

Chapter 2



Global Burden of Mental, Neurological, and Substance Use Disorders: An Analysis from the Global Burden of Disease Study 2010

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INTRODUCTION

A substantial proportion of the world's health problems in high-income countries (HICs) and low- and middle-income countries (LMICs) arises from mental, neurological, and substance use disorders (Murray, Vos, and others 2012; WHO 2008). Treatment rates for these disorders are low, particularly in LMICs, where treatment gaps of more than 90 percent have been documented (Wang, Aguilar-Gaxiola, and others 2007). Even in HICs, where rates of treatment are comparatively higher, treatment for mental, neurological, and substance use disorders tends to be provided many years after the onset of the disorder (Wang, Aguilar-Gaxiola, and others 2007; Wang, Angermeyer, and others 2007).

Global Burden of Mental, Neurological, and Substance Use Disorders

Historically, major health policy decisions have been informed by mortality statistics. Although our understanding of diseases causing premature mortality has expanded, the lack of emphasis on morbidity has undervalued the global impact of prevalent and disabling disorders with lower mortality, such as mental, neurological, and

substance use disorders. Until recently, there was a poor understanding of the comparative global epidemiology of mental, neurological, and substance use disorders and slower progress compared with other diseases in identifying the most cost-effective interventions. To improve the health outcomes of people with mental, neurological, and substance use disorders in HICs and LMICs, it is important to understand not only the number and distribution of affected people among countries, but also the way the disorders affect their health compared with other diseases. There are many summary measures available to measure population health (Alonso, Chatterji, and He 2013; Sassi 2006). In this chapter, we focus on the approach in the Global Burden of Disease Study 2010 (GBD 2010) to measure disease burden—the most comprehensive measure of population health to date, which combines in one metric the disability and mortality associated with a given disease (Murray, Vos, and others 2012).

The first Global Burden of Disease Study, which published data on disease burden in 1990 (GBD 1990) (Murray and Lopez 1996), reported that the category of mental, neurological, and substance use disorders—a grouping that included depression, selected anxiety disorders, bipolar disorder, schizophrenia, epilepsy, dementia, Parkinson's disease, multiple sclerosis,

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and alcohol and drug use disorders—accounted for 10.5 percent of the world's disease burden, as measured by disability-adjusted life years (DALYs). The DALY is a health metric that captures the nonfatal component of the disease burden as years lived with disability (YLDs), and the fatal component as years of life lost (YLLs) to premature mortality (Murray and Lopez 1996). GBD 1990 showed that five of the top 10 causes of disability—making up more than 25 percent of global YLDs for 1990—belonged to the category of mental, neurological, and substance use disorders (Murray and Lopez 1996). In its update of burden estimates for 2000–05, the World Health Organization (WHO) assigned 31.7 percent of all YLDs to mental, neurological, and substance use conditions; the five main contributors of this burden were depression (11.8 percent), alcohol use disorders (3.3 percent), schizophrenia (2.8 percent), bipolar disorder (2.4 percent), and dementia (1.6 percent) (WHO 2008).

Global Burden of Disease Study 2010

In this chapter we present findings from GBD 2010. The GBD 2010 estimated the burden for 291 diseases and injuries and 67 risk factors and was the first comprehensive re-analysis of the burden since GBD 1990 (Lim and others 2012; Lozano and others 2012; Murray, Vos, and others 2012; Salomon and others 2012; Vos and others 2012; Wang and others 2012). GBD 2010 estimated burden for three main cause groups:

- Communicable diseases: infectious or transmissible diseases
- Noncommunicable diseases: noninfectious or non transmissible diseases
- Injuries (accidental or intentional).

The study included a complete epidemiological reassessment of these communicable and noncommunicable diseases and injuries across 187 countries; 21 world regions; males and females; estimated burden for 1990, 2005, and 2010; and 20 age groups. Rather than rely on a selective sample of data points as previous GBD studies had, burden estimates were based on a systematic review of the literature to obtain all available epidemiological data. The estimates were also derived through the use of new statistical methods to model the epidemiological data, quantify disability, adjust for comorbidity between diseases, and propagate uncertainty to final burden estimates (Murray, Vos, and others 2012; Vos and others 2012).

GBD 2010 highlighted a shift in burden from communicable to noncommunicable diseases and from YLLs to YLDs (Murray, Vos, and others 2012; Vos and others 2012). Although communicable diseases remain a health

priority in many LMICs, increasing life expectancies due to better reproductive health, childhood nutrition, and control of communicable diseases meant that more people in 2010 were living to ages where mental, neurological, and substance use disorders were most prevalent (Whiteford, Degenhardt, and others 2013).

In GBD 2010, the burden of mental and substance use disorders was estimated separately from that of neurological disorders, such as dementia, Parkinson's disease, and epilepsy. This approach enabled us to investigate more comprehensively the differences in the epidemiology and burden between these groups of disorders compared with previous GBD studies. Mental and substance use disorders were among the leading causes of disease burden in 2010. They were responsible for 7.4 percent of global DALYs and 22.9 percent of global YLDs, making them the fifth-leading cause of DALYs and the leading cause of YLDs (Whiteford, Degenhardt, and others 2013). Neurological disorders explained 3.0 percent of global DALYs and 5.6 percent of global YLDs (Murray, Vos, and others 2012; Vos and others 2012).

The overarching findings of the study for all 291 diseases and injuries have been presented (Lim and others 2012; Lozano and others 2012; Murray, Ezzati, and others 2012; Murray, Vos, and others 2012; Salomon and others 2012; Vos and others 2012), as have the GBD 2010 results for mental and substance use disorders (Degenhardt, Whiteford, and others 2013; Whiteford, Degenhardt, and others 2013). This chapter presents GBD 2010 burden estimates of mental, neurological, and substance use disorders as a group. Specifically, we quantify the global disease burden attributable to mental, neurological, and substance use disorders and explore variations in burden by disorder type, age, gender, year, and region. This approach provides background and context for chapter 3 in this volume (Charlson and others 2015), which responds to the lack of deaths and fatal burden estimated by GBD 2010 for mental, neurological, and substance use disorders. Most important, this chapter for the first time presents GBD 2010 burden of disease estimates at the aggregated level of mental, neurological, and substance use disorders. Analysis of burden estimates at this aggregated level is important from the clinical and population health perspectives, given that the organization of services in many LMICs does not separate neurological disorders from mental disorders, something seen as a progression of Western medical subspecialization.

METHODOLOGY

Annex 2A summarizes the mental, neurological, and substance use disorders investigated in GBD 2010 and describes how the YLDs, YLLs, and DALYs for each

disorder were estimated. More detailed information about the input data and methods can be accessed elsewhere (Baxter and others 2013; Baxter and others 2014a; Baxter and others 2014b; Degenhardt and others 2011; Degenhardt, Baxter, and others 2014; Degenhardt, Charlson, and others 2014; Degenhardt, Ferrari, and others 2013; Degenhardt, Whiteford, and others 2013; Erskine and others 2014; Ferrari, Baxter, and Whiteford 2010; Ferrari and others 2013a; Ferrari and others 2013b; Saha and others 2005; Whiteford, Degenhardt, and others 2013; Whiteford, Ferrari, and others 2013).

To allow for comparability in measurement, the definitions of dementia and mental and substance use disorders used for GBD 2010 were restricted to diagnostic classifications provided in the *Diagnostic and Statistical Manual of Mental Disorders* (APA 2000) and the *International Classification of Diseases* (ICD-10) (WHO 1992). The epilepsy definition was based on ICD-10 (WHO 1992). For each disorder, YLDs and YLLs were summed to estimate DALYs. For disorders where there were insufficient data to estimate YLLs, YLDs were equated with DALYs. Uncertainty was estimated at all stages of the analysis through microsimulation methods and propagated to the final burden estimates. YLDs, YLLs, and DALYs in this chapter are presented for 1990 and 2010 at the following levels:

- Global
- Disaggregated by disorder type, age, gender, and year
- Disaggregated by the seven superregion groups in GBD 2010: East Asia and Pacific, Eastern Europe and Central Asia, high-income regions (North America, Australasia, Western Europe, high-income Asia Pacific, and southern Latin America), Latin America and the Caribbean, the Middle East and North Africa, South Asia, and Sub-Saharan Africa
- Disaggregated by developed and developing regions.

The terms *developed* and *developing* regions are used here rather than HICs and LMICs for consistency with the presentation of the GBD 2010 estimates. The classification of countries into regions and regions into superregions was based on geographical proximity and epidemiological likeness in cause of death patterns (Murray, Vos, and others 2012; Vos and others 2012). Whiteford, Degenhardt, and others (2013) provide a list of all countries in each region and superregions. Where age-standardized DALY rates are presented, these were estimated using direct standardization to the global standard population that WHO proposed in 2001 (<http://www.who.int/healthinfo/paper31.pdf>).

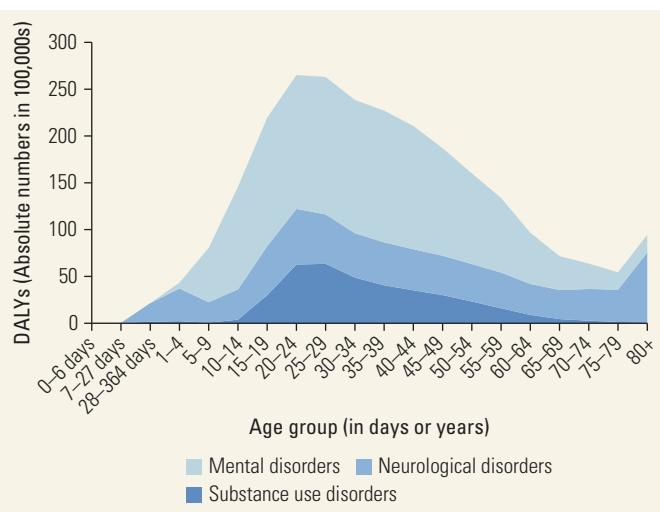
BURDEN OF MENTAL, NEUROLOGICAL, AND SUBSTANCE USE DISORDERS

Mental, neurological, and substance use disorders accounted for 258 million DALYs in 2010, which was equivalent to 10.4 percent of total all-cause DALYs. Within mental, neurological, and substance use disorders, mental disorders accounted for the highest proportion of DALYs (56.7 percent), followed by neurological disorders (28.6 percent) and substance use disorders (14.7 percent). For all three groups of disorders, DALYs occurred across the lifespan (figure 2.1); however, there was a peak in early adulthood (between ages 20 and 30 years) for mental and substance use disorders compared with neurological disorders, where DALYs were highest in the elderly.

Absolute DALYs for mental, neurological, and substance use disorders increased by 41 percent between 1990 and 2010, from 182 million to 258 million DALYs. With the exception of substance use disorders, where age-standardized DALY rates for opioid, cocaine, and amphetamine dependence increased over time, the increase in absolute DALYs for the other disorders was largely caused by changes in population growth and aging. Table 2.1 summarizes the age-standardized DALY rates for 1990 and 2010.

Table 2.2 summarizes the DALYs assigned to each mental, neurological, and substance use disorder in 2010. These disorders as a group ranked as the third-leading cause of DALYs (explaining 10.4 percent of DALYs), after cardiovascular and circulatory diseases (explaining 11.9 percent of DALYs), and diarrhea, lower

Figure 2.1 DALYs Attributable to Mental, Neurological, and Substance Use Disorders, by Age, 2010



Source: <http://vizhub.healthdata.org/gbd-compare>.

Note: DALYs = disability-adjusted life years.

Table 2.1 Age-Standardized DALY Rates Attributable to Mental, Neurological, and Substance Use Disorders, 1990 and 2010

Disorder	Age-standardized DALY rates (per 100,000)			
	Male		Female	
	1990	2010	1990	2010
<i>Mental disorders</i>				
Major depressive disorder	694.8	689.9	1,171.7	1,161.2
Dysthymia	135.3	135.8	189.7	190.0
Bipolar disorder	172.0	172.1	204.6	204.8
Schizophrenia	230.7	223.0	187.8	180.6
Anxiety disorders	274.3	273.0	508.9	510.3
Eating disorders	4.4	3.9	47.6	59.5
Autism	85.1	85.8	29.5	29.6
Asperger's syndrome	85.2	85.0	20.3	20.3
Attention-deficit hyperactivity disorder	10.8	10.6	3.1	3.1
Conduct disorder	111.9	113.3	47.0	47.6
Idiopathic intellectual disability	25.3	17.7	18.2	11.9
Other mental and behavioral disorders	25.5	23.3	21.5	20.8
<i>Neurological disorders</i>				
Alzheimer's disease and other dementias	125.7	155.5	153.7	178.6
Parkinson's disease	32.7	36.6	23.2	23.3
Epilepsy	261.6	269.3	226.0	232.9
Multiple sclerosis	16.3	12.3	23.7	19.8
Migraine	233.1	236.6	405.9	415.8
Tension-type headache	24.1	24.0	28.3	28.3
Other neurological disorders	228.0	259.9	200.0	266.7
<i>Substance use disorders</i>				
Alcohol use disorders ^a	431.0	409.9	117.2	106.0
Opioid dependence	139.0	184.4	63.8	78.4
Cocaine dependence	22.5	22.0	10.3	9.7
Amphetamine dependence	45.4	47.3	26.9	27.6
Cannabis dependence	38.8	36.7	22.3	21.3
Other drug use disorders	83.7	97.0	44.6	47.9

Source: <http://vizhub.healthdata.org/gbd-compare/>.

Note: DALY = disability-adjusted life year.

a. Alcohol use disorders include alcohol dependence and fetal alcohol syndrome.

respiratory infections, meningitis, and other common infectious diseases (explaining 11.4 percent of DALYs). Major depressive disorder was responsible for the highest proportion of mental, neurological, and substance use disorder DALYs (24.5 percent); attention-deficit hyperactivity disorder was responsible for the lowest (0.2 percent).

Overall, in 2010, 124 million mental, neurological, and substance use DALYs occurred among males and 134 million among females. Figure 2.2 shows DALY rates for each mental, neurological, and substance use disorder by gender. Females accounted for more DALYs for most of the mental and neurological disorders, except for mental disorders occurring in childhood, schizophrenia,

Table 2.2 DALYs Attributable to Mental, Neurological, and Substance Use Disorders, 2010

Disorder	Absolute DALYs (to the nearest 100,000)	Proportion of total (all-cause) DALYs (%)	Proportion of mental, neurological, and substance use disorder DALYs (%)
Mental disorders			
Major depressive disorder	63,200,000	2.5	24.5
Dysthymia	11,100,000	0.4	4.3
Bipolar disorder	12,900,000	0.5	5.0
Schizophrenia	13,600,000	0.5	5.3
Anxiety disorders	26,800,000	1.1	10.4
Eating disorders	2,200,000	0.1	0.9
Autism	4,000,000	0.2	1.6
Asperger's syndrome	3,700,000	0.1	1.4
Attention-deficit hyperactivity disorder	500,000	0.02	0.2
Conduct disorder	5,800,000	0.2	2.2
Idiopathic intellectual disability	1,000,000	0.04	0.4
Other mental disorders	1,500,000	0.1	0.6
Subtotal	146,300,000	5.9	56.7
Neurological disorders			
Alzheimer's disease and other dementias	11,400,000	0.5	4.4
Parkinson's disease	1,900,000	0.1	0.7
Epilepsy	17,400,000	0.7	6.8
Multiple sclerosis	1,100,000	0.04	0.4
Migraine	22,400,000	0.9	8.7
Tension-type headache	1,800,000	0.1	0.7
Other neurological disorders	17,900,000	0.7	6.9
Subtotal	73,900,000	3.0	28.6
Substance use disorders			
Alcohol use disorders ^a	17,700,000	0.7	6.9
Opioid dependence	9,200,000	0.4	3.6
Cocaine dependence	1,100,000	0.04	0.4
Amphetamine dependence	2,600,000	0.1	1.0
Cannabis dependence	2,100,000	0.1	0.8
Other drug use disorders	5,100,000	0.2	2.0
Subtotal	37,800,000	1.5	14.7

Source: <http://vizhub.healthdata.org/gbd-compare/>.

Note: DALYs = disability-adjusted life years. DALYs were aggregated across all country, gender, and age groups for 2010.

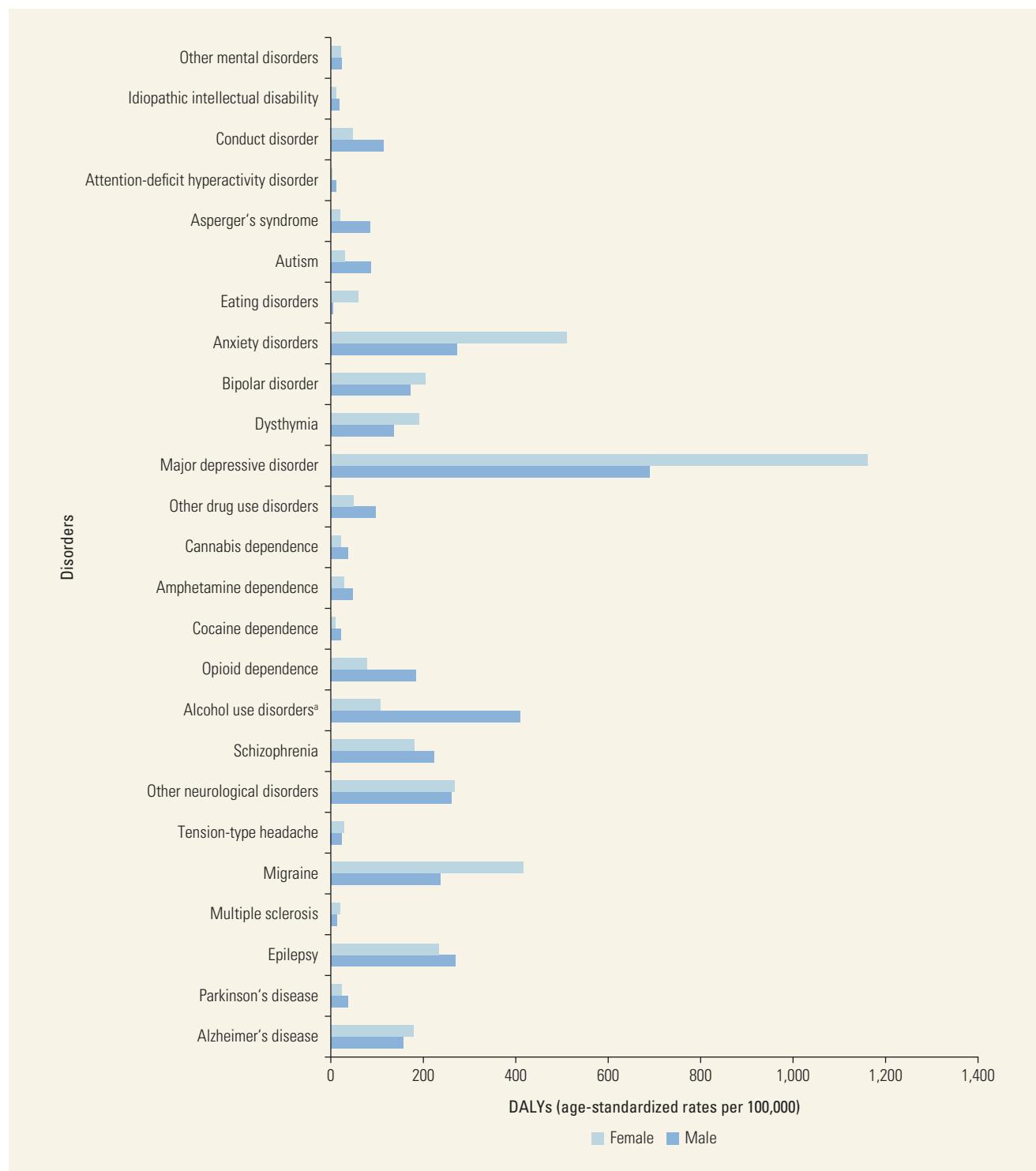
a. Alcohol use disorders include alcohol dependence and fetal alcohol syndrome.

Parkinson's disease, and epilepsy, where males accounted for more DALYs. Males also accounted for more DALYs than females in all substance use disorders.

Figure 2.3 shows the burden attributable to mental, neurological, and substance use disorders as a group

in 2010 by the GBD 2010 superregion groupings and by developed and developing world regions. Overall, the burden of these disorders as age-standardized rates was approximately 1.6 times higher in developed regions (explaining 15.5 percent of total DALYs) compared

Figure 2.2 Age-Standardized DALY Rates Attributable to Individual Mental, Neurological, and Substance Use Disorders, by Gender, 2010



Source: <http://vizhub.healthdata.org/gbd-compare/>.

Note: DALY = disability-adjusted life year.

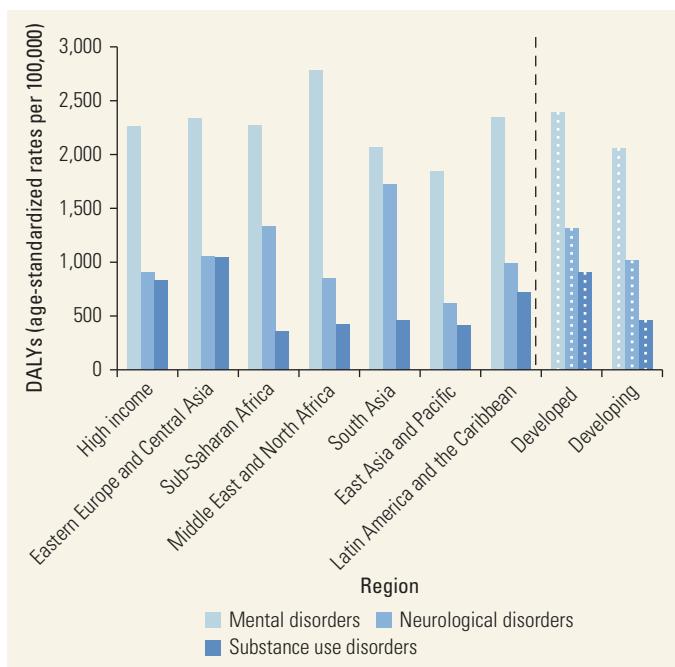
a. Alcohol use disorders include alcohol dependence and fetal alcohol syndrome.

with developing regions (explaining 9.4 percent of total DALYs). When disaggregated by GBD superregions, the burden of mental, neurological, and substance use disorders was highest in Eastern Europe and Central Asia and lowest in East Asia and Pacific. Mental disorders maintained the highest proportion of DALYs in all superregions; the greatest variation in DALYs occurred within substance use disorders, where DALYs were almost three times higher in Eastern Europe and Central Asia, compared with Sub-Saharan Africa, where DALYs were lowest.

Figure 2.4 illustrates the decomposition of global burden by YLDs and YLLs for the overall categories of communicable diseases, noncommunicable diseases, and injuries. Noncommunicable diseases explained a large proportion of YLDs and YLLs in 2010. Within this group, mental, neurological, and substance use disorders were responsible for 28.5 percent of all YLDs, making them the leading cause of YLDs worldwide.

In comparison, mental, neurological, and substance use disorders contributed to only 2.3 percent of YLLs. Deaths and YLLs could be assigned to a mental, neurological, or substance use disorder only when the disorder was considered as a direct cause of death in the ICD-10 cause-of-death directory. Using this approach, the majority of excess deaths in individuals with a mental disorder, in particular, were coded to the direct physical cause of death (for example, suicide deaths were coded

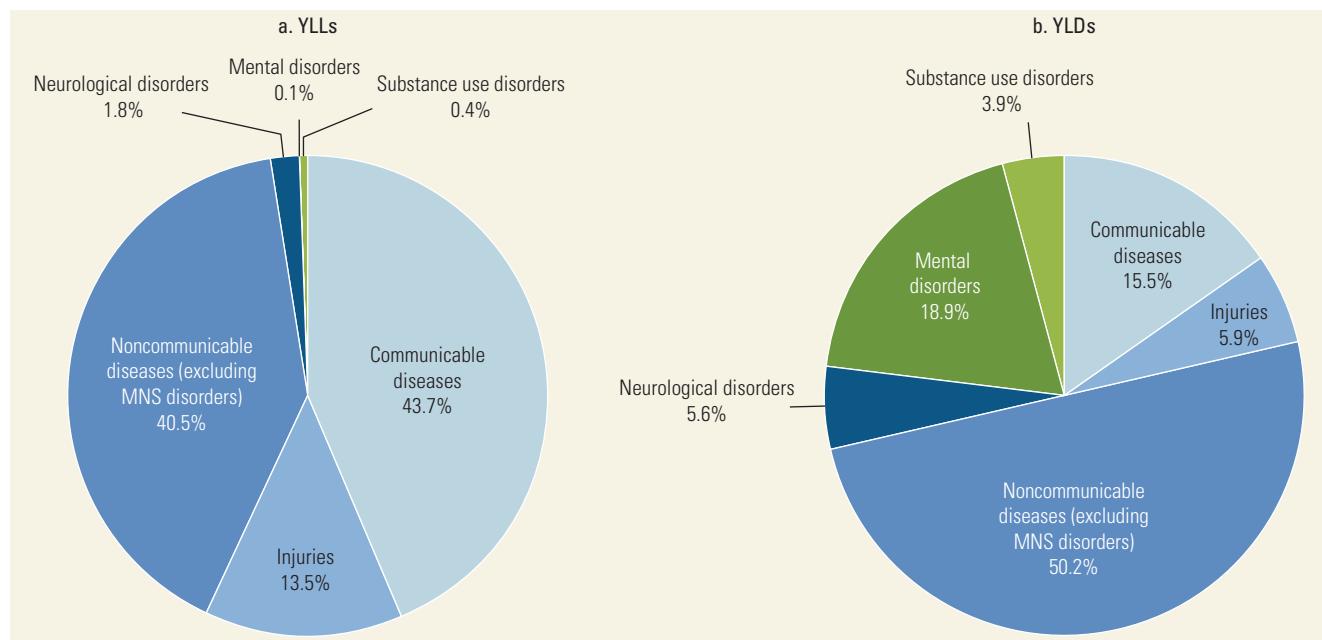
Figure 2.3 Age-Standardized DALY Rates Attributable to Mental, Neurological, and Substance Use Disorders, by Region, 2010



Source: <http://vizhub.healthdata.org/gbd-compare/>.

Note: DALY = disability-adjusted life year. DALYs were disaggregated by GBD 2010's seven superregion groups—East Asia and Pacific, Eastern Europe and Central Asia, high-income regions (North America, Australasia, Western Europe, high-income Asia Pacific, and southern Latin America), Latin America and the Caribbean, the Middle East and North Africa, South Asia, and Sub-Saharan Africa—and by developed and developing regions.

Figure 2.4 Proportion of Global YLDs and YLLs Attributable to Mental, Neurological, and Substance Use Disorders, 2010



Source: <http://vizhub.healthdata.org/gbd-compare/>.

Note: MNS = mental, neurological, and substance use; YLLs = years of life lost; YLDs = years lived with disability.

under injuries as self-harm) rather than to the disorder. An analysis of excess mortality in individuals with mental, neurological, and substance use disorders and the implications for burden of disease estimates is presented in chapter 3 in this volume (Charlson and others 2015).

IMPLICATIONS OF THE GBD 2010 FINDINGS FOR MENTAL, NEUROLOGICAL, AND SUBSTANCE USE DISORDERS

Mental, neurological, and substance use disorders are a leading cause of the disease burden worldwide, substantially contributing to health loss in individuals of all ages, from developed and developing regions.

In GBD 2010, the differences in DALYs between mental, neurological, and substance use disorders were guided by differences in the prevalence, death, and disability weights associated with each disorder. The input data that were used to estimate burden are presented in greater detail elsewhere (Baxter and others 2015; Baxter and others 2014a; Baxter and others 2014b; Degenhardt, Baxter, and others 2014; Degenhardt, Charlson, and others 2014; Degenhardt, Ferrari, and others 2013; Erskine and others 2013; Ferrari and others 2013a; Ferrari and others 2013b; Saha and others 2005). Mental disorders, such as anxiety and depressive disorders, were associated with high levels of prevalence and disability. In comparison, schizophrenia was associated with low prevalence but high levels of disability; an acute state of schizophrenia obtained the highest disability weight in GBD 2010. The same was true for opioid dependence, which, although it had lower prevalence in comparison with other substance use disorders like cannabis dependence, was associated with high disability and death. Migraine, in contrast, was associated with high levels of prevalence but low disability.

Analysis of burden estimates across time illustrated how population growth and a changing age profile between 1990 and 2010 produced a shift in the global disease burden from communicable to noncommunicable diseases and from YLLs to YLDs (Murray, Vos, and others 2012). With improvements in infant and maternal health and declining rates of mortality caused by infectious diseases, particularly in developing regions, more people are now living to the age where noncommunicable diseases such as mental, neurological, and substance use disorders are most prevalent. This demographic and epidemiological transition is contributing to a rise in the absolute burden of mental, neurological, and substance use disorders (Whiteford, Degenhardt, and others 2013).

Although not adopted in GBD 2010, the use of age weighting in many economic analyses and in earlier

GBD studies (Murray and Acharya 1997) recognizes and attempts to incorporate the social preference for avoiding health loss in young adults. In spite of the absence of age weighting in the GBD 2010 estimates, the peak impact of mental, neurological, and substance use disorders in early adulthood remained and demonstrated the ubiquitous effect of these disorders at a time of life when individuals are starting to make significant social and economic contributions to their families and societies. The peak in the total burden of mental, neurological, and substance use disorders was found in young adults. However, unlike many chronic diseases, there is a significant burden in children, lending further evidence to the importance of early intervention strategies for mental, neurological, and substance use disorders.

The presentation of burden estimates by age in GBD 2010 facilitates the selection and tailoring of intervention strategies for mental, neurological, and substance use disorders. For instance, it allows us to identify the ages at which interventions would be most beneficial. Historically, mental, neurological, and substance use disorders occurring in childhood have not been well represented in burden of disease analyses. GBD 2010 was the first study to estimate the burden associated with childhood mental disorders like autism, Asperger's disorder, attention-deficit hyperactivity disorder, and conduct disorder. For countries such as those in Sub-Saharan Africa, where children constitute 40 percent of the population (UN 2011), these findings highlight the need for prevention and treatment services targeted to children and adolescents. The availability of such services is often more sporadic than that of adult services. In addition, the high burden of neurological disorders in elderly persons emphasizes the need for the development and implementation of more effective prevention strategies for these disorders, especially given the worldwide aging of the population, as well as the need for equitable health care resource allocation for people affected by neurological disorders.

The GBD 2010 burden estimates also underlined the extent of the challenge faced by health systems in developed and developing regions as a result of mental, neurological, and substance use disorders. Mental disorder DALYs are highest in the Middle East and North Africa, substance use disorder DALYs are highest in Eastern Europe and Central Asia, and neurological disorder DALYs are highest in South Asia. These regional differences are driven by the global distribution of disorder prevalence and, in some instances, deaths. Analysis of GBD 2010 prevalence data for mental disorders highlighted the effect of conflict status on the estimates. The prevalence of major depressive disorder and anxiety disorders was highest in countries with a history of conflict or war, many of which are in

the Middle East and North Africa (Baxter and others 2014b; Ferrari and others 2013a).

The prevalence of opioid and cannabis dependence was highest in Australasia and Western Europe (Degenhardt, Charlson, and others 2014; Degenhardt, Ferrari, and others 2013). Cocaine dependence was highest in the North America, high-income, and southern Latin America. Although there was less regional variation in the prevalence of amphetamine dependence, the rates were highest in Southeast Asia and Australasia (Degenhardt, Baxter, and others 2014). The largest contributor of deaths and YLLs for drug use disorders was opioid dependence, with particularly high proportions of deaths caused by opioid dependence occurring in the North America high-income region, Eastern Europe, and southern Sub-Saharan Africa.

In many Eastern European and Sub-Saharan African countries, access to interventions found to be effective in reducing the risk of mortality from opioid dependence—such as opioid substitution therapy, needle and syringe programs, and HIV treatment for those who are HIV-positive—is limited. Access to these interventions in the North America High-income region varies subnationally, with insufficient data to determine access rates at the national level (Degenhardt, Charlson, and others 2014). Prevalence and deaths attributable to Alzheimer's disease were highest in North America, high-income Western Europe, and Australasia. In contrast, prevalence and deaths attributable to epilepsy were highest in Sub-Saharan Africa. The geographic differences in the burden of such neurological disorders should be used to inform research priorities and evidence-based, region-specific service delivery and health care planning. Effective interventions have been identified for mental, neurological, and substance use disorders and are described in the following chapters.

YLDs explained a larger proportion of the burden due to mental, neurological, and substance use disorders compared with YLLs. To estimate YLLs, GBD 2010 followed the ICD-10 cause-of-death categories, whereby deaths can only be assigned to a given condition when it is considered a direct cause of death. This approach can only account for some of the excess deaths attributable to mental, neurological, and substance use disorders, given that deaths will also be coded to the direct physical cause of death. For instance, ischemic heart disease or suicide deaths occurring as a result of major depressive disorder will be coded to cardiovascular disease or injuries rather than to major depressive disorder.

The additional burden attributable to mental, neurological, and substance use disorders as a risk factor for other health outcomes can be investigated through comparative risk assessment analysis, which compares

the current health status with a theoretical minimum risk exposure, in this case, the counterfactual status of the absence of mental, neurological, and substance use disorders in the population. The use of this method to estimate the additional burden due to mental and substance use disorders as risk factors for suicide showed that these disorders could account for approximately 60 percent of suicide YLLs in GBD 2010; this would have increased the overall burden of mental and substance use disorders in 2010 from 7.4 percent to 8.3 percent of global DALYs (Ferrari and others 2014). Chapter 3 in this volume (Charlson and others 2015) explores this issue further and presents an analysis of excess mortality in individuals with mental, neurological, and substance use disorders and the implications of this for burden of disease estimates.

LIMITATIONS OF GBD 2010 AND DIRECTIONS FOR FUTURE RESEARCH

Although it represents the most comprehensive assessment of the burden due to mental, neurological, and substance use disorders to date, not all elements of the burden were captured in GBD 2010. By focusing on health loss, the burden in GBD 2010 does not extend to welfare loss; hence, it does not capture all the consequences of mental, neurological, and substance use disorders for families or societies. For a more complete picture of the burden imposed by mental, neurological, and substance use disorders, future research should focus on quantifying the associated welfare losses.

Disability weights in GBD 2010 were derived by surveying the general population (rather than by clinicians, as in previous GBD studies), with the aim of better capturing the societal view of health loss. Nevertheless, adequately encompassing the complexity of health states that represent mental, neurological, and substance use disorders within the survey was challenging; the extent to which the GBD 2010 disability weights entirely reflected the associated health loss is an important area for further research.

Furthermore, the established definitions of mental, neurological, and substance use disorders used in the study may not be sensitive to non-Western presentations of these disorders, which may have led to an underestimation of burden in developing regions. Although these disorders exist in all countries, cultures influence their development and presentation. The predominantly Western-based definitions of mental, neurological, and substance use disorders can be in conflict with cultural contexts (Jorm 2006), leading to challenges in assembling data on global epidemiology. For example, some

languages do not have the words to describe concepts such as “sadness” or “depression” consistent with how they are described in Western countries. Explanations for the onset and progression of mental, neurological, and substance use disorders may be explained through mechanisms such the presence of spirits or curses, rather than as medical disorders (Jorm 2006).

Epidemiological surveys in many LMICs tend to capture somatic manifestations of disorders such as depression and anxiety, which may not be as relevant to other countries and cultures (Cheng 2001; Whiteford, Ferrari, and others 2013; Yang and Link 2009). In their survey of mental disorders in China, Phillips and others (2009) concluded that some cases of minor depression were likely misdiagnosed cases of major depressive disorder, given that standard diagnostic criteria were not sensitive to cross-cultural presentations of this disorder. A task for upcoming GBD analyses will be to explore the extent to which certain disorders are misdiagnosed as other mental or physical disorders in developing countries and the consequence on burden.

Finally, regular updating of burden of disease estimates, using the most up-to-date epidemiological data and burden estimation methodology is important. After GBD 2010 was published, the Institute for Health Metrics and Evaluation at the University of Washington endeavored to make available yearly updates of burden of disease estimates. The Global Burden of Disease Study 2013 (GBD 2013) published in 2015 was the first of these updates (GBD 2013 DALYs Hale Collaborators 2015). Although high-level findings were largely consistent between GBD 2010 and GBD 2013, continued updating of estimates presented in this chapter is required.

CONCLUSIONS

According to the findings in GBD 2010, mental, neurological, and substance use disorders contribute to a significant proportion of the global burden of disease and will continue to do so as the shift in burden from communicable to noncommunicable diseases continues. Health systems worldwide can respond to these findings by implementing proven, cost-effective interventions; where these are limited, it will be important to support the research necessary to develop better prevention and treatment options.

Although GBD 2010 represents the most comprehensive assessment of the burden due to mental, neurological, and substance use disorders to date, some limitations need to be acknowledged. For instance, the definition of burden in GBD 2010 does not extend to welfare loss; accordingly, it does not capture all the consequences of mental, neurological, and substance use disorders on

societies. Definitions of mental, neurological, and substance use disorders and the subsequent quantification of disability may not be fully representative of non-Western presentations of these disorders. Further research into the cross-cultural presentations of these disorders is required for a more comprehensive analysis of burden.

ANNEX

The annex to this chapter is as follows. It is available at <http://www.dcp-3.org/mentalhealth>.

- Annex 2A. Global Burden of Mental, Neurological, and Substance Use Disorders: An Analysis from the Global Burden of Disease Study 2010

NOTE

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REFERENCES

- Alonso, J., S. Chatterji, and Y. He, eds. 2013. *The Burdens of Mental Disorders: Global Perspectives from the WHO World Mental Health Surveys*. Cambridge, U.K.: Cambridge University Press.
- APA (American Psychiatric Association). 2000. *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR)*. 4th ed. Text Revision ed. Washington, DC: APA.
- Baxter, A. J., T. S. Brugha, H. E. Erskine, R. W. Scheurer, T. Vos, and others. 2015. “The Epidemiology and Global Burden of Autism Spectrum Disorders.” *Psychological Medicine* 45 (3): 601–13. doi:21.1017/S003329171400172X.
- Baxter, A. J., G. Patton, L. Degenhardt, K. M. Scott, and H. A. Whiteford. 2013. “Global Epidemiology of Mental Disorders: What Are We Missing?” *PLoS One* 8 (6): e65514.
- Baxter, A. J., T. Vos, K. M. Scott, A. J. Ferrari, and H. A. Whiteford. 2014a. “The Global Burden of Anxiety Disorders in 2010.” *Psychological Medicine* 44 (11): 2363–74.
- Baxter, A. J., T. Vos, K. M. Scott, R. E. Norman, A. D. Flaxman, and others. 2014b. “The Regional Distribution of Anxiety Disorders: Implications for the Global Burden of Disease Study, 2010.” *International Journal of Methods in Psychiatric Research* 23 (4): 422–38. doi:10.1002/mpr.1444.
- Charlson, F. J., A. J. Baxter, T. Dua, L. Degenhardt, H. A. Whiteford, and T. Vos. 2015. “Excess Mortality from Mental, Neurological, and Substance Use Disorders in the Global Burden of Disease Study 2010.” In *Disease*

- Control Priorities* (third edition): Volume 4, *Mental, Neurological, and Substance Use Disorders*, edited by V. Patel, D. Chisholm, T. Dua, R. Laxminarayan, and M. E. Medina-Mora. Washington, DC: World Bank.
- Cheng, A. T. 2001. "Case Definition and Culture: Are People All the Same?" *British Journal of Psychiatry* 179: 1–3.
- Degenhardt, L., A. J. Baxter, Y. Y. Lee, W. Hall, G. E. Sara, and others. 2014. "The Global Epidemiology and Burden of Psychostimulant Dependence: Findings from the Global Burden of Disease Study 2010." *Drug and Alcohol Dependence* 137: 37–47.
- Degenhardt, L., C. Bucello, B. Calabria, P. Nelson, A. Roberts, and others. 2011. "What Data Are Available on the Extent of Illicit Drug Use and Dependence Globally? Results of Four Systematic Reviews." *Drug and Alcohol Dependence* 117 (2–3): 85–101.
- Degenhardt, L., F. Charlson, B. Mathers, W. D. Hall, A. D. Flaxman, and others. 2014. "The Global Epidemiology and Burden of Opioid Dependence: Results from the Global Burden of Disease 2010 Study." *Addiction* 109 (8): 1320–33.
- Degenhardt, L., A. J. Ferrari, B. Calabria, W. D. Hall, R. E. Norman, and others. 2013. "The Global Epidemiology and Contribution of Cannabis Use and Dependence to the Global Burden of Disease: Results from the GBD 2010 Study." *PLoS One* 8 (10): e76635.
- Degenhardt, L., H. A. Whiteford, A. J. Ferrari, A. J. Baxter, F. J. Charlson, and others. 2013. "The Global Burden of Disease Attributable to Illicit Drug Use: Results from the GBD 2010 Study." *The Lancet* 382 (9904): 1564–74.
- Erskine, H. E., A. J. Ferrari, P. Nelson, G. V. Polanczyk, A. D. Flaxman, and others. 2013. "Research Review: Epidemiological Modelling of Attention-Deficit/Hyperactivity Disorder and Conduct Disorder for the Global Burden of Disease Study 2010." *Journal of Child Psychology and Psychiatry* 54 (12): 1263–74.
- Erskine, H. E., A. J. Ferrari, G. V. Polanczyk, T. E. Moffitt, C. J. L. Murray, and others. 2014. "The Global Burden of Conduct Disorder and Attention-Deficit/Hyperactivity Disorder in 2010." *Journal of Child Psychology and Psychiatry, and Allied Disciplines* 55 (4): 328–36.
- Ferrari, A. J., A. J. Baxter, and H. A. Whiteford. 2010. "A Systematic Review of the Global Distribution and Availability of Prevalence Data for Bipolar Disorder." *Journal of Affective Disorders* 34 (1–3): 1–13.
- Ferrari, A. J., F. J. Charlson, R. Norman, A. D. Flaxman, S. B. Patten, and others. 2013. "The Epidemiological Modelling of Major Depressive Disorder: Application for the Global Burden of Disease Study 2010." *PLoS One* 8 (7): e69637.
- Ferrari, A. J., F. J. Charlson, R. E. Norman, S. B. Patten, C. J. L. Murray, and others. 2013. "Burden of Depressive Disorders by Country, Sex, Age, and Year: Findings from the Global Burden of Disease Study 2010." *PLoS Medicine* 10 (11): e1001547.
- Ferrari, A. J., R. E. Norman, G. Freedman, A. J. Baxter, J. E. Pirkis, and others. 2014. "The Burden Attributable to Mental and Substance Use Disorders as Risk Factors for Suicide: Findings from the Global Burden of Disease Study 2010." *PLoS One* 9 (4): e91936.
- GBD 2013 DALYs Hale Collaborators. 2015. "Global, Regional, and National Disability-Adjusted Life Years (DALYs) for 306 Diseases and Injuries and Healthy Life Expectancy (HALE) for 188 countries, 1990–2013: Quantifying the Epidemiological Transition." *The Lancet* Epub August 26. doi: [http://dx.doi.org/10.1016/S0140-6736\(15\)61340-X](http://dx.doi.org/10.1016/S0140-6736(15)61340-X).
- Jorm, A. F. 2006. "National Surveys of Mental Disorders: Are They Researching Scientific Facts or Constructing Useful Myths?" *Australian and New Zealand Journal of Psychiatry* 40: 830–34.
- Lim, S. S., T. Vos, A. D. Flaxman, G. Danaei, K. Shibuya, and others. 2012. "A Comparative Risk Assessment of Burden of Disease and Injury Attributable to 67 Risk Factors and Risk Factor Clusters in 21 Regions, 1990–2010: A Systematic Analysis for the Global Burden of Disease Study 2010." *The Lancet* 380: 2224–60.
- Lozano, R., M. Naghavi, K. Foreman, S. Lim, K. Shibuya, and others. 2012. "Global and Regional Mortality from 235 Causes of Death for 20 Age Groups in 1990 and 2010: A Systematic Analysis for the Global Burden of Disease Study 2010." *The Lancet* 380 (9859): 2095–128.
- Murray, C. J. L., and A. K. Acharya. 1997. "Understanding DALYs." *Journal of Health Economics* 16: 703–30.
- Murray, C. J. L., M. Ezzati, A. Flaxman, S. Lim, R. Lozano, and others. 2012. "GBD 2010: Design, Definitions, and Metrics." *The Lancet* 380 (9859): 2063–66.
- Murray, C. J. L., and A. D. Lopez, eds. 1996. *The Global Burden of Disease: A Comprehensive Assessment of Mortality and Disability from Diseases, Injuries, and Risk Factors in 1990 and Projected to 2020*. Cambridge, MA: Harvard University Press.
- Murray, C. J. L., T. Vos, R. Lozano, M. Naghavi, A. D. Flaxman, and others. 2012. "Disability-Adjusted Life Years (DALYs) for 291 Diseases and Injuries in 21 Regions, 1990–2010: A Systematic Analysis for the Global Burden of Disease Study 2010." *The Lancet* 380 (9859): 2197–223.
- Phillips, M. R., J. Zhang, Q. Shi, Z. Song, Z. Ding, and others. 2009. "Prevalence, Treatment, and Associated Disability of Mental Disorders in Four Provinces in China during 2001–05: An Epidemiological Survey." *The Lancet* 373 (9680): 2041–53.
- Saha, S., D. Chant, J. Welham, and J. McGrath. 2005. "A Systematic Review of the Prevalence of Schizophrenia." *PLoS Medicine* 2 (5): e141.
- Salomon, J. A., H. Wang, M. K. Freeman, T. Vos, A. D. Flaxman, and others. 2012. "Healthy Life Expectancy for 187 Countries, 1990–2010: A Systematic Analysis for the Global Burden of Disease Study 2010." *The Lancet* 380 (9859): 2144–62.
- Sassi, F. 2006. "Calculating QALYs, Comparing QALY and DALY Calculations." *Health Policy and Planning* 21 (5): 402–08.
- UN (United Nations). 2011. *World Population Prospects: The 2010 Revision*. New York: UN.
- Vos, T., A. D. Flaxman, M. Naghavi, R. Lozano, C. Michaud, and others. 2012. "Years Lived with Disability (YLDs) for 1,160 Sequelae of 289 Diseases and Injuries 1990–2010:

- A Systematic Analysis for the Global Burden of Disease Study 2010.” *The Lancet* 380 (9859): 2163–96.
- Wang, H., L. Dwyer-Lindgren, K. T. Lofgren, J. K. Rajaratnam, J. R. Marcus, and others. 2012. “Age-Specific and Sex-Specific Mortality in 187 Countries, 1970–2010: A Systematic Analysis for the Global Burden of Disease Study 2010.” *The Lancet* 380: 2071–94.
- Wang, P. S., S. Aguilar-Gaxiola, J. Alonso, M. C. Angermeyer, G. Borges, and others. 2007. “Use of Mental Health Services for Anxiety, Mood, and Substance Disorders in 17 Countries in the WHO World Mental Health Surveys.” *The Lancet* 370 (9590): 841–50.
- Wang, P. S., M. Angermeyer, G. Borges, R. Bruffaerts, W. Tat Chiu, and others. 2007. “Delay and Failure in Treatment Seeking after First Onset of Mental Disorders in the World Health Organization’s World Mental Health Survey Initiative.” *World Psychiatry* 6 (3): 177–85.
- Whiteford, H. A., L. Degenhardt, J. Rehm, A. J. Baxter, A. J. Ferrari, and others. 2013. “The Global Burden of Mental and Substance Use Disorders, 2010.” *The Lancet* 382 (9904): 1575–86.
- Whiteford, H. A., A. J. Ferrari, A. J. Baxter, F. J. Charlson, and L. Degenhardt. 2013. “How Did We Arrive at Burden of Disease Estimates for Mental and Illicit Drug Use Disorders in the Global Burden of Disease Study 2010?” *Current Opinion in Psychiatry* 26 (4): 376–83.
- WHO (World Health Organization). 1992. *The ICD-10 Classification of Diseases: Clinical Descriptions and Diagnostic Guidelines*. Geneva: WHO.
- . 2008. *The Global Burden of Disease: 2004 Update*. Geneva: WHO.
- Yang, L. H., and B. G. Link. 2009. “Comparing Diagnostic Methods for Mental Disorders in China.” *The Lancet* 373 (9680): 2002–04.