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Global Burden Of Disease Studies: Implications For Mental And Substance Use Disorders

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ABSTRACT Global Burden of Disease studies have highlighted mental and substance use disorders as the leading cause of disability globally. Using the studies' findings for policy and planning requires an understanding of how estimates are generated, the required epidemiological data are gathered, disability and premature mortality are defined and counted, and comparative risk assessment for risk-factor analysis is undertaken. The high burden of mental and substance use disorders has increased their priority on the global health agenda, but not enough to prompt concerted action by governments and international agencies. Using Global Burden of Disease estimates in health policy and planning requires combining them with other information such as evidence on the cost-effectiveness of interventions designed to reduce the disorders' burden. Concerted action is required by mental health advocates and policy makers to assemble this evidence, taking into account the health, social, and economic challenges facing each country.

Historically, quantifying the burden of disease was compromised by the lack of a common and comparable metric other than mortality. Death rates provide little insight into the burden of prevalent disabling diseases.¹ The disability-adjusted life-year (DALY), introduced in the World Bank's 1993 World Development Report,² combined years of life lost to premature mortality and years lived with disability, with one DALY representing one lost year of healthy life. DALYs provided a metric that could be used to compare the health loss from all diseases and injuries.

The first Global Burden of Disease study, known as GBD 1990, confirmed that demographic changes and the epidemiological transition (change in prevalence and distribution of disease in society) are leading to increased burden of noncommunicable diseases and injuries.¹ Mental and substance use disorders, not prominent in mortality tables, emerged as the leading

cause of disability in GBD 1990, making up five of the ten leading causes—with depression being the single leading cause.

The World Health Organization (WHO) created a Disease Burden Unit in 1998 that generated Global Burden of Disease estimates for 2000, 2001, and 2002; estimates were published in annual World Health Reports. In 2008 the WHO updated the estimates for 2004, expanding the causes of death and disability incrementally.³

The next comprehensive update, GBD 2010, was funded by the Bill & Melinda Gates Foundation and conducted by the Institute for Health Metrics and Evaluation (IHME) at the University of Washington.⁴ It contained estimates of burden of disease for 187 countries for 1990, 2005, and 2010. Compared to GBD 1990, GBD 2010 used greatly improved methodology—for example, it included more comprehensive epidemiological data sets, new disability weights, an improved epidemiological modeling strategy to estimate prevalence and propagate 95 percent uncertain-

ty intervals for all outputs, and a comorbidity adjustment.

In GBD 2010, mental and substance use disorders accounted for 7.4 percent of disease burden (in terms of DALYs) worldwide—more than HIV/AIDS, tuberculosis, diabetes, or transport injuries.⁴ GBD 2010 confirmed the ranking of mental and substance use disorders as the leading cause of disability, accounting for 23 percent of all years lived with disability. The burden of mental and substance use disorders increased by 37.6 percent between 1990 and 2010. For most mental disorders, this increase was a result of population growth and aging, but for alcohol and illicit drug use disorders, it was also a result of increasing prevalence rates.⁵

The burden of mental and substance use disorders is highest in younger people; for example, in the United States these conditions account for as much as 50 percent of all disability in people ages 20–24.⁶ Projections of future disease burden revealed that the magnitude of demographic change in sub-Saharan Africa will result in a major epidemiological transition.⁷ The population of this region is expected to double by 2050, reaching 1.8 billion people, and the growth of the population will be accompanied by significant aging. Because 63 percent of the population was under twenty-five in 2010, 53 percent will be over twenty-five in 2050. This will shift the burden from communicable to noncommunicable diseases and from death to disability in a very pronounced way, with a projected increase of 130 percent in the burden of mental and substance use disorders by 2050.

The most recent Global Burden of Disease study, GBD 2013, was published in 2015.⁸ GBD 2013 estimated the burden of 306 diseases and injuries and 79 risk factors from 1990 to 2013. Mental and substance use disorders were ranked as the fifth leading cause of DALYs and the leading cause of years lived with disability globally. Disorder-specific prevalence remained stable for most mental disorders, but population growth continued to drive an increase in the number of prevalent cases. Meanwhile, some substance use disorders (for example, opioid dependence) increased in prevalence over time.

The most prevalent disorders in GBD 2013, in terms of both rates and number of global cases, were anxiety disorders (266 million cases globally) and major depressive disorder (253 million cases). The least prevalent disorders were those that primarily affected children and adolescents, including eating disorders, attention deficit hyperactivity disorder, Asperger's syndrome, autism, and the relatively less prevalent drug use disorders such as cocaine dependence.^{8–11} The next iteration of the study (GBD 2015) is

under way and will estimate DALYs, years lived with disability, and years of life lost to premature mortality for the period 1990–2015.

If the Global Burden of Disease studies are to be used for policy and planning purposes, it is important to understand how the estimates are generated and can be used. In this article we briefly discuss the key methodological issues relevant to the mental and substance use disorder estimates, the use of burden estimates by policy makers, and the avenues for future work on the burden of disease.

Methodological Challenges In Global Burden Of Disease Studies

Detailed descriptions of the Global Burden of Disease methodology have been provided elsewhere.^{5,8–12} Here we summarize how the technical challenges most relevant to mental and substance use disorders have been dealt with.

ASSEMBLING DATA ON DISORDER PREVALENCE

Estimates of years lived with disability are generated by multiplying the prevalence of a given disorder by its disability weight.¹¹ Prevalence data (along with incidence, remission, and excess mortality data) for the twenty mental and substance use disorders included in GBD 2013 were compiled from systematic reviews of the published and grey literature. The number of disorders in GBD 2013 was larger than it was in GBD 1990 (Exhibit 1). The inclusion of many childhood mental disorders has been particularly important, because overall mental and substance use disorders account for a quarter of all disability in people ages 0–24.¹³ Before GBD 2010, burden was estimated for aggregated groups of drug use and alcohol use disorders, respectively. The inclusion of specific substance use disorders in GBD 2010 and 2013 makes it possible to quantify differences in burden between the types of substance use disorders.

In the search for epidemiological data, GBD studies accept estimates derived from community-representative surveys in which respondents were required to meet the threshold for a case using the *Diagnostic and Statistical Manual of Mental Disorders (DSM)*¹⁴ or the *International Classification of Diseases (ICD)*¹⁵ to be included.

One challenge in assembling these data is that individuals in some cultures are known to express symptoms and signs of mental disorder differently than how they are described in the DSM and ICD diagnostic criteria. While the requirement to use these criteria may bias downward estimates of the burden of mental disorders in some cultures, the adoption of common case definitions is necessary to compare burden across countries. Future studies will need to es-

EXHIBIT 1

Mental and substance use disorders in the Global Burden of Disease (GBD) studies 1990 and 2013

Disorder	GBD 1990	GBD 2013
Schizophrenia	Included	Included
Depressive disorders	Unipolar depression	Major depressive disorder, dysthymia
Bipolar disorder	Bipolar disorder	Bipolar I, bipolar II, bipolar NOS, cyclothymia
Anxiety disorders	OCD, PTSD, panic disorder	OCD, PTSD, panic disorder, agoraphobia, simple phobia, social phobia, GAD, separation anxiety disorder, anxiety NOS
Eating disorders	Not included	Anorexia nervosa, bulimia nervosa
Pervasive developmental disorders	Not included	Autism, Asperger's syndrome
Attention deficit hyperactivity disorder	Not included	Included
Conduct disorder	Not included	Included
Alcohol use disorders	Alcohol use	Alcohol dependence, fetal alcohol syndrome
Cannabis use disorders	Not included	Cannabis dependence
Cocaine use disorders	Illicit drug use ^a	Cocaine dependence
Amphetamine use disorders	Illicit drug use ^a	Amphetamine dependence
Opioid use disorders	Illicit drug use ^a	Amphetamine dependence

SOURCE Authors' analysis of data from Whiteford HA, et al. How did we arrive at burden of disease estimates for mental and illicit drug use disorders in the Global Burden of Disease study 2010? (see Note 16 in text). **NOTES** NOS is not otherwise specified. OCD is obsessive-compulsive disorder. PTSD is post-traumatic stress disorder. GAD is generalized anxiety disorder. ^aThe estimate in GBD 1990 referred to "illicit drug use" and appeared to be an estimate of opioid, cocaine, and amphetamine dependence combined.

EXHIBIT 2

Epidemiological studies included in the Global Burden of Disease study 2013 for information about mental and substance use disorders

Disorder	Number of studies by parameter			
	Prevalence	Incidence	Remission or duration	Excess mortality
Major depressive disorder	178	4	5	12
Dysthymia	52	2	2	0
Anxiety disorders	111	4	6	0
Bipolar disorder	39	2	0	6
Schizophrenia	56	25	5	24
Anorexia nervosa	41	6	18	19
Bulimia nervosa	40	4	13	8
Conduct disorder	39	4	5	0
Attention deficit hyperactivity disorder	82	2	11	1
Autism	39	4	4	3
Asperger's syndrome	17	3	1	1
Alcohol dependence	132	1	3	40
Fetal alcohol syndrome	40	0	0	6
Cannabis dependence	131	2	3	0
Cocaine dependence	72	0	4	7
Amphetamine dependence	72	0	4	7
Opioid dependence	47	0	11	43

SOURCE Authors' analysis of data from Global Burden of Disease Study 2013 Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990–2013 (see Note 11 in text).

establish definitions for each diagnosis that take into account the variance in symptomology across cultures to better quantify the prevalence of mental disorders in different cultures.¹⁶

LACK OF COUNTRY-LEVEL DATA The data available for use in Global Burden of Disease studies is limited. Exhibit 2 shows the number of epidemiological studies containing information about mental and substance use disorders in GBD 2013. The available data are unequally distributed across disorders, age groups, countries, and epidemiological parameters.^{5,11,12,16} To deal with this issue and be able to include data derived using various study methodologies and designs, GBD 2013 makes use of DisMod-MR, version 2.0, a Bayesian metaregression tool. The software makes it possible to pool all of the epidemiological data available for a given disorder into a weighted average, while simultaneously adjusting for known sources of variability in estimates reported across studies. If raw data are not available for a given country, the software produces an imputed estimate for each epidemiological parameter based on data available from surrounding countries.^{11,17} This allowed GBD 2013 to include estimates for 188 countries.

THE MOVE TO SUBNATIONAL ESTIMATES Policy makers, especially in larger countries, have increasingly requested burden estimates at a level of disaggregation below the national level. In GBD 2013, burden was estimated at the subnational level for eleven subregions in the United

Kingdom, thirty-one provinces in China, and Mexico's thirty-two states.¹¹ In GBD 2015, subnational estimates are expected for more countries, including Brazil, India, Japan, Kenya, Saudi Arabia, South Africa, Sweden, and the United States.

Disaggregating burden to this level enables better understanding of health disparities that may exist within a country and the implications of these disparities for service planning. Nevertheless, generating burden estimates at the country and subnational levels is hindered by limitations in the availability of subnational data—limitations that will remain particularly severe in the short term for mental and substance use disorders and that are reflected in the wide ranges of 95 percent uncertainty around estimates.

DISABILITY WEIGHTS The disability weights in Global Burden of Disease studies are intended to capture short- or long-term health loss to the individual with a particular disorder. Therefore, the weights do not reflect the family, social, and economic consequences of a disorder.¹⁸ In GBD 1990, disability weights were derived from the views of health professionals, with the expectation that those individuals would be best able to make comparative judgments about different health states.¹

In GBD 2010, disability weights were derived from surveys of the general population, which were designed to capture a societal view of the health loss associated with a disorder. Surveys were administered via face-to-face interviews (in Bangladesh, Indonesia, Peru, and Tanzania), telephone interviews (in the United States), and online (through an open-access web-based survey), with over 30,000 participants providing responses to random pairwise comparison questions. In both the face-to-face interviews and online surveys, participants were asked to choose which of two disorder vignettes they considered to be “the healthier.” Paired comparison data underwent a regression analysis, and results were rescaled to disability weight units between 0 (no loss of health) and 1 (loss equivalent to death).¹⁸ For GBD 2013, the disability weights survey was conducted in an additional four countries (Hungary, Italy, Sweden, and the Netherlands). Interestingly, acute schizophrenia had the highest disability weight of all health states in GBD 2013 (0.778). Assembling brief vignettes that capture the complexity of health states for mental and substance use disorder was difficult, and the extent to which they communicate the loss of health attributable to these disorders is an area of ongoing research.¹⁸

Global Burden of Disease disability weights must also accommodate the severity distribution seen in most disorders. This involves dividing

prevalent cases into different health states that represent differing levels of disability. Those states, in turn, are given different disability weights—for example, mild, moderate, or severe¹¹—with adjustments for any additional disability caused by comorbid conditions.¹⁹

THE CHALLENGE OF INCORPORATING PREMATURE MORTALITY Years of life lost to premature mortality are estimated by multiplying the number of deaths at a given age by the standard life expectancy at that age. In GBD 2013, cause-of-death estimates were derived from such sources as vital registration records, verbal autopsy reports, and maternal and child mortality surveillance systems.

The attribution of a death to a given cause relies on the ICD death-coding system, which can assign a death only to its direct cause—not any underlying cause. Because mental disorders are rarely listed as primary causes of death in mortality databases that use the ICD coding system, the premature mortality of individuals with mental disorders²⁰ is rarely captured. Cause-specific mortality data are included in Global Burden of Disease studies only for schizophrenia, alcohol use disorders, drug use disorders, and anorexia nervosa.⁹ Algorithms need to be developed to reallocate deaths to underlying mental disorders, as has been done for alcohol use deaths coded as cardiovascular deaths in some countries and deaths coded as accidental poisonings that resulted from the use of illicit drugs.

RISK-FACTOR ANALYSES In addition to the burden of prevalent disorders, Global Burden of Disease studies estimate deaths, proportion of disability, and DALYs for risks or clusters of risks. This information can be used to develop better targeted prevention policies. In GBD 2013, seventy-nine risk-outcome pairs were assessed for 188 countries for the period 1990–2013.¹⁰

Significant improvements are being made in the ability to estimate the burden posed by mental and substance use disorders as risk factors for a range of health outcomes. For example, GBD 2010 estimated prevalent burden attributable to the use of injected drugs in that year. In GBD 2013, changes were made to allow the attribution of prevalent burden of HIV, hepatitis B, and hepatitis C to the original exposure via injection, which may have occurred in 2013 or many years earlier. This was particularly important for hepatitis C, which can have dramatic impacts on health for people living with chronic infection decades after first being exposed.¹⁰

The prevalent burden was estimated by extracting data on the proportion of reported HIV cases acquired via different transmission routes. These data come from a number of agen-

cies that conduct surveillance of HIV around the globe. In the case of hepatitis B and hepatitis C, a cohort method was used to trace individuals back in time to estimate their history of injected drug use and their accumulated associated risk of incident hepatitis B and C.

A supplementary analysis was undertaken outside of GBD 2010 to estimate the proportion of suicide-related burden attributable to mental and substance use disorders. In Global Burden of Disease studies, deaths from suicide are counted as intentional injuries, in line with ICD coding. However, the inclusion of DALYs attributable to suicide where the cause was a mental or substance use disorder would have increased the overall burden of mental and substance use disorders in GBD 2010 from 7.4 percent to 8.3 percent of global DALYs.²¹ It would also have changed their global ranking from the fifth to the third leading cause of DALYs.

Mental and illicit drug use disorders remain underrepresented in Global Burden of Disease risk-factor analysis because of the lack of data required to estimate burden for a risk factor–outcome pairing. Future work should quantify causal relationships between mental and substance use disorders and other health outcomes. For instance, GBD 2013 estimated that 9.8 million of the DALYs due to mental and substance use disorders could be attributed to child sexual abuse and intimate partner violence.¹⁰

Another major risk factor is trauma resulting from war and civil conflict. Work done to model the impact of the war in Libya found that the prevalence of severe post-traumatic stress disorder had increased to over 12 percent and severe depression to almost 20 percent, in populations exposed to a high level of political terror and traumatic events.²²

Use Of Results By Policy Makers

Thirty-seven countries have undertaken burden-of-disease studies, and many of them—including Australia, Botswana, China, Japan, Mexico, Norway, Rwanda, Saudi Arabia, and the United Kingdom—are using Global Burden of Disease findings to identify the disorders with the largest and increasing burdens. International agencies such as the World Bank and philanthropic organizations such as the Bill & Melinda Gates Foundation also use Global Burden of Disease data to inform their investment decisions.

In Australia a national burden-of-disease study along with findings on service utilization from a national survey on mental health resulted in major initiatives to increase treatment coverage for anxiety and depressive disorders (which cause the greatest burden) and expand the capacity of

primary health care (where most common mental disorders are treated).²³ Within indigenous populations, mental and substance use disorders have been found to be the leading cause of disease burden,²⁴ and a national indigenous mental health policy is now being developed.

In Japan a burden-of-disease study has informed that country's response to its rapidly aging population and complex combination of noncommunicable disease risk factors.²⁵ Regional and cross-national comparisons for countries in the European Union and European Free Trade Association have shown some success in decreasing premature death and disability from most communicable diseases, conditions affecting mothers and infants, and nutritional causes, but the large and increasing disability caused by musculoskeletal disorders and mental and substance use disorders needs to be addressed.²⁶

In much of Africa and low-income countries in parts of Asia, the burden is still dominated by communicable, maternal, nutritional, and newborn diseases.⁸ This is the case in spite of success in reducing the loss of life from many types of communicable diseases and conditions of early childhood, especially diarrheal diseases and lower respiratory infections. Efforts in these countries remain focused on these historical challenges despite the warnings about the growing burden of noncommunicable disease, including that from mental and substance use disorders.⁷

The use of Global Burden of Disease findings by policy makers in mental health will be enhanced by an understanding of the strengths and limitations of the methodology. First, one metric (such as the DALY) cannot capture all necessary information about the impact of disease and injury. The measurements of disability in these studies are intended to capture only health loss. Thus, information about the impact on the family or society, productivity loss, and the cost to the health sector or other social services is needed. For example, a well-known study undertaken for the World Economic Forum estimated that the cumulative global impact of mental disorders in terms of lost economic output may amount to US\$16 trillion over twenty years—equivalent to 25 percent of the 2010 global gross domestic product.²⁷

Second, the size of the burden of any group of disorders needs to be combined with information on how to respond to the burden, especially in low- and middle-income countries. Work done for the third edition of *Disease Control Priorities* and the WHO found that delivering a scaled-up package of mental health interventions for key mental disorders in sub-Saharan Africa and south Asia would cost on the order of US\$3–\$4 per person.²⁸ This is the type of information nec-

essary for government action.

Third, even where the burden of mental disorders is high and cost-effective treatments exist, other considerations may prevent governments from making mental health a higher priority. For example, governments must consider the importance of mental health as a public good, the impact of untreated mental illness in the community, the need for regulation (for example, of service providers), protection from catastrophic costs and the role of insurance, and demand for private-sector provision of mental health services. Using criteria such as these, an analysis for the World Bank found a strong case for public-sector involvement in mental health treatment.²⁹

Fourth, accessing the vast amount of data generated by Global Burden of Disease studies has proved to be challenging for policy makers. GBD 2013 provides estimates of all-cause mortality, deaths by cause, prevalence, years of life lost to premature mortality, years lived with disability, and DALYs by year, age, and sex for 306 diseases and injuries, seventy-nine risk factors, and 1,500 sequelae for 188 countries, twenty-one regions, seven super-regions, and globally.⁸

To help navigate the data, the IHME at the University of Washington has created data visualization tools,³⁰ which allow researchers and policy makers to contrast their countries' results with those of other countries and see how health profiles change over time. All epidemiological inputs and outputs in GBD 2013 can be accessed via the Global Health Data Exchange, the institute's database of health and demographic data.³¹

Another tool, GBD Compare, allows users to compare DALYs, years lived with disability, and

years of life lost to premature mortality by age, sex, country, year, or some combination of the above³² and to rank causes of disease burden at numerous levels of geographic disaggregation. For instance, users can benchmark leading causes of DALYs in the United States against causes in other Group of Twenty (G20) countries.³³ Reports on the policy implications for the world's regions are provided.³⁴

Conclusion

In most countries, mental health as a policy area does not have the priority that is commensurate with the extent of its burden and the potential to reduce that burden. This is often a result of political expediency and the influence of established professional bodies and advocacy groups within a country. Commenting specifically on the lack of policy response to a report for the World Economic Forum,²⁷ Thomas Insel and colleagues argue that in high-income countries, mental illness is still perceived as an individual or family problem, instead of “a policy challenge with significant economic and political implications,”^{35(p128)} and that in many low- and middle-income countries, mental health care is seen as a luxury. The authors also argue that mental health advocates need to do “a better job of explaining to officials and the public the true costs of mental illness” and to “draw attention to the fact that improved mental health leads to better overall health.”^{35(p134)} While this is true, mental health's position on the health policy agenda has improved over time. Global Burden of Disease studies provide an evidence base that contributes to efforts for further improvement. ■

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