family/caregiver-related factors (72%) and medical personnel-related factors (41%). Shortage of medical personnel especially senior residents and nursing staff remained a constant feature throughout. Among medical personnel-related factors, improper monitoring was single most prevalent factor. (**Table I**).

**DISCUSSION**

Pneumonia, CNS infections and diarrhea were main causes of disease-related mortality and administrative issues followed by family-related reasons were most common modifiable factors in our study.

Our study results were in accordance with national and global estimates of child mortality [1-6] and national audit reports, evaluating modifiable factors, published from South Africa [7-9]. We found a considerable proportion of



**FIG. 1** Causes of deaths in (a) children of all ages (N=487) (b) children 1-12 months (N=237) (c) children 1-5 years (N=138) (d) children above 5 years (N=112).

**TABLE I** MODIFIABLE FACTORS AMONG 107 DEATHS

<i>Modifiable Factors*</i>	<i>N (%)</i>
<i>Family caregiver related</i>	
Transport problem	15 (14)
Female child	5 (5)
Delayed referral	34 (32)
Delay in illness recognition	45 (42)
Maternal Ill-health	4 (4)
Quacks and faith healers	11 (10)
No family related issues	30 (28)
<i>Medical personnel related</i>	
Assessment	
Delayed detection	5 (5)
Alternative diagnosis not considered	2 (2)
Delay in specific management	11 (11)
Case monitoring	20 (19)
Case management	
Delayed referral	1(5)
Prescription error	
No medical personnel issues	63 (59)
<i>Administrative factors</i>	
Bed or ventilator unavailability	57 (53)
Lack of specialized care	3 (3)
Lack of equipment	12 (11)
Lack of medical personnel	
Communication problems	1
Lack of drugs and blood products etc	2
Lack of policy	1

\*More than one modifiable factor were present in some study subjects; #Lack of medical personnel was a constant feature throughout the study.

deaths due to CNS infections and tuberculosis in our study, which is expected because of the referral hospital setting.

Although administrative issues were present universally, majority of them are related to the infrastructure, availability of healthcare personnel and equipments. These factors, though modifiable, are related to health resource allocation and budget constraints. However, a few administrative factors e.g. availability of drugs, and unit policy decisions can be locally modified. There was a high incidence of monitoring issues which is linked to the poor doctor: patient (1:40-1:70)/nurse: patient (1:20-1:30) ratio, with bed occupancy >100% during study period.

We acknowledge the limited sample size of our study

and mixed retrospective-prospective study design. However, our study population was both rural and urban including slums, thereby giving an insight to deaths occurring in all sections of society.

Family-related factors were present in more than two-third of child deaths. Largely, children who died were very sick at admission, which underscores the importance of early health seeking. Majority of our population were daily wagers with poor literacy levels, which could contribute to delayed illness recognition.

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