



Impact of Air Pollution on child health in Bangladesh

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Overview of this Presentation

- Background
- Introduction
- Objectives
- Methods & Materials
- Sources of Air Pollution
- major air pollutants ,their sources and health effects
- Impacts of Air Pollution in developed/developing countries
- Child health problems
- Other health problems
- Discussion
- Conclusions
- Role of health and other sectors
- Policy implications



Background

- Air Pollution is an emerging environmental issue globally, regionally and nationally lead health concern

Aims of Male Declaration

- Increase the awareness on the transboundary air pollution
- Share and receive the stakeholders views and ideas on the implementation of Male Declaration
- Improve the information exchange between information generation and users



What is Indoor air pollution ?

Indoor air pollution defined here as unventilated use of household use of solid fuels

What are the Exposure-Response Relationships?



Introduction

- IMR & NNMR extremely high in Bangladesh
- 120,000/yr death in <5 Pneumonia
- In India 400,-550,000 premature death
- 3 Million deaths among <5 globally



Introduction

- Cook and live together
- 6-8 people/room, meager floor space
- Overcrowding- leads to ARI,CD, Cold. Skin Jaundice & Other Resp. dis.
- Poors-use synthetic materials and papers with bio-mass fuel as LPG high price
- Electric stoves-
- WHO study on IAP, 2002 measuring $SP_{M_{10}}$

Indoor Air Pollution (IAP)

- High in rural as well as urban slum
- IAP- bio mass fuels or coals burned or cooking/heating
- SPM high- thousand times $\mu\text{g}/\text{m}^3$
- Women & children in urban slum both IAP/OAP
- One burner stove converting at 12-18% efficiency rate - pollution

Objectives

- To review the nature, distribution of the air pollution
- To understand the health consequences of air pollution
- To make awareness- policy & decision makers

Methods & Materials

Review of various scientific and popular literatures to explore risk group associated with air pollution

Highlights of major air pollutants ,their sources and health effects (cont...)

Pollutants	Sources	Health effects
SPM	Motor vehicle, Wood-burning, Industrial activities	Respiratory inf. Throat irritation Aggravated asthma RT & lung damage
Sulphur Oxide	Vehicle (Diesel) Factory emissions	Bronchitis Emphysema Asthma, Beans & tomatoes plant growth h↓
Nitrogen Oxide	Vehicle motors Power stations	Respiratory, chest eye irritation, headache, plant growth h↓
Lead	Windblown dust Vehicles, Coal & Wood-burning, Phosphate fertilizer, metal production	Children >3 x than adults Affected CNS Renal damage Hypertension Effects on plants

Highlights of major air pollutants ,their sources and health effects

Pollutants	Sources	Health effects
Carbon Monoxide	Petrol vehicles	↓Ability Carry O ₂ Heart disorders
Aromatic hydrocarbon	Un burn fuel(diesel engine)	Drowsiness Eye irritation
Benzene	Unleaded petrol, emitted from catalytical converters	Carcinogen Affected CNS
Ozone	Reaction between VOCs and NO _x in sunlight	Lung function Asthma Eye irritation Nasal congestion ↓Resistance infection

Health Consequences From IAP

Cooking, heating, lighting, tobacco smoke & burning mosquito coil

Respiratory Disease

Nose, ear ,throat lung

IAP has neglected due to global interest and technical capability to monitor industrial and vehicular pollution rather focused on ambient air monitoring

IAP in rural-60x times higher than urban of developed country

Air Pollution Related Respiratory Illness

- **Pollution ---Types Main Sources**
- Indoor ---Cooking, heating, lighting fumes and dust.
- Tobacco ---smoke Important as predisposing or exacerbating factor, because
- Contains concentrations of many indoor and outdoor pollutants.
- leads to disability and the situations are more vulnerable to e sufferings.

Pollutants and Health Effects

- **Component Probable Mechanism**
- **Particulate** --Inflammation, reduce muco-ciliary clearance, reduce macrophage & immune response
- **Carbon monoxide**-Binds to Hb, reduce O₂ delivery
- **Nitrogen Oxide**- Acute-increases bronchial activity
 - chronic-increased susceptibility infection
- **Sulphur dioxide**-- Acute-increases bronchial activity
 - Chronic-difficult to dissociate from PM
- **Benzo[a]pyrene** --Carcinogenic
- **Formaldehyde** --Nasopharyngeal and airway irritation

Biofuel use leads to very high level IAP

- Typical 24 hr mean in biofuel using home is 1000+ µg/m³
- Can reach 10,000 µg/m³ PM₁₀ (or more) during use of open fire
- EPA: 150 µg/m³ PM₁₀ (1% of 24hr periods); 50µg/m³ annual mean
- Women and young children have greatest exposure

Health Effects of Exposure to Smoke from Solid fuel Use

Health Outcome	Population Affected	Relative Risk		Evidence
		Low	High	
Acute Lower Respiratory Infections (ALRI)	< 5 years	2.0	3.0	Strong
Asthma	Females > 15 yr.	1.4	2.5	Intermediate/moderate
Blindness (cataracts)		1.3	1.6	Intermediate/moderate
COPD		2.0	4.0	Strong
Lung Cancer		3.0	5.0	Strong
Tuberculosis		1.5	3.0	Intermediate/moderate

DOES IAP INCREASE RISK OF ALRI?

Study site	Type	Exposure	OR/RR (95% CI)
Nepal	Cohort	Reported time by fire	2.2 (1.6-3.0)
Pandey 1989			
Gambia	Cohort	Carriage on back (cooking)	M: 0.5 (0.2-1.2) F: 1.9 (1.0-3.9)
Armstrong 1991			
Africa	Case-control	Open fire VS cleaner fuels	2.2 (1.43-3.33)
Collings 1990			
Navajo	Case-control	Use of wood stove	4.8 (1.69-12.91)
Morris 1990			
S India	Case-control	Smoke producing stove	0.8 (0.46-1.43)
Shah 1994			
Gambia	Prospective Case-control	Carriage on back (cooking)	2.6 (0.98-6.65)
Collings 1990			

Air Pollution Related Respiratory Illness

Pollution Types

Main Sources

Indoor

Cooking, heating, lighting fumes and dust.

Tobacco smoke

Important as predisposing or exacerbating factor, because Contains concentrations of many indoor and outdoor pollutants.

AURI-OTITIS MEDIA

- ♦ LDC Acute Upper RI(AURI) studies not specific for Otitis media
- ♦ Case-control (NY State): OR 1.73 (1.03-2.89) for wood stove use (Daigler 91)
- ♦ ETS meta-analysis: 1.48 (1.08-2.04) for OM with either parent smoking; 1.38 (1.23-1.55) for effusion (Strachan 98)

Particulate Concentrations and Population Exposures

Region	AVERAGE CONCENTRATIONS		EXPOSURES (%) GLOBAL TOTAL		
	Indoor $\mu\text{g}/\text{m}^3$	Ambient $\mu\text{g}/\text{m}^3$	Indoor %	Ambient %	Total %
Developed Urban Rural	100	70	7	1	8
	80	40	2	0	2
Developing Urban Rural	250	280	25	9	34
	400	70	52	5	57
Total			86	15	100

Source: Health and environment in sustainable development. Five years after the Earth Summit, 1997, WHO

Chronic Lung Disease

- ♦ More than 20 observational studies in LDCs' community and hospital based
- ♦ Studied Chronic Bronchitis (symptoms), COPD (spirometry), also more severe sequelae. Up to 15%-20%+ of those exposed are affected, full range of pathology seen.
- ♦ Similar limitations as for ALRI in respect of direct exposure measurement and confounding
- ♦ Strong supportive evidence from smoking and ambient pollution
- ♦ Emerging evidence of possible association with fibrosis (+ silica dust) and ILD

ASTHMA and BIOMASS Smoke

- ♦ Debate about role of air pollution in asthma:
 - sensitization: uncertain
 - exacerbation: likely
- ♦ Few studies in LDCs
- ♦ Few measured exposure directly
- ♦ Some not adjusted for confounding
- ♦ LDC evidence inconsistent
- ♦ Developed country evidence also inconsistent

TUBERCULOSIS

- ♦ 3 studies: India(2), Mexico(1)
- ♦ Largest- an analysis of 1992-93 Indian NFHS found adjusted OR of (self-reported) TB= 2.58(1.98-3.37)
- ♦ Both other studies consistent; one age adjusted only
- ♦ If confirmed, increased risk may be due to **reduced resistance to infection**

Cancer

Lung:

- ♦ In LDCs relatively high proportion with lung cancer non-smokers
- ♦ China-review: OR in range 2-6 for exposure to coal smoke in home
- ♦ No evidence reported of association with wood smoke

Cancer

Nasopharynx and Larynx:

- ◆ Several studies (Africa, S America)
- ◆ Adjusted OR for wood smoke=2.68(2.2-3.3) [Pintos 98]

Mechanism:

- ◆ Smoke contains high levels of known carcinogens e.g Benzo[a]pyrene

EYE IRRITATION and CATARACT

- ◆ Sore, red eyes, tears widely reported
- ◆ Hospital based case control study in Delhi: LPG vs. biomass found adjusted **OR=0.62** (0.4-0.98) for cataract
- ◆ Animal (rat) studies report biomass smoke condensates damage lens
- ◆ Evidence from ETS

IAP and Health: summary of evidence

- ◆ ALRI 15+ studies, but lack of direct exposure assessment, control of confounding
- ◆ Otitis Media No LDC, some DC studies, ETS supports
- ◆ COPD 20+ studies, but exposure/confounding
- ◆ Asthma Limited, conflicting evidence

IAP and Health: summary of evidence (Cont....)

- ◆ TB 3 studies. Largest self-reported TB though adjusted for S/Ec factors
- ◆ Cancer Lung (coal), Upper airway (biomass)
- ◆ Birth weight 1 study, ETS & ambient support
- ◆ PNMR 1 study, ETS & ambient support
- ◆ Cataract 1 study, smoking & animal evidence
- ◆ CVD No LDC (biomass) study-expected?

IAP and Childhood ARI

- ◆ 9 Case-control: South Africa, Zimbabwe, *Nigeria, Tanzania, Gambia, *Brazil, *India, Argentina adjusted for confounders; $n = 4311$; Odds Ratios = **2.2-9.9**
- ◆ 3 Cohort: Nepal, Gambia 2 adjusted for confounders; $n = 910$; Odds Ratios = **2.2-6.0**
- ◆ 1 Case-fatality: Nigeria Hospitalized patients; $n = 103$; Odds Ratios = **8.2**
- ◆ 2 US Case-control; $n = 206$ Adjusted for confounders. Odds Ratios = **4.8**
- ◆ **Result of meta-analysis: 2.3 (CI 95% : 1.9, 2.7).**

COPD

- ◆ 3 Case-control studies: Saudi Arabia; Columbia; Mexico 2 adjusted for confounders; 2 show exposure response with years of cooking; $n = 498$
Odds Ratios = **3.3-1.5**
- ◆ 5 Cross-sectional studies: Nepal; India; Bolivia All partly adjusted; 2 show exposure - response with years of cooking; $n = 5528$
Odds Ratios = **1.4-7.9**
- ◆ Women: **3.2** (CI 95% : 2.3, 4.8).
- ◆ Men: **1.8** (CI 95% : 1.0, 2.8).

Diseases Age Wise

Diseases	< 1 year	1-4 year	5-15 year	16+ year	Total
Acute Respiratory inflammation	9.37 %	6.34%	5.63%	5.88%	6.10%
Asthma	0.29 %	1.12%	2.42%	2.80%	2.32%
Eye diseases	1.80 %	2.49%	6.09%	4.40%	4.37%

Various hospital statistics in Bangladesh

Setting- Author	In- No	Age (Yrs)	Pulmonary Illness (%)
SHos Feni	'83-'86	10	32%
SJ Islam	500		
Mymensingh - Lutful K et al.	199-958	1 mo-13	Pneumonia 27%
BICH - Ruhul Amin et al.	1991-3091 cases	<5	ARI 24%

Various hospital statistics in Bangladesh

Setting- Author	In- No	Age (Yrs)	Pulmonary Illness (%)
IPGMR- Moula QM	'86-'87-2380	Neonate- 31%; Pre term	Birth Asphyxia- 29% Death Resp- 17%
BMCH- Rashid A,	'00-'01-254	/Neonate LBW41-	Pneumonia 33% death

Top Ten diseases in ICMH 15.02.99-31.12.01

Pneumonia-	1279
Bronchitis-	778
Br. Asthma-	211
Pulmonary Tuberculosis-	31
Wheezy child-	30
Laryngomalacia-	11
Pleural Effusion-	10
Bronchiolitis Pneumonia-	6
Bronchiectasis-	6
Croup-	4

PERINATAL, INFANT MORTALITY

Setting	Exposure/outcome	Findings
India	Biomass smoke	1.5 (1.0-2.1)
Mexico City	Perinatal mortality PM _{2.5} (3-5 days prior to death)	6.9% (2.5-11.3) increase in IMR for + 10 µg/m ³
USA	IMR PM ₁₀	1.10 (1.04-1.16)
Czech Republic	Perinatal mortality TSP, SO ₂ , NOx Still births	high vs. low No association (but with-LBW)

- ### Limitations of Evidence
- Case definition (what is/ is not ALRI) and ascertainment (how cases found) vary
 - Almost none have measured exposure (or even pollution) directly - used proxies
 - Less than adequate control of confounding factors: partly due to methods partly unavoidable with 'observational' designs
 - Randomized intervention study can overcome these problems

Potential roles for 'Sectors' working in collaboration

- Health**
 - Assess health risks; needs assessment; raise awareness; Health impact Asst; monitoring
- Environment**
 - Locally approaches AQS & targets; environment management; climate
- Housing**
 - Design; materials; quality; safety; ventilation; energy efficiency
- Energy**
 - Supply; pricing; biomass management

Summary of the Evidence (Smith and Mehta, 2000)

Evidence	Diseases
Strong	ARIs, COPD, Lung Cancer
Moderate	Cataract, TB
Limited	Asthma
Insufficient	LBW, Perinatal deaths, Heart diseases

Conclusion

- IAP is critically important health in developing country like Bangladesh
- Less attention has been paid by the researchers and the programmers
- It is the woman's and children right to aware about the threat pose by IAP which will help to take preventive measures

Recommendations:

Short Term Plan

- Provision for ventilation
- Introducing biogas plant

Medium Term Plan

- Social forestry & Plantation of Fuel wood
- Ventilation
- Promotion and training on usage of biogas plant & improved stove
- Promotion of LPG and gas cylinder

Long Term Plan

- Improved type of stove
- Promotion and usage of LPG & Gas cylinder
- throughout the country

Thank You