Burden of Cardiovascular Diseases in India

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**Principal Causes of Death Worldwide**

Total Deaths All Ages: 58 million (2005)

- **30%** Communicable diseases, Maternal/perinatal conditions and nutritional deficiencies
- **30%** Cardiovascular diseases
- **13%** Cancer
- **9%** Injuries
- **9%** Other chronic diseases
- **7%** Chronic respiratory diseases
- **2%** Diabetes

*WHO. Preventing Chronic Diseases. 2005*
Measuring Disease Burden

• Vital registration systems
  – Cause-of-death data certified by a physician
  – Data of 70 countries. Not in India

• Sample registration surveys
  – Used in China. India- Maharashtra.
  – Ongoing SRS study in India.

• Epidemiological assessment
  – Prevalence and incidence data
  – Case-fatality rates for treated and untreated

• Model-derived cause-of-deaths data

Mortality data from RGI Office & Causes of Death

Low Medical Certification and Vital Registration Rates: 13%-36%

Proportionate mortality rates %

Years

Proportionate mortality rates %

Years

Circulatory Infections Injuries Respiratory Perinatal

Shiv Kumar. 2003
Projections for CHD Mortality in India

Global Burden of Diseases Study

No. in Millions

Ghaffar et al. BMJ 2004; 328:807-10
Evaluating Causes of Death in India using Verbal Autopsy

The Million Death Study

9 million deaths annually in India.

www.indiabudget.nic.in. 2009

A Collaborative Effort of
Registrar General of India; SRS, India; CGHR, University of Toronto, Canada; ICMR, Delhi; SJRI, Bangalore; PGI, Chandigarh; WHO, Geneva; CTSU, Oxford; and 21 Medical Colleges and Research Institutions in India

Major Causes of Death in India: All Ages
Million Death Study 2001-2003

Analysis of cause of deaths in 113,692 persons in all the Indian States

CVDs cause 1.7-2.0 million deaths annually in India

Million Death Study 2009
Major Causes of Death in India: Rural vs Urban

Analysis of cause of deaths in 113,692 persons in all the Indian States

Million Death Study 2009
Cardiovascular Mortality in Different Indian States

Males

Females

CVD death rate per 100,000

- <160
- 161 - 240
- 241 - 350
- > 350

Mony P & MDS. 2009
Gaps in Knowledge for CVD Mortality in India & Future Directions

- Vital registration systems do not exist except in Maharashtra state. Support needed to implement VRS. Comparison with the British system.
- Studies in past used the SRS system for enumeration of deaths and its causes (mainly rural). This has led to underestimation.
- The MDS which is government sponsored in phase II (2004-2014) shall provide new information but needs support.
- The new UID initiative of central government can provide vital data but there is a centre-state divide in its scope.
Part II: Burden of Cardiovascular Diseases In Developing Countries

- Cardiovascular diseases: 10%
  - Inflammatory heart disease: 8%
  - Rheumatic heart disease: 5%
  - Ischaemic heart disease: 35%
- Injuries: 16%
- Cancers: 5%
- Neuropsychiatric conditions: 10%
  - Psychiatric: 8%
  - Neuropsychiatric disorders: 10%
- Other diseases: 59%
- Other cardiovascular: 23%

WHO 1998
Increasing Burden of CVD in India

Global Burden of Diseases Study

GBD Study Projections

Ezzati M, et al. WHO 2004
AMI Admissions in a Kerala Hospital
Calicut Experience 1967-1988

CHD Prevalence in Urban Indian Populations

\[ \text{R}^2 = 0.53 \]

CHD Prevalence in Indian Rural Populations

R² = 0.42

Cardiovascular Diseases in India

Epidemiology and causation of coronary heart disease and stroke in India

R Gupta,1 P Joshi,2 V Mohan,3 K S Reddy,4 S Yusuf5

ABSTRACT
Cardiovascular diseases are major causes of mortality and disease in the Indian subcontinent, causing more than 25% of deaths. It has been predicted that these diseases will increase rapidly in India and this country will be host to more than half the cases of heart disease in the world within the next 15 years. Coronary heart disease and stroke have increased in both urban and rural areas. Case–control studies indicate that tobacco use, obesity with high waist:hip ratio, high blood pressure, high LDL cholesterol, low HDL cholesterol, abnormal apolipoprotein A-1:B ratio, diabetes, low consumption of fruits and vegetables, sedentary lifestyles and psychosocial stress are important determinants of cardiovascular diseases in India. These risk factors have increased substantially over the past 50 years and to control further escalation it is important to prevent them. National interventions such as

CORONARY HEART DISEASE AND STROKE MORTALITY
According to the Global Burden of Diseases Study in India, in the year 1990 CHD caused 0.62 million deaths in men and 0.56 million deaths in women (total 1.18 million) and strokes were responsible for 0.25 million deaths in men and 0.22 million deaths in women (total 0.47 million). By the year 2000 CHD had led to 1.59 million deaths and stroke to 0.60 million deaths. Mortality from these conditions is predicted to increase rapidly and the absolute numbers of CHD cases in India to overtake those of the established market economies and China while stroke mortality would also increase (table 1).

Leading major cause groups of deaths during 1984 to 1998 have been reported by the Registrar

Coronary Heart Disease Prevalence (%) 
Urban and Rural Adult Populations in India

Projections for CHD Cases in India

Indrayan A. National Commission for Macroeconomics and Health. 2005
Stroke Prevalence Studies in India
Urban and Rural Adult Populations in India. Rates/100,000

Gupta R. Fortis Med J 2009; 2:
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<tbody>
<tr>
<td>Years of study</td>
<td>1993-98</td>
<td>1998-99</td>
<td>2005-06</td>
<td>2005-06</td>
</tr>
<tr>
<td>Population size studied</td>
<td>Rural 20,842</td>
<td>Urban 50,291</td>
<td>Urban 156,861</td>
<td>Urban/Rural 925,867</td>
</tr>
<tr>
<td>Thrombotic/ h’gic/ non-sp</td>
<td>---</td>
<td>68/32/0</td>
<td>80/18/2</td>
<td>84/11/5</td>
</tr>
<tr>
<td>Annual Incidence rate/100,000</td>
<td>124</td>
<td>36</td>
<td>145</td>
<td>117</td>
</tr>
<tr>
<td>Age-adjusted rate/100,000</td>
<td>262</td>
<td>105</td>
<td>152</td>
<td>135</td>
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Limitations and Strengths of Cardiovascular Epidemiologic Studies

• **Limitations**
  - Small studies.
  - Problems of non-uniform sampling; diagnostic criteria; data analyses, interpretation and presentation, other epidemiological biases.
  - Sampling bias, urban vs rural.
  - National studies needed
  - No risk factor and disease surveillance mechanisms
  - No prospective studies
  - Statistical issues in systematic reviews and meta-analyses.

• **Strengths**
  - At least some data available and careful interpretation can provide useful information.
  - Systematic reviews have identified importance of non-communicable and cardiovascular diseases in India and has propelled action on local and national levels.
  - Future studies can be planned using modern epidemiological techniques including genomics.
  - Large-scale intervention studies can also be planned.
Burden of Cardiovascular Diseases in India

Areas for Future Research

- Cross sectional studies provide only limited information of burden of diseases. Prospective studies are essential to determine incidence (e.g. PURE study).
- Use of validated instruments for cross sectional studies.
- Prospective studies need to be planned in different regions of India to take care of regional and ethnic diversities.
- Identification of genetic differences and functional genomics (genetic epidemiology).
- More funding and supervision needed for such studies.
Part III: Burden of Risk Factors
Major Population-wide Cardiovascular Risk Factors

Figure 1: The causal chain. Major causes of ischaemic heart disease are shown. Arrows indicate some (but not all) of the pathways by which these causes interact.

WHO. Global Health Risks. 2009
Rural-Urban Migration in India and Increasing CHD and Risk Factors

↓ Physical activity
Calorie-dense foods
High-fat diet
Stress

↑ Hypertension
↓ LDL cholesterol
↓ HDL cholesterol
Metabolic syndrome
Diabetes

Adiposity

Obesity

Milieu of Smoking/Tobacco, Inflammatory & Thrombosis Risk Factors

Gupta R & Gupta VP. Curr Science 1998; 74:1074-7
Urban-Rural Differences in Risk Factors

Other Studies
- Gupta (Rohtak, 1975)
- Chaddha (Delhi, 1990)
- Reddy/Shah (ICMR, 1995)
- Gupta (Jaipur, 1997)
- CURES (Chennai, 2005)
- PURE Study India (2010)

Urban vs. Rural Males

Risk Factors for AMI in South Asians
INTERHEART Study. Population Attributable Risks %

- Fruits/Veg: Others 12.2%, South Asians 21.4%
- Alcohol: Others 15.8%, South Asians 19.6%
- Exercise: Others 25.2%, South Asians 27.4%
- Psychosocial: Others 19.6%, South Asians 16.1%
- High WHR: Others 33.3%, South Asians 37.7%
- Diabetes: Others 12.5%, South Asians 11.8%
- Hypertension: Others 19.3%, South Asians 23.9%
- Smoking: Others 36.2%, South Asians 37.5%
- ApoB/ApoA1: Others 45.9%, South Asians 46.8%

Are Risk Factors Increasing in India?

• Societal and Sociological Factors
  • Poverty and Affluence
  • Human Development Index
  • Social determinants of health
• Intermediate Risk Factors
  • Dietary factors
  • Obesity and truncal obesity
• Proximate Risk Factors
  • Smoking
  • Hypertension
  • Dyslipidemias
    • High total/LDL cholesterol
    • Low HDL cholesterol
  • Diabetes and glucose intolerance
Smoking and Tobacco Consumption in India

Pais P, et al. 1998
Increasing Smoking Among Illiterate Men

*Jaipur Heart Watch*

Increasing Hypertension in India
Urban populations: BP $\geq 160/95$

Increasing Hypertension in India
Rural populations: BP ≥160/95

Recent Studies on Hypertension in India
Urban populations: BP ≥ 140/90

Gupta R. J Human Hypertens 2004; 18:73-78
Increasing Total Cholesterol in India

Urban Populations

R² = 0.13

Gupta R. Fortis Med J 2009; 2:
Trends in Dyslipidemias in Jaipur
Jaipur Heart Watch

LDL cholesterol ≥100 mg/dl

Total: HDL cholesterol ≥4.0

Increasing Type 2 Diabetes in India

Trends in Diabetes and IGT in Chennai
Chennai Urban Studies

“Causes of the Causes”
Social Determinants of Diseases
Focus on Non-communicable Diseases

- The social gradient
- Stress
- Early life events
- Social exclusion
- Work
- Unemployment
- Social support
- Addiction including tobacco
- Food
- Transport
- Illiteracy

Marmot & Wilkinson. Social Determinants of Health. 1999
Risk Factors and Cardiovascular Diseases in India
Areas for Future Research

- Setting up population based adult cohorts to track risk factors.
- Identify determinants of risk factors using cross sectional and prospective designs.
- Association of risk factors and CVDs using prospective design. (e.g., PURE study).
- Case-control study designs for rapid assessment of risk factors. Large studies with adequate funding and supervision.
- Risk factor biology and genomics
- Developmental origins of adult diseases and setting-up of birth cohorts (e.g., New Delhi, Pune, Vellore).
Prevention, Management and Control

The Focus: Interventional Research & Action

- Population-based prevention
  - Social engineering
  - Control of various social determinants
  - Shift of the distribution curve to left
  - Example: tobacco control in developed countries

- High-risk individual based
  - Identify and treat approach
  - Example: Hypertension and cholesterol control in US

- High-risk-population based
  - Identify high-risk populations
  - Treat the populations, e.g., polypill
“Mass diseases and mass exposures require mass remedies. Hence, the importance of population-wide strategies in primary prevention.”

Geoffrey Rose, 1992