Overview of global trends in cardiovascular diseases

Presentation to the IOM Committee on Preventing the Global Epidemic of Cardiovascular Disease: Meeting the Challenges in Developing Countries

Derek Yach
MBChB, MPH
April 13th, 2009
Long-term prediction of mortality from leading chronic diseases (number of deaths)
Chronic diseases dominate in most countries today. Policy makers need support to act on this reality!
1. Recent and projected trends in cardiovascular disease (CVD)

2. Major risks for CVD.

3. Relationships between undernutrition and infectious diseases and CVD.

4. The need to take a life course perspective to CVD
CVD is leading cause of death worldwide

Estimated global deaths by cause, all ages, 2005

Cardiovascular mortality rates in women (Age Standardized Death Rates, 45+)

Source: GBD 2004
Global Variation in stroke burden and mortality: estimates from monitoring, surveillance, and modelling.

S Claiborne Johnston, Shanthi Mendis, Colin D. Mathers
Declining cardiovascular mortality rates in women (ASDR, 45+)

Source: WHO mortality database

Obtained for use from Magid Ezzati, Harvard
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Cardiovascular (CVD) epidemic in countries of different stages of development

<table>
<thead>
<tr>
<th>Year</th>
<th>High Income Economies</th>
<th>Economies in Transition</th>
<th>Middle and Low Income Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1940</td>
<td>Rapid increase</td>
<td>Slow increase</td>
<td>Low rates</td>
</tr>
<tr>
<td>1950</td>
<td>Reach the peak</td>
<td>Rapid increase</td>
<td>Slow increase</td>
</tr>
<tr>
<td>1960</td>
<td>Progressive decline</td>
<td>Reach the peak in some countries</td>
<td>Rapid increase in most countries</td>
</tr>
<tr>
<td>1970</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Remains as first cause of death & disability
- First cause of death & disability

Source: WHO, NMH/MNC

Obtained for use from Magid Ezzati, Harvard
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Projected deaths by cause and income, 2004 to 2030

Deaths (millions)

Metabolic risks in relation to national income
A higher % of CVD deaths occur between 35 and 64 years of age in countries with developing economies.

Source: WHF based on "A Race Against Time", The Earth Institute, Colombia University, Stephen Leeder, 2004

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Outline

1. Recent and projected trends in cardiovascular disease (CVD)

2. Major risks for CVD.

3. Relationships between undernutrition and infectious diseases and CVD.

4. The need to take a life course perspective to CVD
The Comparative Risk Assessment (CRA) study

Quantified the role of selected risk factors in global and regional burden of disease using comparable methods

Coordinated at WHO and Harvard 1999-2004
Deaths in 2000 attributable to selected leading risk factors

- Blood pressure
- Tobacco
- Cholesterol
- Underweight
- Unsafe sex
- Fruit and vegetable intake
- High Body Mass Index
- Physical inactivity
- Alcohol
- Unsafe water, sanitation, and hygiene
- Indoor smoke from solid fuels
- Iron deficiency
- Urban air pollution
- Zinc deficiency
- Vitamin A deficiency
- Unsafe health care injections

** = Nutrition Related

Source: WHR 2002

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## World Vegetable Oil Production
(Million Metric Tons)

<table>
<thead>
<tr>
<th></th>
<th>80/81</th>
<th>08/09</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm</td>
<td>4.9</td>
<td>43.2</td>
<td>+782%</td>
</tr>
<tr>
<td>Soybean</td>
<td>9.8</td>
<td>37.8</td>
<td>+286%</td>
</tr>
<tr>
<td>Rape</td>
<td>3.9</td>
<td>19.4</td>
<td>+398%</td>
</tr>
<tr>
<td>Sun Seed</td>
<td>4.6</td>
<td>11.7</td>
<td>+154%</td>
</tr>
<tr>
<td>Groundnut</td>
<td>2.3</td>
<td>4.9</td>
<td>+113%</td>
</tr>
<tr>
<td>Cotton</td>
<td>2.9</td>
<td>5.0</td>
<td>+72%</td>
</tr>
<tr>
<td>Palm Kernel</td>
<td>0.5</td>
<td>5.1</td>
<td>+920%</td>
</tr>
<tr>
<td>Olive</td>
<td>1.9</td>
<td>3.0</td>
<td>+58%</td>
</tr>
<tr>
<td>Coconut</td>
<td>2.8</td>
<td>3.6</td>
<td>+29%</td>
</tr>
<tr>
<td>Total</td>
<td>33.6</td>
<td>133.7</td>
<td>+298%</td>
</tr>
</tbody>
</table>

**World production quadruples in 28 years!**

**Source:** USDA FAS – Nov 2008

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Risk factors are being concentrated by urbanization…

Estimated projected urban and rural populations in the world, 1950-2030

- Tobacco use
- Obesity
- Physical activity

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Health System Reform in China 3

Emergence of chronic non-communicable diseases in China

Gonghuan Yang, Lingzi Kong, Wenhua Zhao, Xia Wan, Yi Zhai, Lincoln C Chen, Jeffrey P Koplan

China has experienced an epidemiological transition shifting from the infectious to the chronic diseases in much shorter time than many other countries. The pace and spread of behavioural changes, including changing diets, decreased physical activity, high rates of male smoking, and other high risk behaviours, has accelerated to an unprecedented degree. As a result, the burden of chronic diseases, preventable morbidity and mortality, and associated health-care costs could now increase substantially. China already has 177 million adults with hypertension; furthermore, 303 million adults smoke, which is a third of the world’s total number of smokers, and 530 million people in China are passively exposed to second-hand smoke. The prevalence of overweight people and obesity is increasing in Chinese adults and children, because of dietary changes and reduced physical activity. Emergence of chronic diseases presents special challenges for China’s ongoing reform of health care, given the large numbers who require curative treatment and the narrow window of opportunity for timely prevention of disease.

<table>
<thead>
<tr>
<th></th>
<th>Age-standardised prevalence rate</th>
<th>Average increase, compared with most recent survey</th>
<th>Estimated population at risk*</th>
</tr>
</thead>
<tbody>
<tr>
<td>People with hypertension†</td>
<td>17.7%</td>
<td>2.67%†</td>
<td>177 000 000</td>
</tr>
<tr>
<td>Overweight people</td>
<td>17.6%</td>
<td>3.23%§</td>
<td>218 000 000</td>
</tr>
<tr>
<td>Obese people</td>
<td>5.6%</td>
<td>5.43%§</td>
<td>68 000 000</td>
</tr>
<tr>
<td>Current smokers†</td>
<td>28.2%</td>
<td>-2.91%</td>
<td>303 000 000</td>
</tr>
<tr>
<td>Male current smokers†</td>
<td>53.2%</td>
<td>-3.01%§</td>
<td>290 000 000</td>
</tr>
<tr>
<td>Female current smokers†</td>
<td>2.2%</td>
<td>-8.26%§</td>
<td>13 000 000</td>
</tr>
<tr>
<td>Passive smokers†</td>
<td>52.2%</td>
<td>-0.49%§</td>
<td>530 000 000</td>
</tr>
</tbody>
</table>

Data for hypertension, overweight, and obesity are from reference 20; data for smoking are from references 27 and 29. *Estimated population at risk extrapolates prevalence to entire population in these subgroups. †Data for people older than 15 years. §Compared with 1991 national survey on hypertension. ¶Compared with 1992 national survey on nutrition and health. ‡Compared with results of 1996 national survey.
Chinese Soybean Oil Consumption
(Million Metric Tons)

48-fold expansion over 25 years...

Source: USDA – Nov 2008

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Risk factors: tobacco use on the rise in developing countries

Cumulative tobacco-related deaths, 2005–2030


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Cardiovascular deaths attributable to smoking

Adult (age, ≥ 30 years) cardiovascular mortality resulting from smoking in GBD Epidemiological sub regions by disease in 2000. Pattern for hypertensive disease is different because it was excluded from main estimates (see Tables 1 and 5). See Table 2 for description of regions.

Obtained for use from Majid Ezzati, Harvard

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Obesity is a global reality

OECD Countries (March 2009)*

China
“The obesity epidemic may be both exaggerated and underestimated (9,10). The burden of spoiled years by obesity is now more important than the burden of lost years. Overweight and mild obesity ceased to be fatal, but a paradoxical consequence of lowered mortality is increased morbidity and care dependence. This holds particularly true among women for whom increased disability goes hand in hand with increased survival, both sharply increasing the number of years lived with disability. Care needs increase even more, as heavy people with disabilities are more difficult to handle.”
Worldwide Variability in Physical Inactivity
A 51 Country Survey

Regina Guthold, MPH, Tomoko Osio, MPH, Kathleen L. Strong, PhD, Somnath Chatterji, MD, Alfredo Momoh, MD, PhD


Background: Physical inactivity is an important risk factor for chronic diseases, but for many (mainly developing) countries, no prevalence data have ever been published.

Objective: To present data on the prevalence of physical inactivity for 51 countries and for different age groups and settings across these countries.

Methods: Data analysis (conducted in 2007) included data from 212,021 adult participants whose questionnaires were collected from 259,526 adult observations from 51 countries participating in the World Health Survey (2002-2003). The validated International Physical Activity Questionnaire (IPAQ) was used to assess days and duration of vigorous, moderate, and walking activities during the last 7 days.

Results: Country prevalence of physical inactivity ranged from 1.6% (Comoros) to 51.7% (Mauritania) for men and from 3.8% (Comoros) to 71.2% (Mauritania) for women. Physical inactivity was generally high for older age groups and lower in rural as compared to urban areas.

Conclusions: Overall, about 15% of men and 29% of women from the 51 countries analyzed here (most of which are developing countries) are at risk for chronic diseases due to physical inactivity. There were substantial variations across countries and settings. The baseline information on the magnitude of the problem of physical inactivity provided by this study can help countries and health policymakers to set up interventions addressing the global chronic disease epidemic. (Am J Prev Med 2008;34(4):495–497) © 2008 American Journal of Preventive Medicine

Figure 2. Prevalence of physical inactivity for women in 51 countries, grouped by WHO region, World Health Survey, 2002–2003. Age-adjusted to WHO standard population.
Deaths attributable to high blood glucose, by region and cause

Obtained for use from Majid Ezzati, Harvard
Distribution of CVD burden attributable to high blood pressure by exposure and region

Obtained for use from Majid Ezzati, Harvard

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REVIEW

A comprehensive review on salt and health and current experience of worldwide salt reduction programmes

FJ He and GA MacGregor
Blood Pressure Unit, Cardiac and Vascular Sciences, St George’s, University of London, London, UK

Cardiovascular disease (CVD) is the leading cause of death and disability worldwide. Raised blood pressure (BP), cholesterol and smoking, are the major risk factors. Among these, raised BP is the most important cause, accounting for 62% of strokes and 49% of coronary heart disease. Importantly, the risk is throughout the range of BP, starting at systolic 115 mmHg. There is strong evidence that our current consumption of salt is the major factor increasing BP and thereby CVD. Furthermore, a high salt diet may have direct harmful effects independent of its effect on BP, for example, increasing the risk of stroke, left ventricular hypertrophy and renal disease. Increasing evidence also suggests that salt intake is related to obesity through soft drink consumption, associated with renal stones and osteoporosis and is probably a major cause of stomach cancer. In most developed countries, a reduction in salt intake can be achieved by a gradual and sustained reduction in the amount of salt added to food by the food industry. In other countries where most of the salt consumed comes from salt added during cooking or from sauces, a public health campaign is needed to encourage consumers to use less salt. Several countries have already reduced salt intake, for example, Japan (1960–1970), Finland (1975 onwards) and now the United Kingdom. The challenge is to spread this out to all other countries. A modest reduction in population salt intake worldwide will result in a major improvement in public health.

Journal of Human Hypertension advance online publication, 25 December 2008; doi:10.1038/jhh.2008.144

Keywords: salt; health; salt reduction programmes
Cardiovascular prevention guidelines in daily practice: a comparison of EUROASPIRE I, II, and III surveys in eight European countries

Kornelia Katsarva, David Wood, Guy De Bacquer, Dirk De Bacquer, Kalavryta, Philipp Koll, for the EUROASPIRE Study Group

The Lancet – Vol 373 March 14, 2009

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>EUROASPIRE III VS EUROASPIRE I</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Difference (95% CI)</td>
<td>p value</td>
<td></td>
</tr>
<tr>
<td>Smoking</td>
<td>-1.2% (-5.0 to 2.5)</td>
<td>0.48</td>
<td></td>
</tr>
<tr>
<td>Overweight and obesity</td>
<td>5.1% (1.1 to 9.1)</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td><strong>Obesity</strong></td>
<td><strong>13.1% (7.6 to 18.6)</strong></td>
<td><strong>0.0002</strong></td>
<td></td>
</tr>
<tr>
<td>Raised blood pressure</td>
<td>3.4% (-3.2 to 9.9)</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>Raised cholesterol concentration</td>
<td>-51.2% (-57.6 to -44.8)</td>
<td>≤0.0001</td>
<td></td>
</tr>
<tr>
<td>Reported diabetes mellitus</td>
<td>9.3% (4.4 to 14.2)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td><strong>Therapeutic control of blood pressure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients</td>
<td>-3.4% (-9.9 to 3.2)</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td><strong>Therapeutic control of cholesterol</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All patients</td>
<td>-51.2% (44.8 to 57.6)</td>
<td>≤0.0001</td>
<td></td>
</tr>
<tr>
<td><strong>Cardioprotective drugs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACE inhibitors and ARBs</td>
<td>42.8% (38.1 to 47.6)</td>
<td>≤0.0001</td>
<td></td>
</tr>
<tr>
<td>Statins</td>
<td><strong>67.8% (60.2 to 75.5)</strong></td>
<td><strong>≤0.0001</strong></td>
<td></td>
</tr>
</tbody>
</table>

Comparison of the three EUROASPIRE studies of cardiovascular prevention in 8 European countries, 1995-6 and 2006-7.
1. Recent and projected trends in cardiovascular disease (CVD)

2. Major risks for CVD.

3. Relationships between undernutrition and infectious diseases and CVD.

4. A life course perspective to CVD
"In the last 25 years, cardiology has made major advances in Africa but we now face a major challenge. The vascular consequences of poor living conditions such as rheumatic heart disease, which kills many thousands, will be joined by the strokes and heart attacks resulting from diabetes and obesity which are increasingly occurring in our populations. We must react now to prevent cardiovascular disease becoming the African epidemic of the mid-21st century."
Rheumatic Heart Disease remains common in many countries
CVD co-exists in many regions with high levels of hunger and under nutrition.

<table>
<thead>
<tr>
<th>Region</th>
<th>% under 5’s underweight</th>
<th>Life expectancy at birth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Saharan Africa</td>
<td>24</td>
<td>50</td>
</tr>
<tr>
<td>Middle East/North Africa</td>
<td>11</td>
<td>69</td>
</tr>
<tr>
<td>South Asia</td>
<td>41</td>
<td>64</td>
</tr>
<tr>
<td>East Asia/Pacific</td>
<td>11</td>
<td>72</td>
</tr>
<tr>
<td>World</td>
<td>23</td>
<td>68</td>
</tr>
</tbody>
</table>

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Relative Risk, prevalence and population attributable risk of selected risk factors for TB, in 22 high TB burden countries*

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Relative risk for Active TB disease</th>
<th>Weighted Prevalence, total Population, 22 TB High Burden Countries</th>
<th>Population Attributable Fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV Infection</td>
<td>8.3</td>
<td>1.1%</td>
<td>7.3%</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>4.0</td>
<td>17.2%</td>
<td>34.1%</td>
</tr>
<tr>
<td>Diabetes</td>
<td>3.0</td>
<td>3.4%</td>
<td>6.3%</td>
</tr>
<tr>
<td>Alcohol dependence</td>
<td>2.9</td>
<td>3.2%</td>
<td>5.7%</td>
</tr>
<tr>
<td>Active smoking</td>
<td>2.6</td>
<td>18.2%</td>
<td>22.7%</td>
</tr>
<tr>
<td>Indoor pollution</td>
<td>1.5</td>
<td>71.1%</td>
<td>26.2%</td>
</tr>
</tbody>
</table>

* Stop TB/WHO, April 2008
Diabetes Mellitus was associated with an increased risk of TB (relative risk = 3.11, 95% CI 2.27-4.26).
1. Recent and projected trends in cardiovascular disease (CVD)

2. Major risks for CVD.

3. Relationships between undernutrition and infectious diseases and CVD.

4. A life course perspective to CVD
A life course approach

CVD

Development of CVD diseases

Fetal life | Infancy and childhood | Adolescence | Adult life

1 | 2 | 3 | 4

Accumulated Chronic Disease and socio-economic risks

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**REVIEW**

Developmental and epigenetic pathways to obesity: an evolutionary-developmental perspective

PD Gluckman and MA Hanson

Although variation in individual lifestyle and genotype are important factors in explaining individual variation in the risk of developing obesity in an obesogenic environment, there is growing evidence that developmentally plastic processes also contribute. These effects are mediated at least in part through epigenetic processes. These developmental pathways do not directly cause obesity but rather alter the risk of an individual developing obesity later in life. At least two classes of developmental pathway are involved. The mismatch pathway involves the evolved adaptive response of the developing organism to anticipated future adverse environments, which have maladaptive consequences if the environment is mismatched to that predicted. This pathway can be used by prenatal undernutrition or stressors that lead the organism to forecast an adverse future environment and change its developmental trajectory accordingly. As a result, individuals develop with central and peripheral changes that increase their sensitivity to an obesogenic environment. It provides a model for how obesity emerges in populations in rapid transition, but also operates in developed countries. There is growing experimental evidence that this pathway can be manipulated by, for example, postnatal leptin exposure. Secondly, maternal diabetes, maternal obesity and infant overfeeding are associated with a greater risk of later obesity. Early life offers a potential point for preventative intervention.


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**Towards optimal nutrition**

- Risk
- Stunted
- Birth Weight
- Obese
Combined effects of overweight and smoking in late adolescence on subsequent mortality: nationwide cohort study

Martin Neovius, Johan Sundström and Finn Rasmussen

BMJ 2009; 338:b496
doi:10.1136/bmj.b496

Fig 3: Relative risks of death with separate contributions from the exposure categories BMI status, smoking status, and their interaction, with point estimates and 95% confidence intervals for relative excess risk due to interaction (RERI) between BMI and smoking status. Models adjusted for muscle strength, socioeconomic status, and age.
Aging and cumulative risks over age are increasing the impact of chronic diseases globally.

CVD (mainly ischemic heart disease and stroke) is today, and will remain for decades, the major overall cause of death in the world.

The interaction between childhood stunting, maternal nutritional and smoking status and CVD in developing countries, requires lifelong and multisectoral policies.

Trends in the major risks will continue to influence incidence for many decades even if childhood prevention is rapidly implemented.

Death rates in middle age and beyond could be reduced within a decade through concerted and combined primary and secondary prevention.

D. Yach – 4/13/09
Acknowledgements

Special thanks to:

Colin Mathers (WHO)
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Helen Alderson (WHF)
Francis Davidson (USAID)
Krisela Steyn (UCT)

for providing ideas, documents and their slides and to Ann LaBombardi who helped assemble and prepare these slides.

D. Yach – 4/13/09
Thank You

Derek Yach
MBChB MPH
April 13th 2009
Supplementary slides
Assumptions – underlying projections

1) Projections take into account: years of schooling, smoking; World Bank projected death rates.

2) Do not include intergenerational effects; increased obesity/diabetes; better treatments.