

Disease burden and mental health system capacity: WHO Atlas study of 117 low- and middle-income countries

Ryan McBain, Carmel Salhi, Jodi E. Morris, Joshua A. Salomon and Theresa S. Betancourt

Background

Treatment coverage for mental disorders ranges from less than 10% to more than 90% across low- and middle-income (LAMI) countries. Studies have yet to examine whether the capacity of mental health systems might be adversely affected by the burdens of unrelated conditions such as HIV/AIDS.

Aims

To examine whether the magnitude of disease burden from communicable, perinatal, maternal and nutritional conditions – commonly referred to as Group 1 diseases – is inversely associated with mental health system capacity in LAMI countries.

Method

Multiple regression analyses were undertaken using data from 117 LAMI countries included in the 2011 World Health Organization (WHO) Mental Health Atlas. Capacity was

defined in terms of human resources and infrastructure. Regressions controlled for effects of political stability, government health expenditures, income inequality and neuropsychiatric disease burden.

Results

Higher Group 1 disease burden was associated with fewer psychiatrists, psychologists and nurses in the mental health sector, as well as reduced numbers of out-patient facilities and psychiatric beds in mental hospitals and general hospitals ($t = -2.06$ to -7.68 , $P < 0.05$).

Conclusions

Evidence suggests that mental health system capacity in LAMI countries may be adversely affected by the magnitude of their Group 1 disease burden.

Declaration of interest

None.

An estimated 450 million people worldwide currently have at least one mental disorder.¹ Although studies have shown that behavioural and pharmacological interventions are effective in treating symptoms of many of these disorders,² the treatment gap – defined as the difference between the number of individuals with a disorder and the number actually treated – ranges from less than 10% to more than 90% across low- and middle-income (LAMI) countries.^{3–5} This begs the question why some LAMI countries' mental health systems have dramatically greater capacity than others.^{6,7} Why, for example, do some countries have 1 psychiatrist for every 30 000 citizens, while others have 1 for every 4 million? One hypothesis which remains untested is that countries' communicable, maternal, perinatal and nutritional conditions – commonly referred to as Group 1 diseases⁸ – compete for resources that might otherwise be allocated to mental healthcare. Group 1 diseases such as HIV/AIDS, tuberculosis and malaria represent a constellation of conditions that disproportionately affect morbidity and mortality levels in LAMI countries, as compared with high-income countries⁹; and this generates strong *a priori* reason to suspect that Group 1 diseases may undermine mental health system capacity in such settings. Competition for resources within countries' health systems has been consistently documented in areas outside of psychiatric services.^{10,11}

In the present paper, we examine the relationship between Group 1 disease burden and key indicators of mental health system capacity, taking into account disparities in countries' economic development and neuropsychiatric burden of disease. We hypothesised that the magnitude of a country's Group 1 disease burden would be inversely associated with mental health system capacity. We also theorised that the impact of government expenditures on health – one aspect of economic development – would be mediated by Group 1 disease burden, meaning that

health expenditures are initially allocated to address Group 1 diseases, after which resources – including personnel and infrastructure – are targeted towards mental healthcare.

Method

Sample

The sample comprised 117 LAMI countries which were included in the 2011 WHO World Mental Health Atlas survey.⁷ In total, 134 LAMI countries completed the survey; however, 17 had a population under 0.5 million and were excluded from the analysis to avoid distortion in prevalence rates. Table 1 provides further descriptive statistics of the sample.

The WHO Mental Health Atlas represents the largest cross-national inventory of mental health resources currently available, documenting information across several mental health system domains, including legislation, financing, infrastructure and human resources. Although data have been collected in 2001, 2005 and 2011, changes in the operational definitions of indicators and survey items limit the ability to perform longitudinal data analysis.

Mental Health Atlas information is collected by country-based focal points, typically within Ministries of Health. Data predominately reflect country resources between the years 2008 and 2010. In order to facilitate accuracy and consistency, several steps were taken. First, WHO headquarters provided a glossary of operational definitions to ensure that all countries reported information on the same entities, institutions and human resources. Second, once country-based information was transferred to WHO headquarters, a series of validity checks were conducted, including the detection of outliers relative to other

Table 1 Sample demographic information

World Health Organization region	Median population, millions (s.d.)	Median US\$ GNI per capita (s.d.)	Median Group 1 DALYs per 100 000 population (s.d.)
Africa (<i>n</i> = 43)	1.2 (2.8)	680 (1972)	27 846 (11 722)
Americas (<i>n</i> = 21)	1.0 (4.6)	4570 (2645)	3995 (3693)
Eastern Mediterranean (<i>n</i> = 14)	2.7 (4.8)	2310 (2108)	4638 (10 470)
European (<i>n</i> = 20)	0.7 (3.7)	4770 (3011)	2657 (2538)
South-East Asia (<i>n</i> = 9)	5.0 (38.9)	2005 (1075)	10 529 (3391)
Western Pacific (<i>n</i> = 10)	1.1 (42.1)	1405 (2109)	5429 (5113)
Total (<i>n</i> = 117)	1.0 (16.9)	2050 (2718)	8628 (13 082)

GNI, gross national income; DALYs, disability adjusted life years.

countries of the same region and income bracket, as well as outliers relative to the information countries had previously provided in the 2000 and 2005 versions of the Atlas. Third, countries were provided with an opportunity to address mistakes, and if an adequate response was not offered, the data point was removed. A full overview of WHO Atlas data collection methodology can be found in the introduction of the 2011 edition.⁷

Dependent measures: mental health system capacity

Mental health system capacity was defined in this study in terms of an array of key health system indicators across two core domains: human resources and facility infrastructure. Within the domain of human resources, the numbers of psychiatrists, nurses and psychologists per 100 000 population working in the mental health sector were used. Psychiatrists are relatively rare in LAMI countries and are therefore required to assume multifaceted roles, variously diagnosing and treating patients, training staff and managing facilities.¹² In contrast, nurses represent the largest group of employees in most LAMI countries' mental health sectors and are primarily responsible for the oversight and care of patients.^{7,13} Last, psychologists represent a human resource for which the main therapeutic focus is psychosocial (rather than pharmacological) intervention.¹⁴

Infrastructure was measured in terms of psychiatric beds per 100 000 population in mental hospitals and general hospitals, as well as out-patient facilities per 100 000 population. In the context of hospitals, the number of beds is considered to be a more precise indicator of capacity, as countries may have only a few facilities with many beds, or, conversely, many facilities with few beds. In contrast to hospitals, out-patient facilities typically serve patients on a diurnal basis, and therefore the number of facilities is more appropriate.

Availability of additional WHO World Health Statistics data¹⁵ allowed for the creation of three relative outcome measures of mental health system capacity: psychiatrists as a percentage of all physicians in the country, psychiatric beds in general hospitals as a percentage of all hospital beds, and psychiatric beds in mental hospitals as a percentage of all hospital beds. Although the primary dependent measures of interest represent overall (absolute) mental health system capacity, these three additional measures may be conceptualised as measures of relative capacity, i.e. the availability of resources in mental health as a function of countries' overall health systems.

Independent measures

Disease burden

Group 1 disease burden was quantified using age-standardised disability-adjusted life-years (DALYs) for 2004, as reported in the 2008 update of the WHO's Global Burden of Disease Project.⁹

Disability-adjusted life-years represent a health measure which unifies information on years of life lost due to premature mortality and years of life lived in disability. A full description of the statistical methods for deriving country estimates can be found in Annex B of the Global Burden of Disease 2004 update,⁹ but it should suffice to say that a broad range of United Nations (UN) data sources and estimation techniques, with a primary reliance on life tables from all UN member states, are central in this process. Accuracy of Group 1 disease burden estimates is contingent on the quality of countries' information systems, but for the primary contributors to DALYs in Group 1 – such as HIV/AIDS, malaria and diarrhoeal diseases – there are often longitudinal data that were used to inform final figures. As with information on mental health system capacity, any noise in these estimates would bias results towards the null hypothesis (i.e. non-significance).

Communicable, perinatal, maternal and nutritional diseases represent the primary (Group 1) disease cluster affecting LAMI countries and are reported in the WHO's global burden of disease (GBD) estimate as prevalence rates per 100 000 population.¹⁶ For each country in the analysis, the aggregate value of the burden due to all conditions in this group (per 100 000 population) was utilised. As a control measure, the number of DALYs attributable to neuropsychiatric conditions (as of 2004) was also included in analyses. This was utilised to account for the fact that, in countries with a more severe burden of neuropsychiatric conditions (e.g. as a consequence of war), the demand for mental health system capacity is likely to be greater. The inclusion of neuropsychiatric condition DALYs also accounts for possible reverse causation, whereby greater mental health system capacity reduces neuropsychiatric burden of disease and potentially affects resources available for treating Group 1 diseases.

Economic measures

Health system capacity is closely related to more general measures of a country's economic development. For example, wealthier countries typically allocate a higher percentage of their budget to healthcare.¹⁷ Conversely, poorer countries are more likely to have recently concluded a civil war, over the course of which infrastructure such as hospitals and community-based facilities are often compromised or intentionally destroyed.¹⁸

We selected three variables to capture economic disparities across countries. The first – government health expenditures per capita in 2006,¹⁵ measured in international dollars at purchasing power parity (PPP \$) – reflects both national-level income and resource allocation to health systems. On the one hand, if a fixed percentage of national-level income were directed to the health sector across all countries (e.g. 5%), this would translate into greater government health expenditures in absolute terms for countries with a larger income per capita. However, as

noted above, wealthier countries also tend to allocate a greater relative amount (percentage) of income to health. Thus, although income per capita alone could be used as a base measure of countries' economic development, utilising only the proportion directed to the health sector more accurately reflects financial resources available for developing health system capacity, which is the overarching outcome of interest in this study.

The second variable related to economic status was the 2006 Failed State Index, which is a multifaceted indicator of country governance and political stability, published yearly by the Fund for Peace.¹⁹ The confluence of poverty, social unrest and civil war can render governments incapacitated or unwilling to develop health system infrastructure; a country's Failed State Index score provides a unique vantage point for viewing this interaction.

The third economic variable used was the Gini coefficient, which measures income inequality. In most LAMI countries, income is positively skewed such that measures like income per capita insufficiently capture the average financial means of an individual. The Gini coefficient internalises this by indexing the heterogeneity (or statistical dispersion) of income within a country. Studies have shown that income inequality within and across countries is associated with greater prevalence of mental disorders.^{20,21} Gini coefficients are not available for all countries in every year; for our analysis we included the most recent value available for each country, which ranged between the years 2000 and 2010.

Methods of analysis

Ordinary least squares multiple linear regression analyses were conducted using STATA/SE 12.0 for Windows. The first model included only Group 1 disease burden as an explanatory variable. A second model included only economic measures in order to characterise the unadjusted relationship between overall country development and mental health system capacity. In the third step, both sets of independent variables were entered alongside DALYs from neuropsychiatric conditions, in order to account simultaneously for the range of possible predictors of mental health system indicators. Variables, apart from the Failed State Index, were highly positively skewed and were therefore log-transformed.

Missing data were addressed using a multiple imputation approach with 100 simulations. This approach characterises the joint probability distribution of all of the variables in the data-set to create multiple simulated values for missing observations, thereby reducing bias in addition to accounting for sampling variability across imputations.²² Although in most instances missing data were minimal, for four measures missingness was greater than 10%: the Failed State Index (11.1%), the number of nurses working in the mental health sector (12.0%), the number of psychologists working in the mental health sector (12.8%), and the number of psychiatric beds in general hospitals (19.7%). In secondary analyses measuring relative outcomes, missingness was more substantial: 7.7% for the proportion of all physicians working as psychiatrists, 18.8% for the proportion of all hospital beds that are psychiatric beds in mental hospitals, and 29.9% for the proportion of all hospital beds that are psychiatric beds in general hospitals. To evaluate the impact of missingness and skewedness on point estimates and confidence intervals, regression analyses were also run on a non-imputed data-set using a non-parametric bootstrap (1000 repetitions), which allows for a bias adjustment in confidence intervals. Parameter estimates from this were comparable to those reported below using ordinary least squares with multiply imputed data-sets.

The second aspect of data analysis – mediation analysis – was conducted in MPlus 6.12 for Windows using path analysis. Of specific interest was the extent to which the relationship between government health expenditures and mental health system capacity was mediated by the magnitude of countries' Group 1 disease burden, represented by the pathway: health expenditures→Group 1 disease burden→mental health system capacity. Parameter estimates and confidence intervals were bias adjusted using a non-parametric bootstrap. Missing data were addressed in MPlus using the full information maximum likelihood approach.

Results

The median magnitude of Group 1 disease burden across countries was 8628 DALYs per 100 000 population (s.d. = 13 082). Tables 2 and 3 present results from the multiple regression analyses assessing the relationships between the magnitude of country Group 1 disease burden and mental health system measures. In naive univariate regressions (Model 1), higher Group 1 disease burden was inversely associated with all outcome measures ($t = -4.82$ to -17.71 , $P < 0.001$). After controlling for measures of economic development and neuropsychiatric disease burden (Model 3), effect sizes were reduced but hypothesis test results remained significant ($t = -2.06$ to -7.68 , $P < 0.05$) in all six instances. A 1% lower burden predicted 1.0% more psychiatrists ($\beta = -1.04$, $t = -7.68$, $P < 0.001$), 0.8% more nurses ($\beta = -0.79$, $t = -3.62$, $P < 0.001$) and 0.7% more psychologists ($\beta = -0.72$, $t = -3.94$, $P < 0.001$) in the mental health sector, as well as 0.5% more mental health out-patient facilities ($\beta = -0.54$, $t = -2.61$, $P < 0.05$), 0.6% more psychiatric beds in mental hospitals ($\beta = -0.60$, $t = -2.06$, $P < 0.05$) and 0.6% more beds in general hospitals ($\beta = -0.57$, $t = -2.22$, $P < 0.05$). Figure 1 illustrates the relationship between Group 1 disease burden and number of psychiatrists working in the mental health sector.

Median health expenditures per capita (2006) across countries was PPP \$86 (s.d. = \$169). The average Gini coefficient – for which 0 indicates perfect equality of income and 100 indicates the highest level of inequality – was 42 (s.d. = 9). Similarly, the average Failed State Index score (lower is better) was 83 (range 23–113; s.d. = 16). Among these three measures of economic development, health expenditure per capita was the most consistently significant across regression models: in the model containing only economic measures (Table 2, Model 2), health expenditure per capita was a significant predictor of all six outcomes ($t = 2.89$ to 9.16 , $P = 0.01$ to $P < 0.001$). In the full model (Table 2, Model 3), health expenditures significantly predicted all human resources outcomes as well as the number of psychiatric beds in mental hospitals ($t = 2.36$ to 3.60 , $P = 0.02$ to $P < 0.001$); for the remaining outcomes this predictor was non-significant ($P > 0.05$).

Group 1 burden of disease was inversely associated with all three relative outcome measures: percentage of physicians that are psychiatrists, percentage of hospital beds that are psychiatric beds in mental hospitals and percentage of hospital beds that are psychiatric beds in general hospitals. However, in each case, the association was non-significant ($t = -0.02$ to -0.92 , $P = 0.36$ to $P = 0.99$).

Table 4 summarises the results from the mediation analyses. The magnitude of Group 1 disease burden mediated the relationship between government health expenditures and mental health system capacity for five of six outcomes, meaning that in all cases but one the indirect effect (health expenditures→Group 1 disease burden→mental health capacity) was significant ($t = 2.07$ to 5.00 , $P < 0.05$). The magnitude of the mediation effect – calculated as

Table 2 Multiple regression analyses: human resources			
Human resource	Model 1, β (s.e.)	Model 2, β (s.e.)	Model 3, β (s.e.)
<i>Number of psychiatrists in mental health sector</i>			
Group 1 disease burden ^a	-1.513 (0.085)***		-1.038 (0.135)***
Government health expenditures ^b		0.995 (0.109)***	0.378 (0.105)***
Failed State Index score		-0.018 (0.010)	-0.006 (0.007)
Income inequality (Gini)		-0.044 (0.013)**	-0.003 (0.011)
Neuropsychiatric DALYs ^c			1.197 (0.66)
Model R^2	$R^2 = 0.74$	$R^2 = 0.62$	$R^2 = 0.79$
<i>Number of nurses in mental health sector</i>			
Group 1 disease burden ^a	-1.097 (0.133)***		-0.792 (-0.219)***
Government health expenditures ^b		0.743 (0.133)***	0.398 (0.168)*
Failed State Index score		-0.018 (0.013)	-0.008 (0.013)
Income inequality (Gini)		-0.032 (0.016)*	-0.004 (0.017)
Neuropsychiatric DALYs ^c			-1.356 (1.057)
Model R^2	$R^2 = 0.40$	$R^2 = 0.39$	$R^2 = 0.47$
<i>Number of psychologists in mental health sector</i>			
Group 1 disease burden ^a	-1.223 (0.127)***		-0.718 (0.182)***
Government health expenditures ^b		0.978 (0.120)***	0.545 (0.144)***
Failed State Index score		-0.012 (0.010)	-0.004 (0.010)
Income inequality (Gini)		0.020 (0.014)	0.049 (0.015)**
Neuropsychiatric DALYs ^c			0.928 (0.849)
Model R^2	$R^2 = 0.48$	$R^2 = 0.59$	$R^2 = 0.67$

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.
 DALYs, disability adjusted life years.
 a. Log of age-standardised DALYs per 100 000 population attributable to communicable, perinatal, maternal and nutritional conditions.
 b. Log of government health expenditure per capita in international dollars at purchasing power parity.
 c. Log of age-standardised DALYs per 100 000 population attributable to neuropsychiatric conditions. All mental health system capacity measures are log of prevalence per 100 000 population.

Table 3 Multiple regression analyses: infrastructure for mental healthcare			
Infrastructure	Model 1, β (s.e.)	Model 2, β (s.e.)	Model 3, β (s.e.)
<i>Number of psychiatric beds in general hospitals</i>			
Group 1 disease burden ^a	-0.776 (0.161)***		-0.571 (0.257)*
Government health expenditures ^b		0.504 (0.175)**	0.370 (0.218)
Failed State Index score		-0.024 (0.014)	-0.013 (0.014)
Income inequality (Gini)		-0.036 (0.020)	-0.020 (0.021)
Neuropsychiatric DALYs ^c			-3.062 (1.211)*
Model R^2	$R^2 = 0.21$	$R^2 = 0.25$	$R^2 = 0.31$
<i>Number of psychiatric beds in mental hospitals</i>			
Group 1 disease burden ^a	-1.250 (0.172)***		-0.601 (0.292)*
Government health expenditures ^b		0.962 (0.178)***	0.654 (0.231)*
Failed State Index score		-0.010 (0.015)	-0.003 (0.015)
Income inequality (Gini)		-0.071 (0.021)**	-0.049 (0.023)*
Neuropsychiatric DALYs ^c			-0.179 (1.342)
Model R^2	$R^2 = 0.33$	$R^2 = 0.37$	$R^2 = 0.39$
<i>Number of mental health out-patient facilities</i>			
Group 1 disease burden ^a	-0.873 (0.124)***		-0.537 (0.206)*
Government health expenditures ^b		0.482 (0.124)***	0.194 (0.155)
Failed State Index score		-0.031 (0.011)**	-0.025 (0.011)*
Income inequality (Gini)		-0.004 (0.015)	0.016 (0.016)
Neuropsychiatric DALYs ^c			0.042 (0.970)
Model R^2	$R^2 = 0.32$	$R^2 = 0.37$	$R^2 = 0.42$

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.
 DALYs, disability adjusted life years.
 a. Log of age-standardised DALYs per 100 000 population attributable to communicable, perinatal, maternal and nutritional conditions.
 b. Log of government health expenditure per capita in international dollars at purchasing power parity.
 c. Log of age-standardised DALYs per 100 000 population attributable to neuropsychiatric conditions. All mental health system capacity measures are log of prevalence per 100 000 population.

the indirect effect as a percentage of the total effect – ranged from 41.1% to 59.8%.

Discussion

This is the first study to empirically assess the strength of relationships between communicable, perinatal, maternal and nutritional disease burden, economic development and

mental health system capacity in a large number of LAMI countries. We found that the magnitude of Group 1 disease burden significantly predicts a number of key mental health system indicators, even after controlling for measures of national-level health expenditures, income inequality and political stability. Moreover, Group 1 disease burden mediates much of the relationship between health expenditures and mental health system capacity.

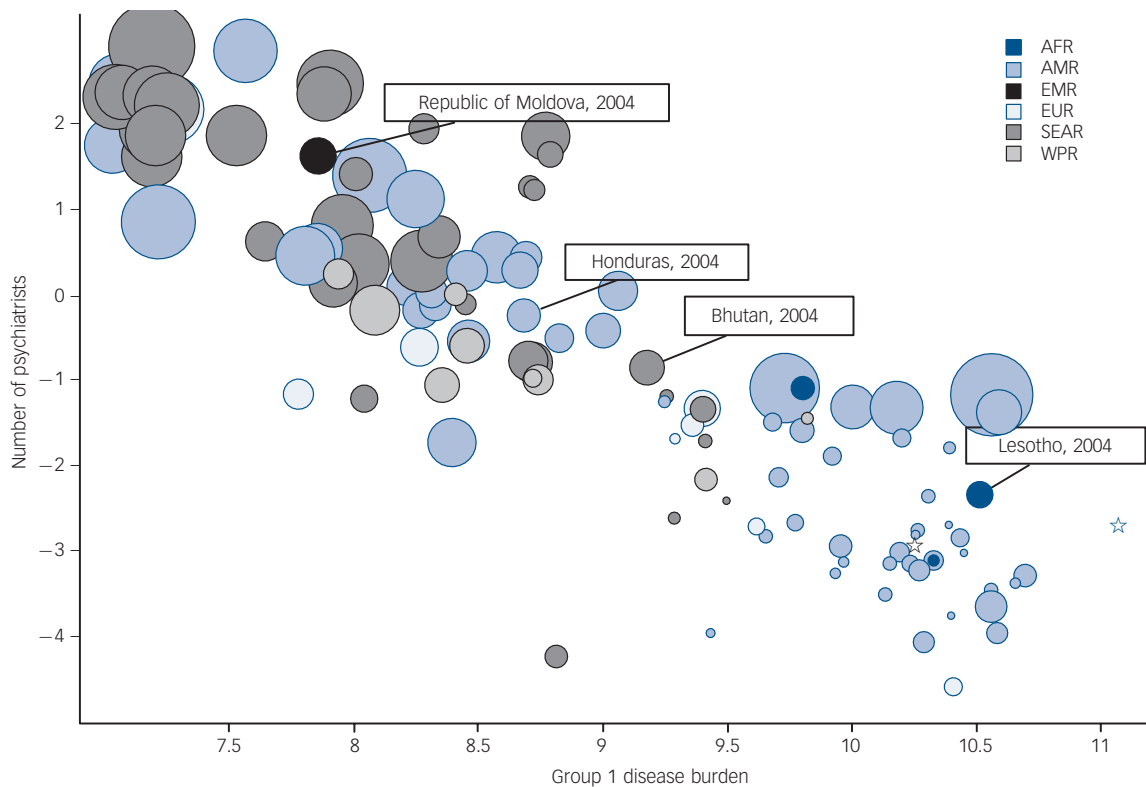


Fig. 1 Association between Group 1 disease burden and number of psychiatrists

The size of each bubble represents government health expenditures per capita, while colour corresponds to World Health Organization geographic region. Numbers of psychiatrists in the mental health sector are represented as the natural log of prevalence rates per 100 000 population. Group 1 disease burden represents the natural log of age-standardised disability-adjusted life-years per 100 000 population. The four highlighted countries serve to illustrate that, even when comparing countries with similar levels of health expenditures, the magnitude of disease burden is inversely associated with mental health system capacity for measures such as the number of psychiatrists. AFR, African Region; AMR, Americas Region; EMR, Eastern Mediterranean Region; EUR, European Region; SEAR, South-East Asia Region; WPR, Western Pacific Region.

Mental health systems and Group 1 disease burden

The relationship between country burden of disease and mental health systems has rarely been discussed or evaluated in the literature.²³ Our analysis shows that the magnitude of Group 1 disease burden is inversely associated with countries' mental health system capacity. Within the domain of human resources, for example, a 1% lower Group 1 disease burden predicted 1.0% more psychiatrists and 0.8% more nurses. By way of illustration, this implies that – compared with a country like Nigeria which has a Group 1 disease burden of almost 30 000 DALYs per 100 000 population – a similar country with half the disease burden (15 000 DALYs) would be expected to have roughly twice as many psychiatrists and 1.8 times as many nurses working

in the mental health sector. Similar observations are found in terms of health system infrastructure, including psychiatric beds in hospitals and out-patient facilities.

Global burden of disease and resource allocation

In settings where Group 1 burden of disease is large, neuro-psychiatric conditions represent a smaller proportion of total disease burden and must compete with a wider array of health priorities.¹⁶ Although evidence shows that mental health interventions are relatively cost-effective – meaning that the cost per DALY averted is less than one to three times the national income per capita²³ – they have less attractive cost-effectiveness ratios than interventions for many Group 1 disease conditions. For instance,

Table 4 Mediation analyses: Group 1 disease burden as a mediator of the relationship between government health expenditures and mental health systems capacity

	Total effect (95% CI)	Indirect effect (95% CI)	% mediated
Domain 1: human resources			
Number of psychiatrists	0.92 (0.09)***	0.55 (0.11)***	59.8
Number of nurses in the mental health sector	0.78 (0.16)***	0.46 (0.14)**	59.0
Number of psychologists	0.95 (0.11)***	0.39 (0.10)***	41.1
Domain 2: infrastructure			
Number of psychiatric beds in general hospitals	0.59 (0.18)**	0.31 (0.15)*	52.5
Number of psychiatric beds in mental hospitals	1.01 (0.19)***	0.30 (0.18)	NAb
Number of mental health out-patient facilities	0.49 (0.12)***	0.27 (0.12)*	55.1

*P<0.05, **P<0.01, ***P<0.001.
 a. All mental health system capacity measures are prevalence per 100 000 population.
 b. Not applicable because total effect or indirect effect was non-significant at P<0.10.

expanding immunisation coverage with standard child vaccines can cost PPP \$2–20 per DALY averted,²⁴ whereas tricyclic antidepressants and psychosocial treatment for depression and anxiety – one of the most cost-effective mental health interventions – are estimated to cost more than PPP \$300 per DALY averted.²

Although we do not expect that decision makers explicitly allocate resources based solely on cost-effectiveness estimates, our findings suggest that there is an implicit recognition of these differences in the decision-making process. This has two implications: first, as LAMI countries experience variants of the epidemiological transition – particularly those in which the incidence of communicable disease declines over time²⁵ – it is conceivable that countries will have greater resources to allocate to mental health. Second, in contexts where Group 1 disease burden is substantial, more persuasive arguments and focused donor support are needed to improve mental health system capacity. On the one hand, the mental health agenda setting process has made significant headway in recent years through initiatives such as *The Lancet's* series on global mental health (2007 and 2011; www.thelancet.com/series/) and WHO's Mental Health Gap Action Programme (www.who.int/mental_health/mhgap/en/). On the other hand, data on the cost-effectiveness of mental health interventions in low-resource settings are limited and, until recently, have failed to account for positive externalities associated with interventions, including poverty reduction²⁶ and reduced burden of care on family members.^{27,28} Given that as much as 50% of mental disorders develop during adolescence, and that these conditions often persist throughout the course of one's adult life,²⁹ the spillover effects on family members' quality of life are likely to be substantial. Additionally, improvements in mental health are liable to affect one's physical health. For instance, studies have shown that individuals with affective disorders exhibit poor adherence to antiretroviral therapy³⁰ and are more likely to take up routine smoking habits.³¹

Mediation analyses

Results from mediation analyses in this study indicate that whether higher-income countries allocate their health budget to mental health systems is partly a function of existing disease burden: for five of six mental health system indicators, this mediatory role was significant ($P < 0.05$) and accounted for an average of 54% of the relationship between government health expenditures and mental health system capacity. Cumulatively, these findings support the hypothesis that whether financial resources are channelled to mental health is contingent on an indirect process through which Group 1 diseases are first targeted, after which available resources (including personnel and infrastructure) are shifted to address mental healthcare. For example, in Mozambique where government health expenditures are PPP \$26 per person per year and the Group 1 disease burden is 27 800 DALYs per 100 000 population, there is only 1 nurse in the mental health sector for every 300 000 persons. In contrast, in Ghana, which has the same government health expenditures but a lower Group 1 disease burden of 17 500 DALYs per 100 000 population, the prevalence rate of nurses is seven times greater.

This conclusion has several ramifications. First, greater government expenditures on health do not necessarily translate directly into mental health system capacity; rather, it is the dynamics of and relationship between disease burden and level of health expenditures that affect the robustness of the mental health system. Second, and relatedly, insofar as gains in health expenditures translate into reductions in Group 1 disease burden, this may in the short-term do little to improve mental health

outcomes, while in the long-run it may free up resources for expansion of the mental health agenda. Last, the development of policies and legislation intended to accelerate countries' mental health programmes should seek to work in conjunction with – rather than in competition with – initiatives aimed at tackling Group 1 diseases. This synergistic approach to mental healthcare has been increasingly emphasised in low-resource settings.³²

Mental health and overarching health system capacity

Findings from this study's relative outcome measures raise a question as to whether Group 1 disease burden uniquely affects mental health system capacity, or is reflective of a more general effect on countries' health systems. If we were to take the non-significance of these results as conclusive, then the data would indicate that substantial Group 1 disease burden overwhelms human resources and infrastructure of countries' overarching health systems, not just the mental health sector. However, given the substantial level of missingness of data associated with these relative measures, that all coefficients were negative (albeit non-significant), and that separate time points and methods of data collection were used for the WHO Mental Health Atlas and WHO World Health Statistics, further evidence is warranted before drawing any inferences.

Limitations and further considerations

An important limitation in this discussion is the use of cross-sectional data. Here, several points should be noted. First, at a theoretical level, it is unlikely that improved mental health system capacity causes a decrease in Group 1 disease conditions. In contrast, a more direct argument can be made that lower rates of Group 1 diseases free up resources to develop mental health system capacity. Nevertheless, the possibility of reverse causality was partially addressed in our analysis by (a) the inclusion of DALYs attributable to neuropsychiatric conditions in regression models, and (b) the fact that global burden of disease estimates were measured at an earlier time point (2004) than outcomes (2011). Second, in final regression models the relationships between independent variables and outcomes were assessed after controlling for potential confounders, thereby reducing potential omitted variable bias. Third, the observed direction, magnitude and consistency of relationships among predictors and outcomes match well with *a priori* expectations, lending positive predictive validity to the findings.

That said, in several instances, results were close to significant but did not exceed the 0.05 alpha threshold. This may be a reflection of the limited power inherent in cross-national comparisons, insofar as these studies utilise data acquired through divergent means and at different points in time. In the present study, all outcome variables were ascertained through the 2011 Mental Health Atlas, and thus the comprehensive nature of this newly released WHO instrument is a strength. The heterogeneity in data collection methods and year of data collection among covariate measures reduces the reliability of specific point estimates reported in the manuscript; however, these inconsistencies are non-differential in nature, and we would therefore expect this to result in an attenuation bias – i.e. a bias towards non-significance. Given that we found a consistent, statistically significant set of results across outcome measures, this is of lesser concern. Last, it should also be noted that the majority of outcome indicators are institutionally oriented and provide limited commentary on the quality of care afforded by available capacity.

In conclusion, this study represents a novel framework for viewing mental health system capacity in a diverse sample of LAMI countries. Subject to the constraints of existing data, this paper provides a set of consistent findings that communicable, perinatal, maternal and nutritional disease burden plays a central role in shaping mental health system capacity in LAMI countries, and that the magnitude of this burden mediates the relationship between government health expenditures and mental health system capacity in these settings. Moving forwards, research and policy efforts aimed at developing the global mental health agenda should take into account the dynamics of these relationships.

Ryan McBain, Carmel Salhi, Department of Global Health and Population, Harvard School of Public Health, Boston, Massachusetts, USA; **Jodi E. Morris**, Department of Mental Health and Substance Abuse, World Health Organization, Geneva, Switzerland, and School of Health and Exercise Sciences, University of British Columbia, Okanagan Campus, Kelowna, Canada; **Joshua A. Salomon**, Department of Global Health and Population, Harvard School of Public Health, Boston, Massachusetts, USA, **Theresa S. Betancourt**, Department of Global Health and Population, Harvard School of Public Health, and Research Program on Children and Global Adversity, FXB Center for Health and Human Rights, Harvard University, Boston, Massachusetts, USA

Correspondence: Ryan McBain, Harvard School of Public Health, 651 Huntington Avenue, Boston, MA 02115, USA. Email: rmcbain@hsph.harvard.edu

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