

# Days out-of-role due to common physical and mental health problems: Results from the São Paulo Megacity Mental Health Survey, Brazil

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**OBJECTIVES:** To investigate the relative importance of common physical and mental disorders with regard to the number of days out-of-role (DOR; number of days for which a person is completely unable to work or carry out normal activities because of health problems) in a population-based sample of adults in the São Paulo Metropolitan Area, Brazil.

**METHODS:** The São Paulo Megacity Mental Health Survey was administered during face-to-face interviews with 2,942 adult household residents. The presence of 8 chronic physical disorders and 3 classes of mental disorders (mood, anxiety, and substance use disorders) was assessed for the previous year along with the number of days in the previous month for which each respondent was completely unable to work or carry out normal daily activities due to health problems. Using multiple regression analysis, we examined the associations of the disorders and their comorbidities with the number of days out-of-role while controlling for socio-demographic variables. Both individual-level and population-level associations were assessed.

**RESULTS:** A total of 13.1% of the respondents reported 1 or more days out-of-role in the previous month, with an annual median of 41.4 days out-of-role. The disorders considered in this study accounted for 71.7% of all DOR; the disorders that caused the greatest number of DOR at the individual-level were digestive (22.6), mood (19.9), substance use (15.0), chronic pain (16.5), and anxiety (14.0) disorders. The disorders associated with the highest population-attributable DOR were chronic pain (35.2%), mood (16.5%), and anxiety (15.0%) disorders.

**CONCLUSIONS:** Because pain, anxiety, and mood disorders have high effects at both the individual and societal levels, targeted interventions to reduce the impairments associated with these disorders have the highest potential to reduce the societal burdens of chronic illness in the São Paulo Metropolitan Area.

**KEYWORDS:** Mental Disorders; Chronic Disease; Disability; Prevalence; Burden of Illness.

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## INTRODUCTION

Similar to many low- and middle- income countries (1), Brazil is facing an epidemiologic transition (2) characterized by an increasing burden of chronic, non-communicable

diseases surpassing infectious diseases (3). According to the most recent Global Burden of Diseases (GBD) report (4,5), 8 of the 10 leading causes of years living with disability (YLD) in the Tropical Latin America region are either chronic pain or mental disorders. The results from the first GBD report in Brazil (2) showed that neuropsychiatric disorders ranked first as the major cause of YLD (34%), followed by chronic respiratory diseases (11.2%).

The World Health Organization (WHO) International Classification of Functioning, Disability and Health (6) defines disability as a broad term for impairments, activity limitations, and participation restrictions, taking into

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account the interaction between health problems and personal and environmental factors. The number of workdays lost is an important component of disabilities, which can be measured by the number of missed days of work (absenteeism) and low performance while at work (presenteeism) (7). In this report, we focus on the number of days out-of-role (DOR), which was defined as the number of days in the 30 days before the interview for which the person was completely unable to work or carry out normal activities because of health problems.

Examining the effects of health problems on the DOR in the 24 countries that participated in the World Mental Health (WMH) Surveys, Alonso and colleagues (8) found that neurological disorders, mood disorders, and anxiety disorders were the most powerful predictors of the DOR at the individual-level, and chronic pain had the greatest population-level effect. This data pattern was quite consistent across countries with different income levels. In Brazil, information on the DOR is scarce and most previous studies were based on administrative official workers' compensation databases obtained from the Brazilian National Social Security Institute (INSS) (9-11). Such data are limited because the Brazilian labor laws require that people miss 15 days of work (absenteeism) before they are entitled to request compensation benefits (sick leave), which means that the much more commonly occurring cases of absence due to sickness with fewer than 15 DOR are omitted. Five of the 10 leading causes of Social Security compensation benefit requests are mental disorders, which are responsible for 19% of the total costs associated with disability benefits (9). In a population-based study, Yano and Santana (12) reported a 1-year prevalence of workdays lost due to health problems of 12.5%, 5.5% of which was directly related to disorders and 4.1% of which was related to disorders aggravated by work. However, no information was provided on the illnesses associated with the DOR. It is essential to quantify the relative importance of specific disorders in accounting for the DOR and to evaluate the extent to which preventive interventions at multiple levels can reduce the impact of the disorders associated with the largest losses. Achieving these goals requires epidemiological data on a broad range of disorders, with adjustments for the high rates of comorbidity within and between physical and mental disorders (8,13-16).

The current report presents such relevant data from the São Paulo Megacity Mental Health Survey (SPMHS), which is the Brazilian component of the WHO's WMH Survey Initiative ([www.hcp.med.harvard.edu/wmh](http://www.hcp.med.harvard.edu/wmh)). Located in Southeastern Brazil, the São Paulo Metropolitan Area (SPMA) houses more than 10% of the Brazilian population (17) and is the fifth largest metropolitan area in the world, with approximately 20 million inhabitants. Thus, the SPMA is an important industrial and commercial center in the Latin American and Caribbean region. The WMH Survey Initiative was launched to carry out general population surveys in countries throughout the world to assess the prevalence and associations with mental disorders (18). One section in the WMH interview assesses the presence of commonly occurring chronic physical disorders, which allows for comparison of the effects of mental and physical disorders on role functioning. In a previous study (19), we found that 1 in every 3 adults living in SPMA had a 12-month history of a mental disorder and that 10% of the respondents had a 'severe' mental disorder, which

represents more than one million adults. These results suggest that mental disorders are likely to have a significant impact on the ability of an individual to perform work activities. In addition, in this previous study, we found comorbidities associated with mental disorders to be a common occurrence, with most of the morbidities concentrated in approximately 40% of the active cases that presented with 2 or more disorders. In the current study, we aimed to directly quantify the relative importance of mental and physical disorders on the DOR in a 12-month period, adjusting for the effects of comorbidity.

## ■ METHODS

### Sample

The SPMHS was designed to be a representative sample survey of household residents aged 18 years and older in the SPMA, an area that consists of the state capital city of São Paulo and its 38 surrounding municipalities, covering a geographical area of 8,051 km<sup>2</sup> (20). At the time of data collection (May 2005 to May 2007), 11 million inhabitants were 18 years or older (20). A detailed description of the sampling and weighting methods is presented elsewhere (21). Briefly, respondents were selected using a stratified, multistage area probability sample of households. Within each household, 1 respondent per household was selected through a Kish table. In all strata, the primary sampling units (PSUs) were 2,000 cartographically defined census count areas (20). Each municipality contributed to the total sample size according to its population size.

Initially, 7,700 households were selected to achieve the planned sample of 5,000 subjects, allowing for a 35% non-response rate. Eligible respondents were those who were 18 years or older, Portuguese-speaking household residents, and without any disability or handicap that would otherwise impair their ability to participate in the interview. A total of 5,237 subjects agreed to participate, but 200 elderly respondents were considered ineligible due to cognitive impairment. The sample size, after sampling, recruitment, and obtaining informed consent, was 5,037. The overall survey response rate was 81.3%.

All interviews were administered face-to-face by trained lay interviewers using training and field quality control procedures as previously described (18,22,23). Each interview consisted of 2 parts. Part I, which was administered to all respondents, contained assessments of core mental disorders (mood, anxiety, impulse-control, and substance use disorders, as well as suicidal behavior). All Part I respondents who met the criteria for any core mental disorder plus a probability sub-sample of Part I non-case respondents were administered Part II, which assessed correlates and additional anxiety disorders, such as obsessive-compulsive disorders (OCDs) and post-traumatic stress disorders (PTSDs). Thus, Part II was divided into 2 strata based on the Part I responses. The first stratum was composed of 2,236 subjects (44.4%) who met the lifetime criteria for at least 1 of the mental disorders assessed in Part I. The second stratum consisted of a random 25% sub-sample of non-cases associated with WMH-CIDI Part I disorders, with a total of 706 (14.0%) respondents. The inclusion of this stratum enabled the comparison of cases and non-cases and correlates of psychiatric morbidity, as well as allowed assessment of additional diagnoses among respondents who were negative for core disorders. Data



were weighted to adjust for the under-sampling of Part II non-cases and to adjust for residual discrepancies between the sample and population distributions of a range of socio-demographic variables. The total number of Part II respondents was 2,942, and these respondents are the focus of the current report.

### Ethics statement

The Research and Ethics Committee of the University of São Paulo Medical School approved the procedures of the SPMHS for recruitment, obtainment of informed consent, and protection of human subjects during the field studies. Respondents were interviewed only after signing an informed written consent form and had assurance of total confidentiality.

### Measurement

**Mental disorders.** Mental disorders were assessed with version 3.0 of the WHO Composite International Diagnostic Interview (CIDI), a fully structured, lay-administered interview designed to generate research diagnoses of common mental disorders according to the definitions and criteria of both the DSM-IV and ICD-10 diagnostic systems (24). The mental disorders considered here include mood disorders (major depressive disorder and bipolar disorder), anxiety disorders (panic disorder and/or agoraphobia, specific phobia, social phobia, generalized anxiety disorder, and post-traumatic stress disorder), and substance use disorders (SUDs: alcohol abuse with and without dependence and drug abuse with and without dependence). Only the disorders present in the 12 months prior to the interview are considered here.

Blind clinical re-interviews using the Structured Clinical Interview for DSM-IV Axis I disorder (SCID-I) (25) with a probability sub-sample of WMH respondents showed generally good agreement between the WMH-CIDI and SCID diagnoses (26). Preliminary results of the clinical reappraisal study in the SPMHS with a probability sub-sample of 775 respondents (not included in the previous validation study cited above) showed good total classification accuracy (range: 76-99%) and an area under the receiver operating characteristic curve of approximately 0.7 for any disorder.

**Chronic physical disorders.** Physical disorders were assessed with a standard chronic disorders checklist. Checklists of this type have been shown to yield more complete and accurate reports of disorder prevalence than estimates derived from responses to open-ended questions (27,28). Reports based on such checklists have been shown in previous methodological studies to have moderate to good concordance with medical records (29,30).

The 8 disorders considered here are arthritis, cardiovascular disorders (heart attack, heart disease, hypertension, and stroke), chronic pain disorders (chronic back or neck pain and other chronic pain), diabetes, migraines or other frequent or severe headaches, insomnia, digestive disorders (stomach or intestinal ulcers), and respiratory disorders (seasonal allergies, asthma, COPD, and emphysema). The symptom-based disorders in this set (arthritis, pain disorders, heart attack, and stroke) were assessed based on the respondents' reports as to whether they experienced the disorder in the 12 months prior to the interview, while the remaining disorders were assessed based on respondent reports of whether a doctor or other health professional had

ever told them they had the disorder, and only the disorders that had been present in the previous year were considered.

**Days out-of-role.** A modified version (31) of the WHO Disability Assessment Schedule (WHO-DAS) (32) was used to ask respondents the number of days in the 30 days before the interview (i.e., beginning yesterday and going back 30 days) for which they were completely unable to work or carry out their normal activities because of problems with either physical health, mental health, or the use of alcohol or drugs. The recall period for the DOR (30 days) was different from the period for disorders (12 months) because we wanted to include effects not only of active disorders but also of recent disorders that may still have important effects on the participants' health valuations. Good concordance of these reports has been documented between payroll records of employed people (33,34) and prospective daily diary reports (35).

### Statistical analysis

Multiple regression analysis was performed to examine associations of the physical and mental disorders assessed in the survey with the reported DOR in the past 30 days, controlling for age, gender, employment status, and education. As substantial comorbidity was found among the disorders (36), models were estimated that captured the effects of comorbidity. However, because there are 1,556 ( $2^{11} - 12$ ) logically possible interactions among the 11 disorders, some constraints had to be imposed on the interaction models. Although a number of constrained models were estimated, the best-fitting model was a model that included a single composite estimate of the interaction between each of the 11 disorders and the weighted sum of the other 10 disorders, where the weights used to calculate the sum were the regression coefficients associated with the marginal effects of the other 10 disorders under the model with the outcome. The term 'marginal effect' is used to describe the effect of a given disorder among respondents who have 1 and only 1 disorder, i.e., a comparison of the DOR among respondents who have either a single focal disorder or who have none of the disorders outside of the control variables. Iterative nonlinear regression analysis was used to estimate the coefficients in this model (37), with the inclusion of a separate dummy predictor variable for each of the 11 disorders, a weighted count of all the disorders experienced by respondents who had 2 or more disorders (coded 0 for respondents with either 0 or 1 disorder), and a term for the interaction between each of the 11 disorder-specific dummy predictor variables and the weighted sum. This model was estimated iteratively using the regression coefficients from the previous iteration of the model to calculate the weighted sum and then continuing to calculate successively revised weighted sums in each new iteration until the solution converged. The regression coefficients in this final model associated with the 11 disorder-specific dummy variables can be interpreted as marginal effects of the disorders, while the coefficients associated with the interactions can be interpreted as the extent to which the incremental effect of the focal disorder varies as a function of comorbidity magnitude. A SAS macro (40) was written to implement this procedure.

Because the outcome variable (a 0-30 measure of the number of days out-of-role) was highly skewed, the use of ordinary least squares regression analysis to estimate the above model is likely to yield estimates that are both biased



and inefficient (37). We addressed this problem using generalized linear models (GLMs) in SAS (40) to investigate a range of nonlinear link functions and non-normal error structures to build a better-fitting model. Standard diagnostic procedures to compare the model fit (38) showed that the GLM with a log link function and variance proportional to the mean was the best-fitting model. The results reported below are based on this model.

As the prediction equation includes interaction terms, the predictive effect of each disorder is impossible to determine by inspection of the model coefficients. This problem was addressed by performing simulations to produce a single term that summarized all of the component interaction effects of each disorder. The simulation was performed by estimating the predicted value of the outcome for each respondent based on the coefficients in the final model (the base estimate) and then repeating this exercise in a modified form 11 different times, each time assuming that 1 of the 11 disorders no longer existed (i.e., by recalculating each individual's weighted sum based on the assumption that the focal disorder was not present and then multiplying out predicted values on the outcome using the final model coefficients based on the assumption that the individual did not have the focal disorder and assuming that the weighted sum was equal to its value in the absence of the focal disorder). The estimated individual-level effect of each disorder was obtained by subtracting the predicted value of the outcome in the restricted version of the model (i.e., the version of the model that deleted the focal disorder is not considered) from the value in the unrestricted version and calculating the mean differences in the subsample of respondents who did, in fact, have the focal disorder. The estimated societal-level effect of the disorder was then obtained by multiplying the individual-level estimate by the prevalence of the disorder to calculate the mean DOR due to the disorder and then by dividing that product by the total mean DOR to produce an expression of the proportion of all DOR in the population due to the focal disorder. The same procedure was used to calculate the societal-level effects of any physical disorder, any mental disorder, and any of the 11 considered disorders. A SAS macro (40) was written to implement these simulations.

Because the SPMHS data are geographically clustered and weighted, design-based methods were needed to obtain accurate estimates of standard errors and statistical significance. The Taylor series linearization method (39) implemented in SAS (40) was used for this purpose in the basic model. The more computationally intensive method of Jackknife Repeated Replications (39), implemented in a SAS macro that we wrote for this purpose, was used to obtain standard errors of the simulated estimates of individual-level and societal-level disorder effects. Significance tests were consistently evaluated using 0.05-level, two-sided design-based tests.

**RESULTS**

Of the 2,942 respondents, 52.8% (SE 1.4) were female, 40.2% (SE 1.6) were not married, the mean age was 39.0 years (SE 0.5), 45.0% (SE 1.5) had at least 8 years of education, and 20.6% (SE 1.0) were not working (retired or unemployed) at the time of data collection (Table 1).

**Table 1 - Demographic characteristics of the São Paulo Megacity Mental Health Survey sample (n = 2,942).**

	Unweighted			Weighted		
	N	%	SE	N	%	SE
<b>Gender</b>						
Women	1703	57.9	0.9	1554	52.8	1.4
Men	1239	42.1	0.9	1388	47.2	1.4
<b>Age (years)</b>						
18-24	407	13.8	0.7	583.3	19.8	1.2
25-34	684	23.2	0.7	719.3	24.4	1.2
35-49	1028	34.9	0.7	959.7	32.6	1.3
50-64	594	20.2	0.7	445.2	15.1	0.9
65 or +	229	7.8	0.5	234.5	7.9	0.7
<b>Education</b>						
Low (0-4 years)	799	27.2	0.7	668.7	22.7	1.0
Medium-low (5-8 years)	733	24.9	0.7	655.1	22.3	1.0
Medium-high (9-11 years)	976	33.2	0.9	1064.0	36.2	1.3
High (12 or more years)	434	14.7	0.6	554.3	18.8	1.2
<b>Income</b>						
Low	730	24.8	0.8	644.0	21.9	0.9
Medium-low	818	27.8	0.7	838.2	28.5	0.9
Medium-high	673	22.9	0.8	661.5	22.5	1.0
High	721	24.5	0.8	798.3	27.1	1.2
<b>Marital Status</b>						
Married	1848	62.8	1.0	1759.0	59.8	1.5
Previously Married	592	20.1	0.6	480.6	16.3	1.0
Never Married	502	17.1	0.7	702.5	23.9	1.1
<b>Occupation</b>						
Working/student	1767	60.1	0.9	1948.0	66.2	1.2
Work at home	494	16.8	0.7	387.9	13.2	0.7
Retired	279	9.5	0.5	249.4	8.5	0.5
Unemployed	402	13.7	0.6	356.8	12.1	0.9

**The distribution of the days out-of-role**

The mean number of health-related DOR in the previous month was 1.3 in the total sample (Table 2), representing an annualized median of 15.8 (SE 2.0). The overall mean can be decomposed into 13.1% (SE 1.3) of respondents who reported any DOR, among whom the mean DOR was 9.9, representing an annualized median of 120.1 (SE 7.4) DOR. The median among those with any DOR was 3.4 days, with a right-skewed distribution, which was lower than the mean, representing an annualized median of 41.4 (SE 5.5) DOR.

**Disorder prevalence estimates**

Three-fourths (73.5%) of the respondents reported 1 or more of the disorders included in this study (Table 3). The proportion of respondents reporting at least 1 physical disorder during the previous 12 months (68.5%) was more than 2-fold higher than the proportion reporting any mental disorder during the previous 12 months (27.3%).

Chronic pain disorders were the most commonly reported physical disorders (33.5%), followed by headaches/migraines (29.2%), respiratory disorders (24.6%), cardiovascular disorders (22.0%), and insomnia (12.1%). Anxiety disorders were the most common mental disorders (17.0%), followed by mood disorders (13.1%).

The mean DOR per year varied by disorder (Table 3). Respondents with any disorder had an average of 20 more DOR in a year than those without disorders. The top 7 disorders associated with the highest mean number of DOR were digestive disorder (53.0), arthritis (39.0), mood disorder (38.8), substance use disorder (35.6), anxiety disorder (33.7), chronic pain disorder (30.6), and diabetes



**Table 2** - Distribution of the number of days completely out of role in the month prior to the interview among the total population and among respondents with a positive number of days out of role. Data were obtained from the São Paulo Megacity Mental Health Survey (n = 2,942).

	Total population	Respondents with non-zero days out of role
0 days, % (SE)	86.9 (1.3)	0.0
1 day, % (SE)	2.6 (0.4)	20.0 (3.2)
2 days, % (SE)	2.2 (0.5)	16.6 (2.7)
3-5 days, % (SE)	2.7 (0.4)	20.6 (2.6)
6-10 days, % (SE)	1.6 (0.3)	12.0 (1.5)
11-20 days, % (SE)	1.5 (0.3)	11.3 (1.8)
21-30 days, % (SE)	2.6 (0.4)	19.5 (2.5)
Mean, last 30 days (SE)	1.3 (0.2)	9.9 (0.6)
Median, last 30 days (SE)	0.0 (0.2)	3.4 (0.5)
Mean, annual (SE)	15.8 (2.0)	120.1 (7.4)
Median, annual (SE)	0.0 (3.0)	41.4 (5.5)

(30.0). Those respondents with any mental disorder had more DOR (30.1) than those with any physical disorder (19.8).

Comorbidity was the norm; specifically, respondents who reported any disorder had an average of 2.8 disorders, and 71.5% of respondents with a disorder reported at least 2 disorders. The odds ratios (ORs) between the pairs of disorders were largely positive (92.7% of all the 11x10/2 = 55 ORs between the pairs of disorders) and statistically significant (74.5% of all ORs). The ORs were higher (median and inter-quartile range) among pairs of physical (2.2, 1.7-2.6) and mental (2.4, 1.9-3.9) disorders than between physical-mental pairs (1.5, 1.2-2.6) (detailed results of all ORs are available upon request).

**Effects of disorders on the DOR**

Although the 11 interaction terms in the iterative non-additive GLM model were significant as a set in predicting the DOR ( $\chi^2_{11} = 65.3, p < 0.001$ ), the only individually significant interaction term was for anxiety disorders. This interaction term was negative, which means that the impact of anxiety disorders on the DOR becomes smaller as the number of comorbid disorders increases. The marginal effect of anxiety disorders, in comparison, was significantly positive, which means that pure anxiety is associated with an elevated number of DOR. The negative interaction means that the magnitude of this elevation decreases as comorbidity

increases. However, as noted in the section on analysis methods, the magnitudes of the coefficients in the GLM equation are difficult to interpret both because the coefficients are expressed in terms of a log link function and because the presence of composite interaction terms makes it impossible to identify the total effects of any single disorder. The simulation method described in the section on analysis methods was used to transform these coefficients into a more easily interpretable form.

Table 4 shows the individual- and societal-level effects of each disorder on the DOR in a way that combines the marginal effects of pure disorders and incremental effects of comorbid disorders (Table 4).

Focusing first on the individual-level effects, our results show that 4 of the 11 disorders, namely pain, anxiety, mood, and substance disorders, are significant. Individual-level effects are quite similar across the 4 disorders, which are associated with a range of 14.0-19.9 DOR per year. However, due to the much higher prevalence of pain disorders than either anxiety or mood disorders and the much higher prevalence of anxiety and mood disorders than substance use disorders, the societal-level effect of pain disorders (35.2% of all DOR) is much greater than the societal-level effects of anxiety (15.0%) or mood (16.5%) disorders, while the latter effects are much higher than the societal-level effect of substance use disorders (3.6%). Taken together, the physical disorders account for a higher proportion of all

**Table 3** - Twelve-month prevalence of the disorders investigated and the mean number of days completely out-of-role per year. The São Paulo Megacity Mental Health Survey (n = 2,942).

Disorder present in the previous 12 months	Prevalence (%)	SE	Mean yearly DOR	SE
<b>Any physical disorder</b>	68.5	2.0	19.8	2.4
Arthritis	7.6	0.9	39.0	9.8
Cardiovascular	22.0	1.2	24.4	2.8
Chronic pain	33.5	1.4	30.6	4.4
Diabetes	5.4	0.6	30.0	5.3
Digestive	2.6	0.2	53.0	14.3
Headache-migraine	29.2	1.5	20.9	2.8
Insomnia	12.1	0.9	26.5	3.5
Respiratory	24.6	1.1	18.2	2.2
<b>Any mental disorder</b>	27.3	0.8	30.1	3.7
Any mood disorder	13.1	0.7	38.8	5.6
Any anxiety disorder	17.0	0.7	33.7	5.4
Any substance disorder	3.8	0.4	35.6	8.0
<b>Any disorder</b>	73.5	1.7	20.0	2.4

DOR: days out-of-role.



**Table 4** - Simulated annual effects of each disorder on the number of days completely out-of-role at the individual<sup>1</sup> and societal levels. Data are from the São Paulo Megacity Mental Health Survey (n = 2,942).

Disorder	Individual level		Societal level	
	Mean	SE	%	SE
<b>Any physical disorder</b>			47.0*	12.2
Arthritis	13.7	8.4	6.6	4.0
Cardiovascular	0.0	4.9	0.0	7.1
Chronic pain	16.5*	3.7	35.2*	6.6
Diabetes	4.7	6.6	1.6	2.3
Digestive	22.6	15.0	3.7	2.3
Headache-migraine	2.1	2.9	3.9	5.5
Insomnia	-1.3	3.9	-1.0	3.0
Respiratory	0.3	3.3	0.5	5.3
<b>Any mental disorder</b>			33.5*	7.4
Anxiety disorder	14.0*	5.4	15.0*	5.2
Mood disorder	19.9*	5.7	16.5*	4.5
Substance use disorder	15.0*	7.0	3.6*	1.8
<b>Any disorder</b>			71.7	4.6

\*Significant at the 0.05 level, two-sided test.

<sup>1</sup>Adjusted by age, gender, education, employment, and number and type of comorbid disorders.

DOR (47.0%) than the mental disorders (33.5%), while all 11 disorders considered here account for 71.7% of all DOR reported in the sample.

## DISCUSSION

We were able to directly quantify the relative importance of mental and physical disorders in accounting for the DOR in a population-based sample of the largest metropolitan area in South America, where information on health-related disability is limited.

Our results confirmed that chronic, non-communicable diseases are highly prevalent in the general population and cause a large amount of disability, measured as the DOR in this Brazilian metropolitan area (2,3). Although the proportion of respondents with physical illnesses was more than 2-fold the proportion of those with mental disorders, sufferers of common mental disorders reported approximately 50% more DOR than those with physical disorders, showing that mental disorders are associated with a greater amount of productivity loss than the chronic physical disorders assessed herein. Among physical disorders, chronic pain is the most important contributor to the DOR, which remains the case at the individual level, even after adjusting for comorbidity. Our results are also in line with the recently published GBD data for the Tropical Latin America region (Brazil and Paraguay), which show an increasing trend in disability levels due to common mental disorders, such as major depression, anxiety, and SUD, as well as pain and other musculoskeletal disorders, as the top 10 leading causes of years living with disability (YLD) (4,5).

While respiratory and cardiovascular diseases were highly prevalent, these disorders accounted for only a small number of additional DOR, even when comorbidity was considered, both at the individual and societal levels. These results are consistent with GBD data in Brazil (2), which reveal that cardiovascular diseases are the single most important cause of mortality (with a contribution to years of life lost [YLL] of 24%). However, these disorders were responsible for 2.7% of the YLD.

At the societal level, the 11 health disorders considered in our study accounted for more than three-quarters of all DOR in the general population (PARP = 71.7%). Physical and mental disorders accounted for 47.0 and 33.5% of all DOR, respectively. Our results show that chronic pain was both highly prevalent and disabling, and it was, by far, the most important contributor to days completely out-of-role in the population, followed by mood and anxiety disorders. Apart from chronic pain, arthritis and digestive diseases were also significant physical disorders. Pain disorders and gastrointestinal complaints have been described as some of the most frequent somatic symptoms among the attendees of specialty clinics and are particularly likely to remain unexplained (41), resulting in increasing disability and a higher utilization of health care, which is commonly unsatisfactory (42). The self-perceived health disability of digestive diseases was the highest among all disorders considered herein at the individual level, dropping to fifth in the rank at the societal level due to the low prevalence of these disorders.

In Brazil, population-based estimates of the impact of mental disorders at both the individual and societal levels in terms of work loss are lacking. Mood and anxiety disorders were highly associated with DOR in our sample and were responsible for approximately one-third of the DOR at the societal level. These findings are broadly consistent with previous studies in Brazil (43), and other countries (15,16,44,45) have revealed that mental disorders are among the disorders most strongly associated with productivity loss. In addition, disability benefits due to mental disorders had a steady growth between 1998 and 2002, and depression was the leading cause of disability benefits among individuals with mental disorders (9). Among the investigated diseases, the prevalence of SUD in SPMHS was one of the lowest (3.8%), but SUD contributed substantially to more than 1 month of DOR. After controlling for comorbidities, SUD remained strongly associated with work loss in different aspects; it was the third most disabling cause at the individual level, accounting for 15.0 additional yearly DOR, and, at the population level, it exerted a significant impact on work loss. This result is in contrast with previous reports from other countries (8,15), which did not show such a strong association of SUD with DOR after adjusting for comorbidity. Nevertheless, there is considerable evidence that SUD produces significant loss of life and disability worldwide; for instance, the global burden of disease attributable to alcohol and illicit drug use amounts to 5.4% of the total burden (46,47). Therefore, our results reinforce the finding that SUDs are an important target for improving productivity in Brazil (48,49).

This study has a number of noteworthy limitations. First, only a restricted set of the most common disorders was included in the analysis, and some disorders were pooled to form larger disorder groups. Some burdensome disorders, such as dementia and psychosis, were not assessed in our survey. Neurological disorders (epilepsy, multiple sclerosis, and stroke), which have been reported as a major cause of high individual-level effects (2,8,50), were not considered in the analysis due to their low prevalence in our sample. While the disorders we did include are among those most commonly reported in previous population studies, the expansion and disaggregation of these disorders are clearly needed in future studies. Second, diagnoses of chronic physical disorders were based on self-reports; however,



previous research has demonstrated reasonable correspondence between self-reported chronic disorders, such as diabetes, heart disease, and asthma, and general practitioner records. Third, we only considered the DOR for which the respondents reported they were completely unable to perform their work or usual activities. It is common that individuals also perform their role activities less or worse than expected (e.g., presenteeism); therefore, information about DOR underestimates total productivity loss (51). Fourth, the target population was restricted to people living in a large metropolitan area; generalization of the results to individuals living in rural areas or small cities is not warranted, even though an estimated 85% of the Brazilian population live in urban areas (52). Finally, to increase the validity of self-reporting, we assessed the restriction of activities in the 30 days prior to the interview and then extrapolated this information to the entire year, thus improving the comparability with published literature.

## Implications

The results of the current report indicate that chronic pain and mental disorders are major contributors to loss of productivity and human capital in the adult population living in the largest metropolitan area in Brazil. This finding has relevant implications for the prevention of disability; specifically, addressing only 1 disorder (either through treatment or prevention) when it coexists with other disorders will render a less effective outcome than addressing all of the coexisting disorders. Additionally, human resource professionals and occupational doctors who manage prevention should make early diagnoses and promote rehabilitation of work-related musculoskeletal pain disorders and mental disorders.

Lowering the impact of common and disabling disorders such as chronic pain, mood, and anxiety would have a major productivity return. Medically unexplained symptoms are related to more disabling physical disorders, such as digestive disorders and chronic pain. These disorders should be addressed with psychosocial interventions to avoid high spending on health services. If we take into account the fact that indirect costs are usually higher than direct medical and social service costs to treat disorders, the prevention and treatment of these disorders should be cost-effective.

**Conflicts of interest:** Dr. Kessler has been a consultant or had research support for his epidemiological studies for the past 3 years from Sanofi-Aventis, Shire Pharmaceuticals, and Johnson & Johnson Pharmaceuticals. The remaining authors declare no competing interests.

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## AUTHOR CONTRIBUTIONS

Andrade LH, Viana MC, and Wang YP conceived and designed the experiments. Andrade LH and Viana MC performed the experiments. LHA, Baptista MC, Alonso J, Petukhova M, Bruffaerts R, Kessler RC, and Wang YP analyzed the data. Andrade LH, Baptista MC, Alonso J, Petukhova M, Bruffaerts R, Kessler RC, Silveira CM, Siu ER, Wang YP, and Viana MC wrote the manuscript.

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