

Contents

Foreword by Samuel H. Preston	xv
Preface	xvii
Editors	xix
Advisory Committee to the Editors	xxi
Contributors	xxiii
Disease Control Priorities Project Partners	xxv
Acknowledgments	xxvii
Abbreviations and Acronyms	xxix
Chapter 1 Measuring the Global Burden of Disease and Risk Factors, 1990–2001	1
Alan D. Lopez, Colin D. Mathers, Majid Ezzati, Dean T. Jamison, and Christopher J. L. Murray	
History of Burden of Disease Studies	2
Applications of Burden of Disease Analysis	4
Improving the Comparative Quantification of Diseases, Injuries, and Risk Factors: The 2001 GBD Study	5
Major Findings of the 2001 GBD Study	7
Conclusions	10
References	11
Part I: Global Burden of Disease and Risk Factors	15
Chapter 2 Demographic and Epidemiological Characteristics of Major Regions, 1990–2001	17
Alan D. Lopez, Stephen Begg, and Ed Bos	
Regional Demographic Characteristics	18
Changes in Mortality, 1990–2001	21
Trends in Causes of Child Death, 1990–2001	28
Discussion	32
Conclusions	35
Annex 2A: Key Demographic Indicators, by Country/Territory, 1990 and 2001	36
Acknowledgments	43
Notes	43
References	43

Chapter 3	The Burden of Disease and Mortality by Condition: Data, Methods, and Results for 2001	45
	Colin D. Mathers, Alan D. Lopez, and Christopher J. L. Murray	
	Quantifying the Global Burden of Disease	46
	Estimating Deaths by Cause: Methods and Data	51
	Global and Regional Mortality in 2001	68
	Estimating Incidence, Prevalence, and YLD: Methods and Data	73
	Burden of Disability and Poor Health in 2001	85
	Global Burden of Disease in 2001	87
	Discussion and Conclusions	90
	Annex 3A: Definitions, Mortality Data Sources, and Disability Weights	94
	Annex 3B: Deaths by Cause, Sex, Age, and Region, 2001	126
	Annex 3C: DALYs (3,0) by Cause, Sex, Age, and Region, 2001	180
	Acknowledgments	234
	References	234
Chapter 4	Comparative Quantification of Mortality and Burden of Disease Attributable to Selected Risk Factors	241
	Majid Ezzati, Stephen Vander Hoorn, Alan D. Lopez, Goodarz Danaei, Anthony Rodgers, Colin D. Mathers, and Christopher J. L. Murray	
	Burden of Disease Attributable to Risk Factors	242
	Risk Factor Selection	242
	Burden of Disease Attributable to Individual Risk Factors	247
	Joint Effects of Multiple Risk Factors	252
	Burden of Disease Attributable to Multiple Risk Factors	255
	Directions for Future Research	267
	Discussion	267
	Annex 4A: Population Attributable Fractions, Attributable Deaths, Years of Life Lost Because of Premature Mortality (YLL), and Disability-Adjusted Life Years (DALYs) by Risk Factor, Disease Outcome, Age, Sex, and Region	269
	References	394
	Part II: Sensitivity Analyses	397
Chapter 5	Sensitivity and Uncertainty Analyses for Burden of Disease and Risk Factor Estimates	399
	Colin D. Mathers, Joshua A. Salomon, Majid Ezzati, Stephen Begg, Stephen Vander Hoorn, and Alan D. Lopez	
	Discounting and Age Weighting in the DALY Measure	400
	Sensitivity of Burden of Disease and Injury Results to Variations in Key Parameter Values	402
	Sensitivity of Risk Factor Estimates to Variations in Key Parameter Values	406
	Uncertainty Analysis of the Global Burden of Disease Estimates	408
	Uncertainty Estimates for All-Cause Mortality and Life Expectancies	409
	Uncertainty Estimates for Regional Mortality by Cause	411
	Uncertainty in Disability Weights	413
	Uncertainty Arising from Epidemiological Estimates	417
	Uncertainty in the Disease Burden Attributable to Risk Factors	420
	Discussion	423
	Conclusions	424
	Acknowledgments	425
	References	425

Chapter 6	Incorporating Deaths Near the Time of Birth into Estimates of the Global Burden of Disease	427
	Dean T. Jamison, Sonbol A. Shahid-Salles, Julian Jamison, Joy E. Lawn, and Jelka Zupan	
	Stillbirths and Neonatal Mortality in the Context of the	
	Global Burden of Disease	428
	The Burden of Disease Resulting from Events Near the Time of Birth	431
	Conclusions	442
	Annex 6A: Flexible Functional Forms for the Acquisition of Life Potential	442
	Annex 6B: Supplementary Tables	445
	Annex 6C: Causes of Neonatal Mortality: Comparison of Numbers	
	from the Global Burden of Disease with those from the	
	Child Health Epidemiology Reference Group	461
	Acknowledgments	462
	References	462

List of Boxes

Box 1.1	Disability-Adjusted Life Years	3
---------	--------------------------------	---

List of Figures

Figure 1.1	Overview of Burden of Disease Framework	2
Figure 2.1	Changes in Population Age Distribution, 1990–2001	22
Figure 2.2	Population Sex Ratios at Different Ages, 2001	23
Figure 2.3	UN's versus Authors' Life Table Parameters, 1990	24
Figure 2.4	Change in Risk of Death for Children Under Five by Cause (probability of mortality per 1,000 live births), 1990–2001	31
Figure 3.1	Relationship between Health Expectancies and Health Gaps in a Stationary Population	47
Figure 3.2	Variation across Selected Countries in Coding for Ill-Defined CVD Causes, 1979–98	57
Figure 3.3	Mortality Rates for Socioeconomic Strata, by Cause Group, from China's Two Mortality Data Systems	59
Figure 3.4	CodMod Estimation of Major Cause Group Proportional Mortality for Islamic Republic of Iran, 2001	61
Figure 3.5	Proportional Distribution of Total Deaths by Broad Cause Group, 2001	68
Figure 3.6	Death Rates by Broad Cause Group, Region, and Broad Age Group, 2001	69
Figure 3.7	Leading Causes of Premature Death (YLL) and of Deaths, Worldwide, 2001	73
Figure 3.8	Disease Model Underlying DisMod	74
Figure 3.9	Input Prevalences and Incidence Rates Estimated Using DisMod II, for Diabetes Mellitus Cases in Males, Sub-Saharan Africa	75
Figure 3.10	Life Expectancy, HALE, and Lost Healthy Years by Region and Sex, 2001	87
Figure 3.11	YLL, YLD, and DALYs by Region, 2001	87
Figure 3.12	Burden of Disease by Broad Cause Group and Region, 2001	88
Figure 3.13	Age Distribution of Burden of Disease by Income Group, 2001	89
Figure 4.1	Mortality and the Burden of Disease Attributable to Leading Global Risk Factors, by World Bank Region	248
Figure 4.2	Burden of Disease Attributable to 10 Leading Regional Risk Factors, by Disease Type	251
Figure 4.3	Mediated and Direct Effects of a Risk Factor	253
Figure 5.1	Age-Weighting Function Incorporated into the DALY	401
Figure 5.2	Effect of Age Weighting and Discounting on the YLL per Death at Various Ages for Females	401

Figure 5.3	Effect of Age Weighting and Discounting on the Male-Female Gap in YLL per Death	402
Figure 5.4	Effect on YLL per Death of Varying the Parameter β in the DALY Age-Weighting Function	402
Figure 5.5	Effects of Changing the Discount Rate and Age Weighting on DALYs' Broad Cause and Age Composition, 2001	404
Figure 5.6	Relationship between the Rank Order of Causes of the Global Burden Using DALYs(3,1) and DALYs(3,0) in 2001	404
Figure 5.7	Relationship between the Rank Order of Causes of the Global Burden of Disease in 2001, Using Uniform Age Weights and 3 Percent Discounting and No Discounting	405
Figure 5.8	Effects of Changing the Discount Rate and Age Weighting on Global Rankings for the Top 20 Causes of the Burden of Disease, 2001	406
Figure 5.9	Effects of Changes in Key DALY Parameters on Proportion of the Global Disease Burden Attributable to Risk Factors	407
Figure 5.10	Effects of Changes in Key DALY Parameters on Proportion of the Regional Disease Burden Attributable to Risk Factors for Low- and Middle-Income Countries	407
Figure 5.11	Effects of Changes in Key DALY Parameters on Proportion of the Regional Disease Burden Attributable to Risk Factors for High-Income Countries	408
Figure 5.12	Uncertainty Ranges for Child and Adult Mortality for WHO Member States, 2001	410
Figure 5.13	Uncertainty in Average Life Expectancy at Birth, by Sex and DCP Region, 2001	411
Figure 5.14	Sensitivity of Uncertainty Ranges to Changes in Between-Country Correlation Assumptions	413
Figure 5.15	Assumed 95 Percent Uncertainty Ranges for Disability Weights Based on Constant Variance Distribution for Logit of Disability Weight	416
Figure 5.16	Relative 95 Percent Uncertainty Ranges for Disability Weights Based on the Assumption of a Constant Variance Distribution for Logit of Disability Weight across All Disability Weights	417
Figure 5.17	Estimated 95 Percent Uncertainty in Total DALYs(3,0) Due to Uncertainty in Estimation of Disability Weights, Top 20 Causes, Low- and Middle-Income Countries	420
Figure 5.18	PAF Sensitivity to Exposure and Relative Risks	422
Figure 6.1	Age Distribution of Deaths of Children under Five in Low- and Middle-Income Countries, 2001	429
Figure 6.2	ALP, Traditional DALYs, and DALYs(3,0,.54)	438
Figure 6.3	Ratio of DALYs Lost at Age 20 to Age 0 as a Function of Age Weighting	439
Figure 6.4	YLL for Deaths at Different Ages	440
Figure 6A.1	Relationship between Time to Complete ALP and Life Potential at Age 0 for Several Values of A	444
Figure 6A.2	Ratio of DALYs Lost at Age 20 to Age 0 as a Function of A	444

List of Tables

Table 1.1	Deaths and Burden of Disease by Cause—Low- and Middle-Income Countries, High-Income Countries, and World, 2001	8
Table 1.2	Deaths and Burden of Disease Attributable to Risk Factors—Low- and Middle-Income Countries, High-Income Countries, and World, 2001	10
Table 2.1	Percentage of Regional Population Covered by Censuses, circa 1990 and 2000	18

Table 2.2	Population Size and Composition, Fertility, and GNP, by World Bank Region, 1990 and 2001	20
Table 2.3	Selected Mortality Characteristics by Sex and World Bank Region, 1990 and 2001	26
Table 2.4	Mortality in Children Under Five by Cause, 1990 and 2001	29
Annex 2A	Key Demographic Indicators, by Country/Territory, 1990 and 2001	36
Table 3.1	Availability of Data for Estimation of All-Cause Mortality Rates by Age and Sex	52
Table 3.2	Availability of Data for Estimation of Causes of Death by Age and Sex	55
Table 3.3	Distribution of Percentage of Total Deaths Assigned to Ill-Defined Codes for 105 WHO Member States, Most Recent Available Year	57
Table 3.4	Correction Factors Giving Proportion of Ill-Defined CVD Deaths to Be Reassigned to IHD, by Age and Sex	58
Table 3.5	Numbers of Data Sets Contributing to Epidemiologically Based Estimates of Deaths Due to Specific Causes	62
Table 3.6	The 10 Leading Causes of Death, by Broad Income Group, 2001	70
Table 3.7	The 10 Leading Causes of Death, by Sex, in Low- and Middle-Income Countries, 2001	70
Table 3.8	The 10 Leading Causes of Death in Children Ages 0–14, by Broad Income Group, 2001	70
Table 3.9	The 10 Leading Causes of Death in Adults Ages 15–59, by Broad Income Group, 2001	71
Table 3.10	The 10 Leading Causes of Death in Low- and Middle-Income Countries, by Region, 2001	72
Table 3.11	Numbers of Country Data Sources Contributing to the Estimation of YLD, by Region and Cause	77
Table 3.12	The 10 Leading Causes of YLD, by Broad Income Group, 2001	86
Table 3.13	The 10 Leading Causes of YLD, by Sex, Worldwide, 2001	86
Table 3.14	The 20 Leading Causes of Global Burden of Disease, DALYs(3,0), 2001	88
Table 3.15	The 10 Leading Causes of Burden of Disease by Broad Income Group, 2001	89
Table 3.16	The 10 Leading Causes of the Burden of Disease in Low- and Middle-Income Countries, by Region, 2001	91
Table 3A.1	Regional Reporting Categories for the Disease Control Priorities Project	94
Table 3A.2	GBD Cause Categories and ICD Codes	95
Table 3A.3	Data Sources and Methods for Estimation of Mortality by Cause, Age, and Sex	100
Table 3A.4	GBD Regional Epidemiological Analysis Categories	107
Table 3A.5	GBD Cause Categories, Sequelae, and Case Definitions	108
Table 3A.6	Disability Weights for Diseases and Conditions (Except Cancers and Injuries)	119
Table 3A.7	Disability Weights for Malignant Neoplasms and Their Long-Term Sequelae	124
Table 3A.8	Disability Weights for Injuries	125
Table 3B.1	Deaths by Cause, Sex, and Age in Low- and Middle-Income Countries, 2001	126
Table 3B.2	Deaths by Cause, Sex, and Age in the East Asia and Pacific Region, 2001	132
Table 3B.3	Deaths by Cause, Sex, and Age in the Europe and Central Asia Region, 2001	138
Table 3B.4	Deaths by Cause, Sex, and Age in the Latin America and the Caribbean Region, 2001	144

Table 3B.5	Deaths by Cause, Sex, and Age in the Middle East and North Africa Region, 2001	150
Table 3B.6	Deaths by Cause, Sex, and Age in the South Asia Region, 2001	156
Table 3B.7	Deaths by Cause, Sex, and Age in the Sub-Saharan Africa Region, 2001	162
Table 3B.8	Deaths by Cause, Sex, and Age in High-Income Countries, 2001	168
Table 3B.9	Deaths by Cause, Sex, and Age in the World, 2001	174
Table 3C.1	DALYs(3,0) by Cause, Sex, and Age in Low- and Middle-Income Countries, 2001	180
Table 3C.2	DALYs(3,0) by Cause, Sex, and Age in the East Asia and Pacific Region, 2001	186
Table 3C.3	DALYs(3,0) by Cause, Sex, and Age in the Europe and Central Asia Region, 2001	192
Table 3C.5	DALYs(3,0) by Cause, Sex, and Age in the Middle East and North Africa Region, 2001	204
Table 3C.6	DALYs(3,0) by Cause, Sex, and Age in the South Asia Region, 2001	210
Table 3C.7	DALYs(3,0) by Cause, Sex, and Age in the Sub-Saharan Africa Region, 2001	216
Table 3C.8	DALYs(3,0) by Cause, Sex, and Age in High-Income Countries, 2001	222
Table 3C.9	DALYs(3,0) by Cause, Sex, and Age in the World, 2001	228
Table 4.1	CRA Risk Factors, Exposure Variables, Theoretical-Minimum-Risk Exposure Distributions, and Disease Outcomes	243
Table 4.2	Distribution of Risk Factor-Attributable Mortality and Burden of Disease, by Age and Sex	249
Table 4.3	Joint Contributions (PAFs) of the Leading Risk Factors to Mortality and Burden of Disease, by Region	255
Table 4.4	Individual and Joint Contributions of Risk Factors to 10 Leading Diseases and Total Burden of Disease	256
Table 4.5	Individual and Joint Contributions of Risk Factors to Mortality and Burden of Disease from Site-Specific Cancers	260
Table 4.6	Individual and Joint Contributions of Risk Factors to Mortality and Burden of Disease from Cardiovascular Diseases	263
Table 4.7	Individual and Joint Contributions of Risk Factors to Mortality and Burden of Disease from Major Diseases of Children	265
Annex 4A	Population Attributable Fractions, Attributable Deaths, Years of Life Lost Because of Premature Mortality (YLL), and Disability-Adjusted Life Years (DALYs) by Risk Factor, Disease Outcome, Age, Sex, and Region	269
Table 5.1	Standard Life Expectancies at Selected Exact Ages and Discounted YLL Due to a Death at Selected Ages	402
Table 5.2	Implications of Variation in Choice of Age-Weight Parameter β on the Age-Weighting Function	403
Table 5.3	Comparison of the Effects of Changing the Discount Rate (r) and the Age-Weighting Factor (K) on the Composition of DALYs(r,K), 2001	403
Table 5.4	Effects of Changing the Discount Rate (r) and the Age-Weighting Factor (K) on the Second-Level Cause Group Composition of DALYs(r,K), 2001 (percentages of total DALYs)	405
Table 5.5	Estimated Total Deaths and 95 Percent Uncertainty Ranges for Selected Causes, by Region, 2001	414
Table 5.6	Estimated 95 Percent Uncertainty Ranges for YLD and DALYs Arising from Uncertainty in Disability Weights for Selected Causes for Low- and Middle-Income Countries, 2001	418
Table 5.7	Estimated 95 Percent Uncertainty Ranges Arising from Uncertainty in Disability Weights for the Top 40 Causes of the Burden of Disease in Low- and Middle-Income Countries, 2001	421

Table 6.1	Population Totals and Numbers of Births, 2001	429
Table 6.2	Age Distribution of Deaths under Age 5, 2001	429
Table 6.3	Estimated Death Rates under Age 5, by Country Income Level, 2001	430
Table 6.4	Deaths by Age and Cause, 2001	432
Table 6.5	Values of Selected ALP Functions	439
Table 6.6	Discounted YLL at Different Ages of Death for Several DALY Formulations	440
Table 6.7	Disease Burden at Different Ages Using Different Measures, Low- and Middle-Income Countries, 2001	441
Table 6.8	Disease Burden from Selected Groups of Causes Using Different Measures, Low- and Middle-Income Countries, 2001	441
Table 6B.1	Deaths (Excluding Stillbirths) from Selected Causes, by Age, 2001	445
Table 6B.2	YLL(3,0) from Selected Causes, by Age, 2001	446
Table 6B.3	YLD from Selected Causes, by Age, 2001	447
Table 6B.4	The Burden of Disease—DALYs(3,0) from Selected Causes, by Age, 2001 (Excluding Stillbirths)	448
Table 6B.5	YLL _{SB} (3,0,1) Calculated to Include Stillbirths (Valued the Same as Newborn Deaths)	449
Table 6B.6	The Burden of Disease—DALY _{SB} (3,0,1). Calculated to Include Stillbirths (Valued the Same as Newborn Deaths)	452
Table 6B.7	YLL _{SB} (3,0,.54) Calculated to Include Stillbirths and Gradual ALP	455
Table 6B.8	The Burden of Disease—DALY _{SB} (3,0,.54). Calculated to Include Stillbirths and Gradual ALP ($A = .54$)	458
Table 6C.1	Causes of Neonatal Mortality, Worldwide in 2001	461
Glossary		465
Index		469