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Indirect Estimates of Avoidable Mortality in Low Income and Middle Income Countries

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Indirect Estimates of Avoidable Mortality in Low Income and Middle Income Countries

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Abstract

Objective: To provide estimates of age-, sex- and cause-specific avoidable mortality among young and middle age in low and middle-income countries in 1998 by using mortality in a hypothetical non-smoking high-income population as the reference.

Design: Mortality data compiled by the Global Burden Disease Project and other information were used to estimate sex, age and cause-specific risks of dying in1998 for different low and middle-income regions as well as for the reference population. The excess risks of dying in the low and middle-income regions against the reference population were then calculated. Finally, the contributions of different causes to the excess risk of dying in each age and sex group were determined.

Results: Avoidable mortality is large in low and middle-income countries. For each age group, a few conditions are responsible for most (70-75%) of the excess risk of dying in those countries. In the 0-4 age group, these conditions include lower respiratory infections, diarrhea, perinatal conditions, childhood vaccine-preventable diseases, and malaria. In the 5-29 age group, these include HIV/AIDS, injuries, cardiovascular diseases, tuberculosis, lower respiratory infections in both sexes and maternal conditions in females. In the 30-69 age group, these include cardiovascular diseases, tuberculosis, HIV/AIDS, COPD in both sexes, maternal conditions in females, and lung cancers in males .

Conclusions: Information on avoidable mortality could help policy-makers better identify priorities in their disease control agenda.

Indirect Estimates of Avoidable Mortality in Low and Middle-Income Countries

I. INTRODUCTION

This papers aims to provide estimates of age-, sex- and cause-specific avoidable mortality among young and middle age in low and middle-income countries in 1998. Generally speaking, mortality rates in high-income countries are lower than in low and middle-income countries. Therefore, mortality in high-income countries is used in this paper as the standard reference, with an adjustment to remove smoking-attributable deaths in high-income countries. By calculating age-, sex- and cause-specific avoidable mortality in low and middle-income countries, the paper aims to answer two questions:

- Which causes contribute to most of the mortality differences between high-income countries and low and middle-income countries?
- How much does each cause contribute to such differences?

This paper first discusses the conceptual basis of avoidable mortality. It then outlines specific steps in the methodology used. Key results of the analyses are presented, after which a brief discussion follows.

II. DEFINITION OF AVOIDABLE MORTALITY

In recent years, new indicators for the health status of a population have been developed. Summary measures such as disability-adjusted life years (DALY) and disability-adjusted life expectancies (DALE), which take into account both mortality and morbidity, have been formulated and their values estimated for different regions of the world by the Global Burden of Disease Project (Murray and Lopez 1996). However, such developments in the assessment of the health status of a population have not diminished the usefulness of mortality as an indicator for several reasons. First, although mortality does not capture all illnesses, specifically neuropsychiatric and musculoskeletal diseases,

(and the former is quite important globally), it has quite a strong correlation with morbidity for most major diseases. Second, it is important to note that measurement error in disability estimates is much greater than that in mortality, and often can exceed the desired change in health outcomes. For example, a health policy planner may set a goal for a 10% improvement in a health outcome, but if measurement error exceeds 10% in the health outcome measure, he or she will not know if the intervention worked. Death is a distinct, objectively recognized event and being the most severe negative aspect of health makes it easy to record. Thus, the use of mortality indicators should reduce measurement error in health policy-making. Third, mortality accounts for a higher proportion of total DALYs than does disability at high levels of mortality, such as those faced by many low-income countries. Finally, eighty percent of the estimated 56 million annual deaths worldwide occur in the world's poorer regions, this reinforces the importance of mortality statistics as a fundamental measure of health status in developing countries (Sen and Bonita 2000). For these reasons, mortality, despite being a crude measure, is still more available and reliable than the newer measures, especially in low and middle-income countries.

However, total mortality figures, while useful to overall policy discussion, do not tell us about what marginal changes could result from major intervention programs beyond declines in age-specific death rates. The concept of *avoidable mortality* adds four dimensions to total mortality involving interventions, comparison populations, avoidance of premature deaths, and exclusion of epidemics. We discuss each in turn.

First, the notion of avoidable mortality depends on the availability of effective interventions against specific diseases in a population.

Second, the existence of a gap in the age-and-sex standardized mortality rates between two comparable populations indicates a potential or approximate benchmark for improvement. The high-mortality population could, potentially, reduce its death rates to the levels attained by the low-mortality population. This is the basic concept behind the measurement of avoidable mortality in a population, pioneered by William Farr more than 100 years ago in England (Farr 1885). Avoidable mortality (or the excess risk of

dying) is thus a measure of how much the health of a population can be improved, using the lower mortality level of another population as a feasible goal. In other words, avoidable mortality is defined in relation to a standard mortality pattern. (The two terms "*avoidable mortality"* and "*excess risk of dying"* will be used interchangeably throughout the paper.)

Third, within a population, the extent of avoidable mortality differs by age. Most deaths in old age (defined in this paper as 70 or older) are unavoidable, while most deaths in childhood (age 0-4) and youth (age 5-29) are not. A substantial fraction of deaths in middle age (age 30-69) are also avoidable. Historic experience in Europe and North America suggests that only two hundred years ago, of the newborns who survived the hazards of young age, only about 1 in 6 reached old age. However, by the late 20th century, about 5 in 6 of newborns would reach old age on the condition that they do not take up smoking later in life (Peto *et al.* 1994; Casselli 1991).

Fourth, in high-income countries, death rates before old age have been falling dramatically over the last 50 years, during which these countries have been spared major periodic causes of death such as wars or genocide, famine, or other man-made disasters. If for example, these countries were today swept by an influenza epidemic equal in magnitude to that of 1918-19, it would be inappropriate to use death rates during that time as a comparison group. The most prominent epidemic is smoking-attributable mortality. Smoking has accounted for about 60 million deaths in developed countries from 1950 to 2000 (Peto *et al*. 1994). Absent smoking, death rates from various causes, including cancers have fallen nearly everywhere in developed countries, including in the former socialist economies.

For the above reasons, we use mortality in three reference populations against which avoidable mortality in low and middle-income countries would calculated. The first reference group is high-income countries. . The second reference group is a hypothetical non-smoking high-income population which has the same mortality profile as the first group, except in middle age where mortality rates of non-smokers in high-income countries are used. There is value in using a wide range of high-income countries than a

single country with low mortality (for example, Japan) because we would benefit from a larger sample size. A hypothetical low and middle-income population with a mortality pattern constructed from the current lowest age and sex-specific death rates in all developing regions is the third reference group.

III. DATA AND METHODOLOGY

Data

Data used in this paper include:

- 1990 and 1998 data on mortality by age, sex and cause for different regions of the world compiled by the Global Burden of Disease (GBD) Project of the World Health Organization (WHO).
- 1998 data on age structure by country compiled by the United Nations (UN).
- 1995 and 2000 US non-smokers' mortality rates in major smoking-attributable disease categories (Peto , personal communication).

Methodology

We estimated age, sex and cause-specific avoidable mortality in low and middle-income countries through three sets of two-way comparisons. The reference mortality for such comparisons is that in:

- a hypothetical non-smoking high-income population which has the same mortality profile as in high-income countries, except in middle age where mortality rates of non-smokers in high income countries were used ("first best" scenario or "ideal")
- high-income countries ("second best" scenario)
- a hypothetical low and middle income population with a mortality profile constructed from the current lowest age and sex-specific death rates in all developing regions ("third best" scenario)

The following steps were taken:

- *Simplify the number of disease categories to 22 according to ICD10 classification:*

This step aims to reduce the number of disease categories from 107 specific causes of death to 22 key groups, within the framework of ICD10 classification (Table 1). The new disease grouping was applied to all regions. We maintained the first level of the GBD categorization, which includes three broad causes:

- Group 1 causes: communicable diseases, maternal, perinatal and nutritional disorders;
- Group 2 causes: non-communicable diseases; and
- Group 3 causes: injuries.

- *Adjust the age-group of 1998 GBD data, using the age distribution of 1990 GBD data*

GBD data for 1998 are reported by five age groups: 0-4, 5-15, 15-44, 45-59, and 60+. However, we decided to use under five (0-4), young (5-29) and middle age (30-69) age groups so as to more clearly separate the wide age range of 15-44 and 60+. The 1998 GBD age grouping is therefore not ideal for our analyses. We rectified this by applying the age distribution of the 1990 GBD data (which are 0-4, 5-14, 15-29, 30-44, 45-59, 60-69, and 70+, and therefore can be reduced to our desired age grouping) to the 1998 GBD data. The underlying assumption is that the age structure for sex and cause-specific deaths did not change significantly between 1990 and 1998. The regions by which the GBD project reports mortality data, however, did change during this period. Therefore, before adjusting the age grouping, we aligned the 1990 regions to the 1998 regions (Table 2). There are some discrepancies, but these should be small.

- *Construct age, sex and cause specific mortality rates for a hypothetical non-smoking high-income population*

Mortality profile of this "*ideal*" population is that of high-income countries after the removal of the effect of smoking on mortality in middle age. First, we replaced high-income countries' 1998 death rates for six disease categories in the middle age group with the corresponding 1998 US non-smokers death rates in the 30-69 age group. The six disease categories, which bear most of the impact of smoking on mortality, are listed below:

- Lung cancer;
- Upper aerodigestive cancers (mouth, oropharynx, esophagus);

- Other cancers (stomach, colon/rectum, liver, pancreas, melanoma and other skin, breast, cervix, corpus uteri, ovary, prostate, bladder, lymphoma, leukemia, and other cancers);
- Cardiovascular diseases;
- Chronic Obstructive Pulmonary Diseases (COPD); and
- Other respiratory diseases (asthma).

The 1998 US non-smoking death rates in middle age for those six categories were thus used as the standard and they were estimated from those in 1995 and 2000, based on data from a prospective study of 1 million middle-age Americans, and derivation of a "smoking impact ratio" (Peto *et al*. 1994, Peto personal communication). We then re-calculated the sex-specific overall death rates of the middle age group. As smoking attributable mortality is low outside middle age (Peto *et al*. 1994), we used actual GBD sex-specific death rates of other age groups in high-income countries for this ideal population.

- *Construct age, sex and cause specific mortality rates for a hypothetical low and middle-income population*

We used the lowest available death rates by age and cause among all low and middle income GBD regions in 1998 to construct the mortality profile of this hypothetical population.

- *Calculate death rates and probability of dying by age, sex and cause in different populations*

After modifying age and disease categories, we calculated death rates and the probability of dying for each population using the following formulae:

Death rate m = total deaths / mid-year population N

Probability of dying $q = 1 - \exp(-n*m)$

Probability of dying for different cause $q_i = q * (D_i / D)$

where n represents the age interval in years and m represents the death rate. The underlying assumption is that the death rate m is constant within each age interval (and that it remains so into future years). Based on the multiple decrement life table technique

(SHENGCHAO to provide ref), the probabilities of dying are in the same ratio as the mortality rates or as the recorded deaths themselves.

- *Calculate the excess risk of dying by age, sex and cause in different low and middle-income populations against reference groups.*

The q differential between each low and middle-income population versus each reference group constitute the excess risk of dying.

- *Calculate the contribution of different causes to the excess risk of dying in different low and middle income populations*

The contribution of each cause to the overall excess risk of dying in each age group was calculated by dividing the age, sex and cause specific excess death rate by the corresponding excess death rate by all causes in that age group.

IV. RESULTS

Estimates of age, sex, and cause-specific avoidable mortality in low and middle-income countries by regions using three different reference groups are tabulated in the accompanying appendices. In this paper, we limit our discussion to the estimates of avoidable mortality in all low and middle-income countries, using the "ideal" non-smoking high-income population as the reference group. Such estimates represent the largest extent of mortality that could theoretically be avoided in low and middle income countries. We first discuss the excess risk of dying by all causes and broad categories in each age group, and then the contribution of the different causes to the overall excess risk of dying.

Excess risk of dying by age, sex and broad cause in low and middle income countries

By all causes, avoidable mortality is highest in the 30-69 age group, where the excess risk of dying is 15.7% among males and 14.2% among females. It is second highest in the 0-4 age group, with an excess risk of dying 7.3% among males and 7.2% among females. The excess risk of dying is lowest in the 5-29 age group, at 3.9% among males and 4.7% among females. However, the ranking is not the same for the

contribution of avoidable mortality to the risk of dying in different age groups. It is highest in the 0-4 age group where 86% of the risk of dying is avoidable in males and 88% in females. The 30-69 age group is lowest in this ranking with avoidable mortality accounts for 45% of the risk of dying in males and 53% in females. The proportion of avoidable mortality in the risk of dying thus decreases with age and is higher in females than in males within the same age group (Table 3).

By broad categories of death, Group 1 causes (communicable diseases, maternal conditions, perinatal conditions and nutritional deficiencies) pose the highest excess risk of dying in the 0-4 age group (6.5% in males and 6.3% in females). Such a risk is lower in the 30-69 age group (4.5% and 5.2%), and lowest in the 5-29 age group (1.8% and 2.6%). A very large proportion of the risk of dying from Group 1 causes is avoidable in all age and sex groups, (ranging from 80% to 97%) and it is more so in females than in males within each age group. (Table 4). Avoidable mortality due to Group 2 causes (non-communicable diseases) is high in the 30-69 age group (9.2% in male and 7.8% in female), lower in the 5-29 age group (0.8% and 1.0%) and lowest in the 0-5 age group (0.3% and 0.4%). A significant proportion of the risk of dying from Group 2 causes is avoidable in all age and sex groups (ranging from 38% to 73%) and it is more so in females than in within each age group(Table 5). Similarly, avoidable mortality due to Group 3 causes (injuries) is high in the 30-69 age group (2.0% in males and 1.2% in females), lower in the 5-29 age group (1.3% for male and 1.0% for female), and lowest in children under 5 (0.5% and 0.4%). A significant proportion of the risk of dying from Group 3 causes are also avoidable in all age and sex groups (ranging from 41% to 84%) and it is more so in females than in males within each age group (Table 6) .

Thus among the three age groups, middle age is characterized with: highest overall avoidable mortality, highest excess risks of dying from Group 2 and 3 causes, and second highest excess risk of dying from Group 1 causes. Children under five have the second highest overall avoidable mortality, highest excess risks of dying from Group 1 causes, and lowest excess risks of dying from Group 2 and 3 causes. Avoidable mortality by all three broad causes in the 5-29 age group is in the middle compared to those in the other two age groups.

Contribution of broad and specific causes to age and sex-specific excess risks of dying in low and middle-income countries

In the 0-5 age group, Group 1 causes are the most important contributor to the excess risk of dying, accounting for 89% of avoidable mortality in males and 88% in females. Group 2 causes contribute 7% to avoidable mortality in males and 6% in females, while Group 3 causes contribute 5% and 6% respectively. Among males in this age group, 7 out of 10 conditions with the largest contributions to the excess risks of dying belong to Group 1 causes: lower respiratory infections (20%), diarrhea diseases (18%), , perinatal conditions (14%), childhood vaccine-preventable diseases (14%), and malaria (9%), HIV/AIDS (5%) and other infections (3%). Other major conditions contributing to avoidable mortality in this age group are unintentional injuries (5%), and nutritional deficiencies (3%) (Figure 1). Avoidable mortality profile by cause for female in this age group was almost identical (Figure 2).

In the 5-29 age group, Group 1 causes remain the largest contributor to the overall excess risk of dying, responsible for 46% of avoidable mortality in males and 56% in males. The role of injuries becomes more prominent here, with Group 3 causes contributing 33% to avoidable mortality in males and 22% in females. Group 2 causes contribute 21% to avoidable mortality in both males and females. Among males in this age group , the specific causes with the largest contributions to the excess risk of dying include: unintentional injuries (17%), intentional injuries (16%), HIV/AIDS (16%), cardiovascular diseases (10%), tuberculosis (6%), other non-communicable diseases (6%), lower respiratory infections (6%), childhood vaccine-preventable diseases (5%), and malaria (5%). The profile of cause-specific avoidable mortality in females in this age group is similar, except for HIV/AIDS (18%), unintentional injuries (11%), intentional injuries (11%), and maternal conditions (10%).

In the 30-69 age group, Group 2 causes become the largest contributor to avoidable mortality (59% in males and 55% in females). Group 1 causes contribute 29% to avoidable morality in males and 37% in females while Group 3 causes contribute 13% and 9% respectively. Among males in this age group, the largest contributors to

avoidable mortality are: cardiovascular diseases (27%), tuberculosis (12%), HIV/AIDS (9%), lung cancer (9%), unintentional injuries (8%), COPD (8%), upper aerodigestive cancers (6%). Among females, the top contributors to avoidable mortality are: cardiovascular diseases (42%), HIV/AIDS (11%), tuberculosis (9%), maternal conditions (7%), COPD (6%), other non-communicable diseases (5%). Thus there are significant differences in avoidable mortality between males and females. The contributions of cardiovascular diseases and HIV/AIDS to the excess risk of dying are higher in females than in males. On the other hand, those of lung cancer, COPD, upper aerodigestive cancers, tuberculosis, and unintentional injuries are higher in males than in females.

Avoidable mortality by all causes in each of the GDB region:

Africa has the highest avoidable mortality by all causes in all age groups among the regions. For African males in the under five and middle age group, the excess risks of dying, at around 16.8% and 30.5% respectively, double those in the corresponding age groups in all low and middle-income countries. In the 5-29 age group, excess risk of dying among African males is about 13.1%, which more than triples that in all low and middle income countries. The avoidable mortality pattern of females in Africa is almost identical to that of males.

For the 0-4 and 5-29 age groups, China has the lowest avoidable mortality among males (1.7% and 0.8% respectively) while Low and Middle-Income Europe has the lowest for females (2.1% and 0.8%). Interestingly, in China, avoidable mortality is significantly higher in females in these age groups (at 2.4% and 1.8% respectively) than in males while the reverse is true for Low and Middle-Income Europe. For the 0-4 age group, besides Africa, regions with relatively high avoidable mortality for both males and females include Other Low and Middle-Income Western Pacific (6.1% and 5.2%), India (8.5% and 9.5%), Other Low and Middle-Income Southeast Asia (6.3% and 5.4%) and Low and Middle-Income Eastern Mediterranean (7.4% and 7.5%).

For the 30-69 age group, Low and Middle-Income Europe has the highest avoidable mortality in males (20.24%) and India in females (17.15%). Low and Middle-Income Europe also has a wide gender gap in avoidable mortality in middle age. At

8.20%, the excess risk of dying among middle-aged females in this region is less than two times than that among males. In fact, it is the lowest among all regions (Table 8).

V. DISCUSSION

The Global Burden of Disease project is a significant development in the assessment of global health status. Information provided by the project on the indicators of burden of diseases in different regions has yielded valuable information for the development of national and international health policies. This exercise is an application of GBD data with the purpose of examining avoidable mortality by age, sex and cause in developing countries, which can be helpful in further defining attainable health priorities in each age group for each region. Table 7 illustrates the value added by such information. The left column, which shows the ranking of different conditions by 1998 death rate in middle -aged males in low and middle-income countries, simply provides information on the cause-specific burden of disease in this population. However, the right column shows the ranking of the same causes by their excess risk dying as well as their contributions to the total excess risk of dying. Such information thus indicates how much the health of the population could be improved if we address each cause. It is worth noting in Table 7 that the two columns illustrate differences in the rankings of many conditions. The implication is that disease control priorities might differ depending on whether total or avoidable burden of disease is used.

The key finding of this exercise is that for each age group, there is just a handful of conditions that were responsible for most of the mortality gap between rich and poor countries in 1998. More specifically, for children under five, these conditions include lower respiratory infections, diarrhea, perinatal conditions, childhood vaccine-preventable diseases, and malaria. These five conditions account for around 75% of the total excess risk of dying (Figures 1 and2). For young people aged from 5 to 29, the top conditions are HIV/AIDS, unintentional and intentional injuries, cardiovascular diseases, tuberculosis, lower respiratory infections in both sexes and maternal conditions in females (Figures 3 and 4), which together account for around 70% of the overall excess risk of dying. In middle age, similarly, these conditions are cardiovascular diseases,

tuberculosis, HIV/AIDS, COPD in both sexes maternal conditions in females, and lung cancers in males (Figures 5 and 6). They account for 75% of the excess risk of dying in both sexes.

Low cost and effective prevention and treatment for these conditions exist and are discussed elsewhere (Commission on Macroeconomic Background Papers). Since GBD data were utilized for these calculations, the avoidable mortality estimates have the same confidence intervals of corresponding GBD mortality estimates.

Another issue is whether special treatment is given to the smoking in this exercise. It could be argued that when creating the ideal population, we should always eliminate all risk factors that are more prevalent in rich countries, such as smoking, obesity, sedentary lifestyles, alcohol consumption, and intentional injuries. However, we chose to remove only the health effect of smoking for three reasons. First, the burden of disease caused by smoking in developed countries is large. Tobacco kills 4 million a year, mostly in developed countries. Second, smoking-attributable risk of dying has been well established. Third, smoking can be controlled by a package of simple interventions that governments can adopt (Jha *et al.*, 2000).

VI. CONCLUSIONS

It has been recommended that addressing the major causes of the total burden of disease with cost-effective interventions could do much to improve health (World Bank 1993). However, indicators of burden of disease themselves do not give a practical sense of what is achievable in this goal. Information on avoidable mortality would help policy-makers to identify priorities in their disease control agenda. This information also provides the basis to estimate the health impact of implementing a package of basic interventions against the major causes responsible for most of the avoidable mortality in low and middle-income countries.

Table 1: Simplified disease classification (based on ICD10)

I. Communicable diseases, maternal and perinatal conditions and nutritional deficiencies
- Tuberculosis
- STDs excluding HIV
- HIV/AIDS
- Diarrhea diseases
- Childhood vaccine-preventable diseases
- Malaria
- Other infectious diseases
- Lower respiratory infections
- Other respiratory (upper respiratory infections and otitis media)
- Maternal conditions
- Perinatal conditions
- Nutritional deficiencies

II. Non-communicable conditions
- Lung cancer
- Upper aerodigestive cancers (mouth, oropharynx, esophagus)
- Other cancers
- Other non-communicable diseases
- Neuropsychiatric disorders
- Cardiovascular diseases
- Chronic obstructive pulmonary disease
- Other respiratory diseases (including asthma)

III. Injuries
- Unintentional
- Intentional

Table 2: GBD regional groupings for 1990 and 1998

GBD region groupings for 1990	GBD region groupings for 1998
Established Market Economies	High-Income Countries
Sub-Saharan Africa	Africa
Latin America and the Caribbean	Low and Middle-Income Americas
Middle Eastern Crescent	Low and Middle-Income Eastern Mediterranean
Formerly Socialist Economies of Europe (FSE)	Low and Middle-Income Europe
India	India
China	China
Other Asia and Islands	Southeast Asia: Other Low and Middle- income
	Western Pacific: Other Low and Middle- income

Source: Murray and Lopez 1996, GBD unit 2000

Table 3: Risk of dying and avoidable mortality in low and middle-income countries, 1998

	Males			Females		
	0 to 4	5 to 29	30 to 69	0 to 4	5 to 29	30 to 69
Risk of dying in low and middle-income countries (a)	8.6%	6.1%	35.0%	8.2%	5.6%	26.7%
Risk of dying in "ideal" non-smoking high-income population (b)	1.2%	2.2%	19.2%	1.0%	0.9%	12.6%
Excess risk of dying (avoidable mortality) in low and middle-income countries (c=a-b)	7.3%	3.9%	15.7%	7.2%	4.7%	14.2%
Relative contribution of avoidable mortality to risk of dying in low and middle-income countries (d=c/a)	86%	63%	45%	88%	84%	53%

Table 4: Risk of dying and avoidable mortality due to Group 1 causes (communicable diseases, maternal conditions, perinatal conditions, and nutritional deficiencies) in low and middle-income countries, 1998

	Males			Females		
	0 to 4	5 to 29	30 to 69	0 to 4	5 to 29	30 to 69
Risk of dying in low and middle-income countries (a)	7.2%	1.9%	5.6%	6.8%	2.7%	5.7%
Risk of dying in "ideal" non-smoking high-income population (b)	0.7%	0.1%	1.1%	0.5%	0.1%	0.5%
Excess risk of dying (avoidable mortality) in low and middle-income countries (c=a-b)	6.5%	1.8%	4.5%	6.3%	2.6%	5.2%
Relative contribution of avoidable mo rtality to risk of dying in low and middle-income countries (d=c/a)	91%	94%	80%	93%	97%	91%

Table 5: Risk of dying and avoidable mortality due to Group 2 causes (non-communicable diseases) in low and middle-income countries, 1998

	Males			Females		
	0 to 4	5 to 29	30 to 69	0 to 4	5 to 29	30 to 69
Risk of dying in low and middle-income countries (a)	0.8%	1.4%	24.3%	0.8%	1.4%	18.8%
Risk of dying in "ideal" non-smoking high-income population (b)	0.5%	0.6%	15.1%	0.4%	0.4%	11.0%
Excess risk of dying (avoidable mortality) in low and middle-income countries (c=a-b)	0.3%	0.8%	9.2%	0.4%	1.0%	7.8%
Relative contribution of avoidable mortality to risk of dying in low and middle-income countries (d=c/a)	43%	59%	38%	52%	73%	41%

Table 6: Risk of dying and avoidable mortality due to Group 3 causes (injuries) in low and middle-income countries, 1998

	Males			Females		
	0 to 4	5 to 29	30 to 69	0 to 4	5 to 29	30 to 69
Risk of dying in low and middle-income countries (a)	0.6%	2.8%	5.0%	0.5%	1.5%	2.3%
Risk of dying in "ideal" non-smoking high-income population (b)	0.1%	1.5%	3.0%	0.1%	0.4%	1.1%
Excess risk of dying (avoidable mortality) in low and middle-income countries (c=a-b)	0.5%	1.3%	2.0%	0.4%	1.0%	1.2%
Relative contribution of avoidable mortality to risk of dying in low and middle-income countries (d=c/a)	81%	45%	41%	84%	70%	53%

Table 7: Cause-specific mortality and avoidable mortality in males aged 30-69 in low and middle-income countries, 1998

Mortality		Avoidable mortality		
Causes	Death rate (per 10,000)	Causes	Excess risk of dying	Contribution of each cause to the overall excess risk of dying
All Causes	**108**	**All Causes**	**0.1571**	**100%**
Cardiovascular diseases	34	Cardiovascular diseases	0.0427	27%
Other cancers	14	Tuberculosis	0.0193	12%
Other noncommunicable diseases	10	HIV/AIDS	0.0144	9%
Unintentional injuries	9	Lung cancer	0.0140	9%
Intentional injuries	6	COPD	0.0131	8%
Tuberculosis	6	Unintentional injuries	0.0123	8%
HIV/AIDS	6	Upper aerodigestive cancers	0.0090	6%
Lung cancer	5	Other cancers	0.0084	5%
COPD	5	Intentional injuries	0.0079	5%
Upper aerodigestive cancers	3	Other noncommunicable diseases	0.0065	4%
Lower respiratory infections	2	Other infectious diseases	0.0036	2%
Other respiratory diseases	2	Lower respiratory infections	0.0027	2%
Other infectious diseases	2	Malaria	0.0020	1%
Neuropsychiatric disorders	1	Diarrhea diseases	0.0019	1%
Diarrhea diseases	1	Other respiratory	0.0005	0%
Malaria	1	Childhood diseases	0.0005	0%
Childhood diseases	0	Nutritional deficiencies	0.0003	0%
Nutritional deficiencies	0	STDs excluding HIV	0.0002	0%
STDs excluding HIV	0	Other respiratory infections	0.0000	0%
Other respiratory infections	0	Maternal conditions	0.0000	0%
Perinatal conditions	0	Perinatal conditions	0.0000	0%
Maternal conditions	0	Neuropsychiatric disorders	-0.0023	-1%

Figures: Contribution of different causes to the excess risk of dying in low and middle-income countries (the ideal population as the reference)

Figure 1: Contribution of different causes to the excess risk of dying among males of the 0-4 age group in low and middle-income countries, 1998

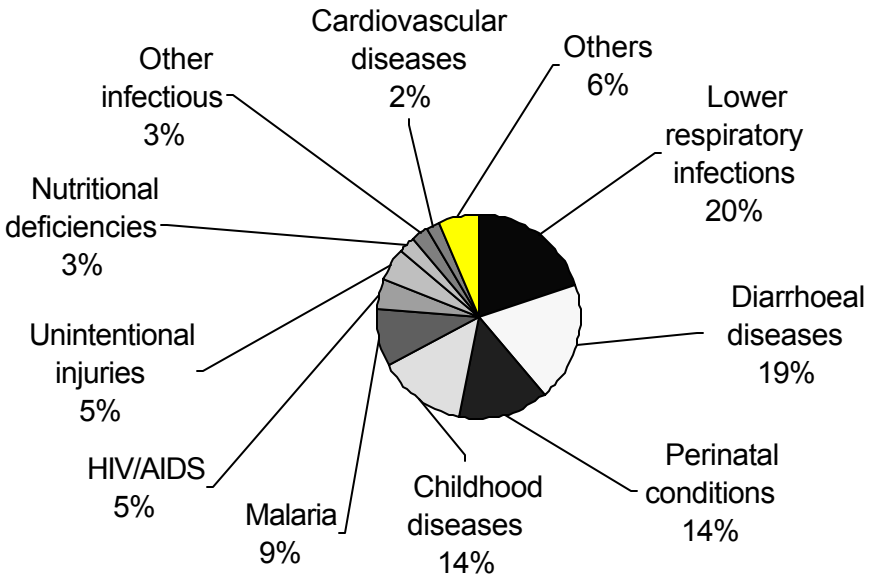

Figure 2: Contribution of different causes to the excess risk of dying among females of the 0-4 age group in low and middle-income countries, 1998

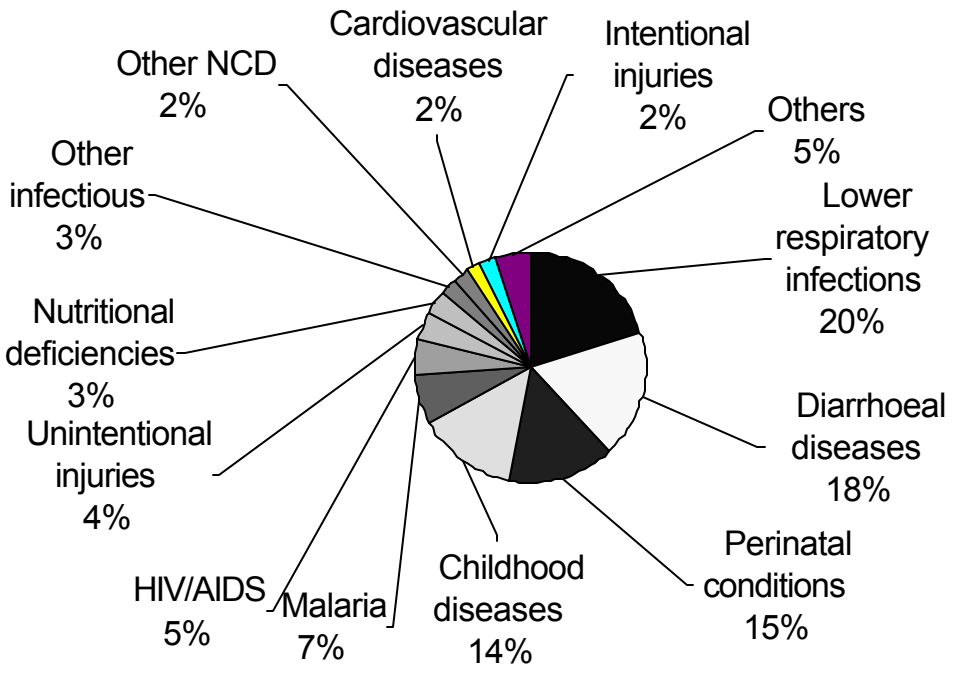

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Figure 3: Contribution of different causes to the excess risk of dying among males of the 5-29 age group in low and middle-income countries, 1998

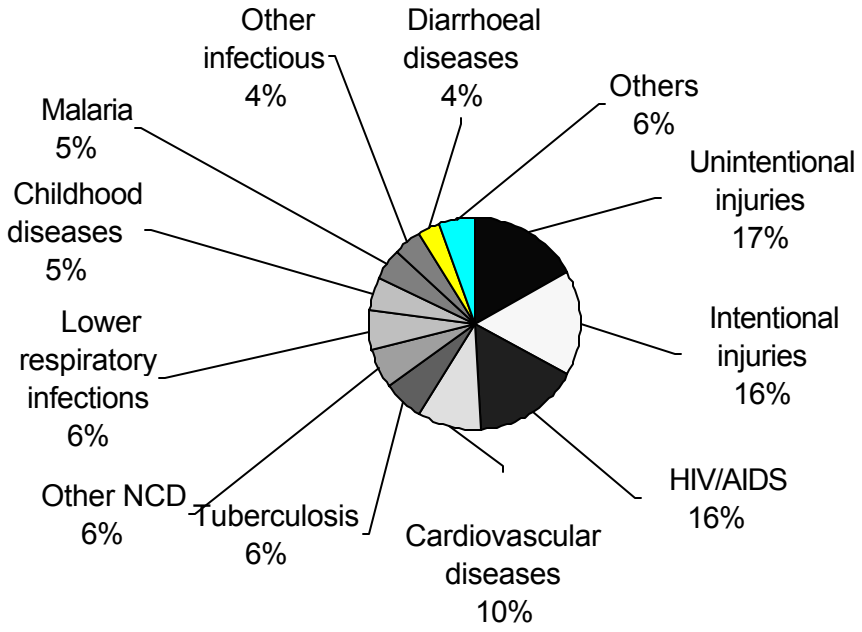


Figure 4: Contribution of different causes to the excess risk of dying among females of the 5-29 age group in low and middle-income countries, 1998

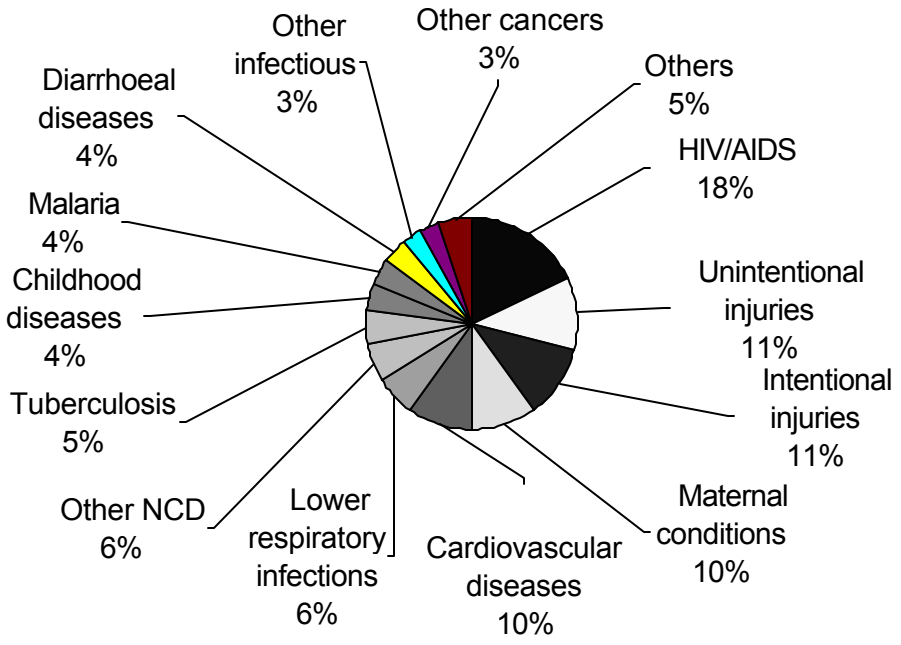


Figure 5: Contribution of different causes to the excess risk of dying among males of the 30-69 age group in low and middle-income countries, 1998

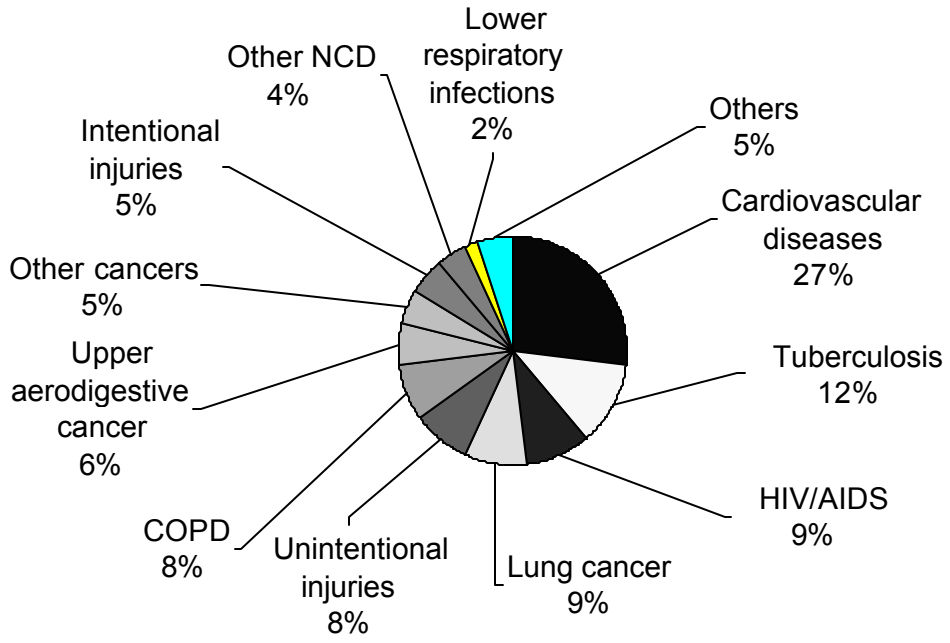
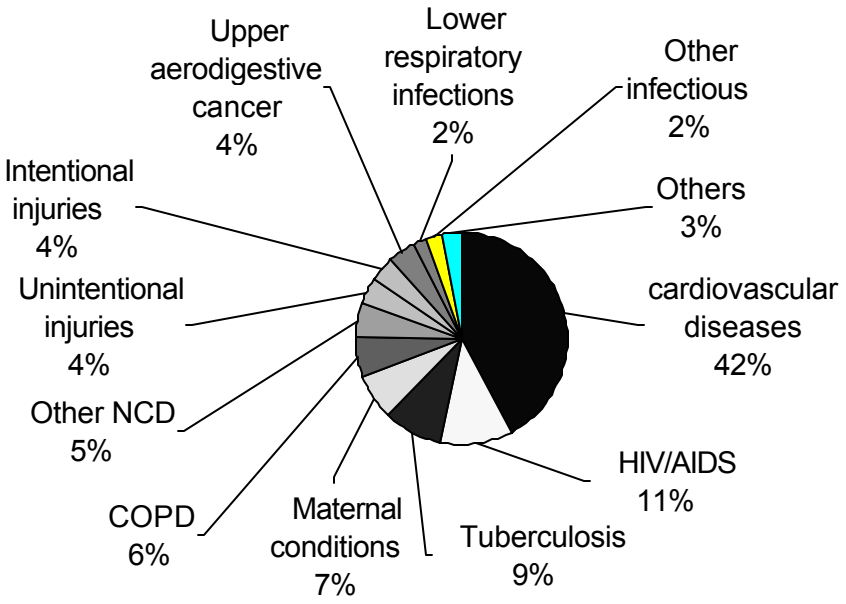


Figure 6: Contribution of different causes to the excess risk of dying among females of the 30-69 age group in low and middle-income countries, 1998



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