Cardiovascular Disease in the Developing World

Gene Bukhman, MD, PhD
Division of Social Medicine and Health Inequalities
Brigham and Women’s Hospital

Prepared as part of an education project of the Global Health education Consortium
And collaborating partners
Learning objectives

• Understand the Epidemiology of Cardiovascular Disease in Low and Middle-Income Countries
• Review the History of Cardiovascular Disease Control
• Examine Interventions to Treat Heart Failure in Developing Countries
  – Cardiomyopathies
  – Hypertension
  – Rheumatic Heart Disease
Health Sector ODA Commitments

- Bilateral agencies
- Multilateral agencies
- Bill and Melinda Gates Foundation
- Public-private partnerships

Year:
- 2000
- 2001
- 2002
- 2003
- 2004

Commitments ($ millions):
- 0
- 1,000
- 2,000
- 3,000
- 4,000
- 5,000
- 6,000
Notes on the New Global Health

Since 2000, overseas development assistance commitments have more than doubled. This development has followed the recommendations of the World Health Organization’s Commission on Macroeconomics and Health and the creation of new institutions such as the Global Fund to Fight AIDS, Tuberculosis and Malaria. Although targeted at priority disease, these funds have also helped rebuild health care systems in developing countries. These health care systems now have the opportunity to address the spectrum of conditions that affect patients in these settings. Symptomatic cardiovascular disease - long neglected - accounts for a substantial fraction of the need.

Zero Sum?

“… HIV/AIDS, but also tuberculosis and malaria – … have captured virtually all the attention and money devoted to international health problems.”

Leeder et al. *A Race Against Time.* Columbia University. 2004

Beyond Microbes and Marlboros: Rethinking Cardiovascular Risk

- Traditional Risk Factors: hypertension, tobacco, hyperlipidemia, lack of physical activity, diabetes, streptococcal pharyngitis
- Biosocial risk factors: history and political economy as they influence the distribution of biological agents (organisms and molecules)
Cardiovascular Epidemiology of Developing Countries I

- Cardiovascular Disease: damage to the heart or blood vessels
  - Sudden Cardiac Death
  - Stroke
  - Heart Failure
  - Endocarditis
  - Renal Failure
  - Peripheral Vascular Disease

- Biosocial inequalities determine downstream distribution of disease
Cardiovascular Epidemiology of Developing Countries II

- 1910: diseases of the heart displace tuberculosis as leading cause of death in the United States
- During early 20th century cardiovascular diseases thought rare in sub-Saharan Africa, India – with little evidence
- By World War II increasing awareness of heart failure in Africa, rheumatic fever in India
- First global assessment of cardiovascular disease burden not until early 1990s
- World Health Organization effort in late 1990s to assemble global risk factor prevalence
- Epidemiology of heart failure still unclear in most of the world
1929

BLOOD PRESSURE IN THE AFRICAN NATIVE.
ITS BEARING UPON THE AETIOLOGY OF HYPERPIESIA AND ARTERIO-SCLEROSIS.

BY C. P. DONNISON, M.B., B.S. LOND.,
LATE MEDICAL OFFICER, EAST AFRICAN MEDICAL SERVICE.

Early cardiovascular epidemiology in sub-Saharan Africa

- Donnison 1929
- 1000 Kenyan Men near Lake Victoria
- No increase in blood pressure with age
- Minimal heart disease of any kind
- Attributed to lack of stress of traditional life
I think almost everybody who has been closely associated with the African native will agree that he very rarely can be described as living a high pressure existence. McDowall's has suggested that the physiological rise in blood pressure that occurs as a result of mental stress is to provide for the increased muscular activity that should naturally follow occasions that create mental stress, but that under civilised conditions mental stress often fails to be followed by its physiological safety valve of muscular action. This view certainly receives support from the rarity of high blood pressure in the African native.
Mid-century recognition of cardiovascular burden in developing countries

- Paul Dudley White sends colleagues to Albert Schweitzer’s clinic in Gabon to report on prevalence of cardiovascular disease
- In contrast with Donnison, Miller and Spencer find an extraordinary prevalence of – nonischemic – cardiovascular pathology
- The group’s plea for health equity goes largely unheeded
1959: Paul Dudley White meets Albert Schweitzer

Gunsbach, Alsace, France, 1959. Seated by the roadside in his native town, Dr. Albert Schweitzer discusses plans with Dr. White concerning an investigation of the jungle villages of Gabon, West Africa. It was from these villages that many patients journeyed by canoe to the Schweitzer Hospital. Courtesy of Erica Anderson.
American Journal of Cardiology 1962

Survey of Cardiovascular Disease Among Africans in the Vicinity of the Albert Schweitzer Hospital in 1960*

David C. Miller, m.d.,† Steven S. Spencer, m.d.§ and Paul D. White, m.d.§
Lambaréné, Gabon, West Africa

Fig. 1. Map of Africa, showing the location of Lambaréné in the Republic of Gabon.
Sanborn Electrocardiograph. 1960
The number of people with heart complaints astonishes me more and more.”¹ So wrote Dr. Albert Schweitzer in 1921 after his first sojourn as physician and surgeon in French Equatorial Africa, 1913 to 1917. Therefore, it should not have come to us as a surprise to find an unusually high prevalence of such diseases in our survey of diseases of the heart and blood vessels at his hospital from March to September 1960. To discover, however, that three quarters of the inpatients and outpatients at this famous hospital have definite evidence of one or more cardiovascular diseases was indeed unexpected.
## Prevalence of Cardiovascular Disease in Lambaréné, Gabon 1960

<table>
<thead>
<tr>
<th>Condition</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overt Heart Failure</td>
<td>7%</td>
</tr>
<tr>
<td>Rheumatic Heart Disease</td>
<td>12%</td>
</tr>
<tr>
<td>Hypertension or Hypertensive Heart Disease</td>
<td>7%</td>
</tr>
</tbody>
</table>

Miller et al. 1962
“The high prevalence of mitral stenosis is astonishing… We believe strongly that it is a duty to help bring to these sufferers the benefits of better penicillin prophylaxis and of cardiac surgery when indicated. The same responsibility exists for those with correctable congenital cardiovascular defects…”

Miller, Spencer and White 1962
Health Transition Paradigm

- Developed by Omran in 1970s
- Focus on move from infectious to non communicable causes of death with improvements in nutrition and development of antibiotics
- Correlate of aging
- Paradigm lead to neglect of pre-transition cardiovascular burden among the young
- Neglect of mid-twentieth century progress in prevention and treatment of heart disease

Causes of Death in England and Wales, 1860–1960

Omran. Milbank Quarterly. 1971
Mortality from Tuberculosis and Heart Disease in 25 to 34 year olds (United States 1900 to 1995)

Mortality per 100,000

- National TB Association
- Sanatoria
- Artificial pneumothorax
- Framingham TB
- American Heart Association
- Penicillin
- Streptomycin
- Mercurial diuretics
- Hydralazine and reserpine
- NHLBI
- Propranolol
- Chlorthalidone
- Thrombolysis and ASA
- 2D echo
- CCUs
- RI
- New York City MDR-TB outbreak
- Medicare and Medicaid
- Framingham Heart Study

CDC/NCHS, National Vital Statistics System, Mortality
Impression of global salience of cardiovascular disease invigorated by Global Burden of Disease Study

- Preliminary results in World Bank’s 1993 World Development Report
- Projections for 2020 published by 1996
- Policy focus remained on prevention of vascular disease through tobacco legislation
# Cardiovascular and TB DALYs in WDR ‘93

<table>
<thead>
<tr>
<th></th>
<th>Africa</th>
<th>Developing Countries</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB</td>
<td>4%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>CVD</td>
<td>4%</td>
<td>9%</td>
<td>11%</td>
</tr>
<tr>
<td>Neuro-Psychiatric</td>
<td>3%</td>
<td>6%</td>
<td>7%</td>
</tr>
</tbody>
</table>

*World Development Report 1993*
# Cardiovascular DALYs by region in WDR ’93

<table>
<thead>
<tr>
<th></th>
<th>Africa</th>
<th>Developing Countries</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronary</td>
<td>0.4%</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>Stroke</td>
<td>2%</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>Rheumatic</td>
<td>0.4%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Carditis</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
</tr>
</tbody>
</table>

*World Development Report 1993*
Science 1996

Evidence-Based Health Policy—Lessons from the Global Burden of Disease Study

Christopher J. L. Murray and Alan D. Lopez

% DALYs Worldwide 1990 and 2020

Projected % DALYs in Developing Countries 2020

- HIV: 3%
- Tuberculosis: 3%
- Major Depression: 6%
- Coronary Disease and Stroke: 10%

“The demands on governments worldwide for inappropriate curative services may be due, in part, to a lack of information about what is cost-effective. The emphasis on treatment over prevention results in health care systems being oriented to expensive technologies for diagnosis and treatment of heart disease, rather than to community and medical education programs to reduce the risk of CVD. Transferring the Western paradigm of health care will place unrealistic burdens on health care systems with extremely limited resources.”

**Institute of Medicine 1998**

Interventions to Treat Heart Failure in Developing countries

- Cardiomyopathy
- Hypertension
- Rheumatic Heart Disease
Heart Failure Prevalence in Hospitals

- 3% of discharges in the United States
- 3% in Kenyan referral hospital
- 7% in Northern Nigeria

*National Hospital Discharge Survey 2004*
Mendez and Cowie. *Int J Cardiol.* 2001

Symptomatic heart failure is as common or more common in African hospitals as in the United States. [www.cdc.gov](http://www.cdc.gov)
Mean Age of Heart Failure Patients

• Ghana: 42 years old
• Minnesota: 77 years old


Heart failure patients are much younger in Africa. In the United States more than half of heart failure patients are actually older than 80.

Causes of Heart Failure in Minnesota

- 65% heart failure on the basis of coronary disease
- 29% heart failure on the basis of hypertension
- 4% idiopathic dilated cardiomyopathy
- 2% severe valvular disease
Causes of Heart Failure referred for echocardiography in Accra, Ghana

- Hypertensive heart disease: 21%
- Rheumatic heart disease: 21%
- Dilated cardiomyopathy: 12%
- Endomyocardial Fibrosis: 4%
- Hypertrophic cardiomyopathy: 2%
- Congenital heart disease: 10%
- Heart failure on the basis of coronary disease: 10%
- Pericardial disorders: 8%
- Infective endocarditis: 5%
- Primary pulmonary hypertension: 2%
- Other: 5%

Amoah and Kallen. Cardiology. 2000
Cardiovascular Burden in sub-Saharan Africa Likely Comparable to Other Priority Conditions

% of total disease burden in sub-Saharan Africa in 2001

<table>
<thead>
<tr>
<th>Condition</th>
<th>% of Total Disease Burden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Ischemic CVD</td>
<td>3.8%</td>
</tr>
<tr>
<td>Total CVD</td>
<td>5.1%</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>2.3%</td>
</tr>
<tr>
<td>Maternal Health</td>
<td>2.6%</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

Most of CVD Burden in sub-Saharan Africa Among young and young adults in 2001

% of CVD burden by Age group

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 29</td>
<td>24%</td>
</tr>
<tr>
<td>0 – 44</td>
<td>38%</td>
</tr>
<tr>
<td>0 – 59</td>
<td>61%</td>
</tr>
</tbody>
</table>
2001 Burden of CVD in sub-Saharan Africa by Age Group

**% of CVD burden by cause in those under 60 in sub-Saharan Africa**

<table>
<thead>
<tr>
<th>Cause</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>RHD + Congenital Heart Disease + HTN of Pregnancy + Inflammatory Heart Disease</td>
<td>43%</td>
</tr>
<tr>
<td>Total Non-Ischemic CVD</td>
<td>80%</td>
</tr>
<tr>
<td>Ischemic CVD</td>
<td>20%</td>
</tr>
</tbody>
</table>

Case 1

- 39 year old woman, Gravida 4, Para 4
- Developed exertional dyspnea, orthopnea 1 year ago immediately after last delivery
- Previously diagnosed and treated for heart failure
- Now readmitted with Class III symptoms off medication
- Treated with lasix, digoxin, captopril
Echocardiography:
Dilated Left Ventricle
EF 20 to 25%
Cardiomyopathies

- Peripartum Cardiomyopathy
  - Rare in United States
  - As common as 1 in 300 live births in rural Haiti
  - 50% have complete recovery of ventricular function in 6 months in United States

- Dilated Cardiomyopathy
  - HIV
  - Following myocarditis
  - Chagas in Latin America
  - Untreated hypertensive heart disease

- Endomyocardial Fibrosis
  - Common in pockets of tropical sub-Saharan Africa, South America, Asia
  - Echocardiographic Diagnosis
  - Heart failure therapies likely less effective
  - Surgery palliative with high peri-operative mortality
Impact of Multi-drug Therapy for Class III Heart Failure with EF < 40%

Annual Mortality with Sequential addition of therapies

Notes on Impact of Multi-drug Therapy

For patients with systolic heart failure the introduction of loop diuretics - available in the United States since the 1960s - probably reduce mortality by 70%. Addition of sequential therapies including ACE inhibitors, heart failure beta-blockers and possibly spironolactone or hydralazine-isosorbide dinitrate further decrease the annual risk of death. Although mortality increase for these patients with time, multi-drug regimens probably add 5 to 10 years of additional life at a cost of less than 50 cents per day.


Faris et al. Cochrane Collaboration. 2006
McMurray and Pfeffer. Lancet. 2005
Treating Dilated Cardiomyopathy

- Diagnostic confidence
- Multidrug regimens
- Community Health Workers
Case 2

- 55 year old man with known hypertension
- In clinic with class II to III heart failure symptoms
- Former smoker
- BP 210/100 on Atenolol 50 and ASA 100
Echocardiography: Thick Left Ventricular Wall
Hypertensive Heart Disease

- Malignant hypertension nearly eradicated in the community in the United States since the 1960s
- Common in countries without delivery systems for anti-hypertensive medications
Men 45 to 74 in Framingham Cohort 1950 to 1989

Stage 4 Hypertension Almost Eradicated

- percent on hypertension therapy
- SBP > 210 or DBP > 120
- SBP 180 - 209 or DBP 110 - 119

Mosterd et al. 1999
Notes on Men 45 to 74…

Despite sub-optimal adherence to anti-hypertension regimens in the United States, the most severe forms of hypertension have virtually disappeared with the introduction of thiazide diuretics and subsequently beta blockers and calcium channel blockers.

Case 3

- 12 year old boy with failure to thrive following an episode of polyarthralgias and fever 2 years ago
- Now admitted with Class II to III symptoms
- 2 weeks prior to presentation had chest pain and with progression of dyspnea
- Loud holosystolic murmur throughout the precordium
- Parents are farmers, 5 siblings
- Started on lasix, captopril, and PCN
Echocardiography: Flail Anterior Mitral Valve Leaflet
Cardiovascular Surgery for Rheumatic Valvular Disease

- Highly effective intervention
- Limited surgical capacity in sub-Saharan Africa
- Governments, international institutions must subsidize
Summary

• Cardiovascular disease among poorest billion still predominantly heart failure from myocarditis, hypertension, and rheumatic valve disease

• Effective interventions can prevent death and improve the quality of life for these patients but will require health system initiatives
General References

Papers

Books
Credits

Gene Bukhman, MD, PhD
Division of Social Medicine and Health Inequalities
Brigham and Women’s Hospital
Department of Social Medicine
Harvard Medical School
Boston, MA 2007
Acknowledgements

The Global Health Education Consortium gratefully acknowledges the support provided for developing these teaching modules from:

*Margaret Kendrick Blodgett Foundation*
*The Josiah Macy, Jr. Foundation*
*Arnold P. Gold Foundation*

This work is licensed under a [Creative Commons Attribution-Noncommercial-No Derivative Works 3.0 United States License](https://creativecommons.org/licenses/by-nc-nd/3.0/us/).