

Comprehensive review characterizing the epidemiology of *Streptococcus pneumoniae* in India

Hope Johnson¹, Geoffrey Kahn¹, Anne Palaia², Orin Levine¹, Mathuram Santosham^{1,2,3}

1. International Vaccine Access Center, Johns Hopkins Bloomberg School of Public Health 2. Dept. of Pediatrics, Johns Hopkins School of Medicine 3. Center for American Indian Health, Johns Hopkins Bloomberg School of Public Health

INTRODUCTION

In 2008 the National Technical Advisory Group on Immunization (NTAGI) of India recommended introduction of pneumococcal conjugate vaccine (PCV), yet PCV remains available only on the private market. To inform decisions for national PCV introduction, we assessed the availability and quality of data on pneumococcus in India and neighboring countries.

METHODS

Pneumococcal carriage and disease burden data from India, Pakistan, Bangladesh, Sri Lanka, and Nepal were identified from citations in existing reviews and a search of the literature published from Jan 2005 to Feb 2011. Studies were screened then relevant data were double-abstracted and assessed by quality criteria.

RESULTS

Direct observation of pneumococcus is uncommon in India, particularly for pneumonia:

TABLE 1 – Incidence of invasive pneumococcal disease and attributable proportion of pneumococcal pneumonia and IPD

Location	Study years	Study design	Age (mo.)	Syndrome definition	Diagnostic methods	Incidence (child-years)
Bangalore, Karnataka ¹	2006	Population-based surveillance	0-59	IPD-associated syndromes, not specified	Blood and CSF culture	15/1000
Location	Study years	Study design	Age (mo.)	Syndrome definition	Diagnostic methods	Proportion
Vellore, Tamil Nadu ²	1985-1987	Cross-sectional	0-71	Pneumonia – radiologically confirmed or persistent crepitations/bronchial breath sounds	Blood culture	5.4%
New Delhi ³	1988-1989	Cross-sectional	0-143	Pneumonia – radiologically confirmed or clinical evidence	NPA culture, blood/urine LAT	12.1%
New Delhi ⁴	1991-1992	Cross-sectional	0-59	Severe pneumonia – fast breathing, retractions, w/ or w/o other danger signs	Blood culture, blood/urine LAT	28.2%
Multi-site, nat'lly representative ⁵	1993-1997	Sentinel surveillance	0-∞	Invasive disease, any	Blood, CSF, other sterile fluid culture	5.4%
New Delhi ⁶	1995-1997	Cross-sectional	2-59	Severe pneumonia – tachypnea w/ retractions	Blood culture	5%

But are these estimates likely, or even plausible, when placed in the country's epidemiological context?

The median isolation rate of any bacteria in cases of pneumonia is 18% and viral isolation rates are shown below:

TABLE 2 – Attributable proportion of viral pneumonia

Location	Study years	Study design	Age (mo.)	Syndrome definition	Diagnostic methods	Proportion
Vellore, Tamil Nadu ²	1985-1987	Cross-sectional	0-71	Pneumonia – radiologically confirmed or persistent crepitations/bronchial breath sounds	NPA or OP swab IFA	37%
New Delhi ³	1988-1989	Cross-sectional	0-143	Pneumonia – radiologically confirmed or clinical evidence	NPA or OP swab culture	30%
New Delhi ⁶	1995-1997	Cross-sectional	2-59	Severe pneumonia – tachypnea w/ retractions	NPA IFA	38%
Multi-site ⁷	2000-2002	RCT	2-59	Non-severe pneumonia – tachypnea without any danger signs	NP swab IFA	23.4%
Ballabgarh, Haryana ⁸	2001-2004	Cohort	0-42	ARI – WHO definitions	NPA IFA	16%
New Delhi ⁹	2005-2007	Cross-sectional	0-59	ALRI or severe ALRI – WHO definitions	NPA PCR	35.2%

Nearly half of all pneumonia cases would appear to be neither bacterial nor viral...

The effectiveness of antibiotics, particularly cotrimoxazole and amoxicillin, suggest that most severe pneumonias are bacterial:

TABLE 3 – Antibiotic treatment efficacy

Location	Study years	Study design	Age (mo.)	Syndrome definition	Comparator	Outcome
Gadchiroli, Maharashtra ¹⁰	1988-1989	Case-control	0-47	Fatal pneumonia – verbal autopsy	Villages w/ active case management (cotrimoxazole) vs. adjacent villages w/o	54% reduction
Abbottabad, Pakistan ¹¹	1985-1987	Observational	0-59	Fatal pneumonia – verbal autopsy	Pre- and post-active case management (cotrimoxazole)	55% reduction
Matlab, Bangladesh ¹²	1988-1993	Case-control	0-23	Fatal pneumonia – verbal autopsy	Villages w/ active case management (various abx) vs. similar villages w/o	54% reduction
Kathmandu, Nepal ¹³	1984-1987	Observational	0-59	Fatal pneumonia – verbal autopsy	Pre- and post-active case management (ampicillin)	69% reduction
Multi-site ¹⁴	2000-2004	RCT	2-59	Very severe pneumonia – WHO definition	Treatment failure following chloramphenicol vs. ampicillin+gentamycin	16.1% (chlor) 11.2% (amp+gent)

Once it is established that most severe pneumonias are bacterial, it makes sense to consider what proportion of bacterial pneumonias are due to pneumococcus:

TABLE 4 – Attributable proportion of pneumococcal pneumonia among cases of confirmed bacterial pneumonia

Location	Study years	Study design	Age (mo.)	Syndrome definition	Diagnostic methods	Proportion (all isolates)	Rank - bacterial causes
Vellore, Tamil Nadu ²	1985-1987	Cross-sectional	0-71	Radiologically confirmed or persistent crepitations/bronchial breath sounds	Blood culture	29.6% (5.4%)	1st
New Delhi ⁶	1995-1997	Cross-sectional	2-59	Tachypnea w/ retractions	Blood culture	33% (5%)	2nd

Among bacterial pneumonia cases, *S. pneumoniae* appears as the first or second leading cause in India.

CONCLUSION

India has available a significant amount of data on pneumonia, including bacterial pneumonia, and pneumococcal disease. Inferences on the burden of disease are improved by looking at different types of data to assess internal consistency in the findings, and by comparing results with those observed in neighboring countries. The lack of robust disease specific incidence data, for example, is inconsistent with the observations that co-trimoxazole reduces overall pneumonia mortality. Studies from neighboring countries show similar results, and can bolster confidence in the data from India.

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