

Table 1. Demographic characteristics of total sample with perceived barriers to mental health treatment in the World Mental Health Japan Survey 2002–2006 ($n = 4130$)

	All respondents		Did not seek care		Delayed access to care		Dropped out of care	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Age (years)								
18–49	1659	40.2	27	75.0	36	56.3	18	72.0
≥50	2471	59.8	9	25.0	28	43.8	6	24.0
Sex								
Men	1868	45.2	14	38.9	17	26.6	8	32.0
Women	2262	54.8	22	61.1	47	73.4	16	64.0
Education (years)								
0–12	2710	65.6	16	44.4	30	46.9	11	44.0
≥13	1416	34.3	20	55.6	34	53.1	13	52.0
Total	4130	100.0	36	100.0	64	100.0	24	100.0

defined as either the use of the mental health professionals or general medical professionals for problems with emotions, nerves, mental health, or the use of alcohol or drugs.

Reasons for not seeking mental health services

Respondents who reported no use of mental health care services were asked whether they felt they might have needed to see a professional for mental health problems in the previous 12 months. Those who had felt the need but did not access any mental health services were asked the reason for not seeking care (multiple answers allowed; see Table S2).

Reasons for delayed access to mental health services

Respondents who reported accessing mental health care but had delayed access to it for ≥4 weeks after they first felt a need to see a professional for mental health problems were provided a list of potential reasons for the delay from which to choose (multiple answers allowed; see Table S2).

Reasons for dropping out of mental health services

Respondents who had accessed mental health care in the previous 12 months were asked if the treatment had ceased and, if so, if they had 'quit before the provider wanted me to stop.' Those who saw a provider and 'quit' were then provided a list of potential

reasons for dropping out similar to the list for not seeking health care (multiple answers allowed; see Table S2).

Data analysis

Proportions of 'reasons for not seeking,' 'reasons for delayed access,' and 'reasons for dropping out' were compared between the groups classified on the basis of sex, age, or education using Fisher's exact tests. Statistical significance was set at a 2-sided $P < 0.01$. All statistical analyses were conducted using STATA version 12 (STATA Corp, College Station, TX, USA).

RESULTS

Sample characteristics

The flow of the study respondents through the interview is shown in Figure 1. Of the 4130 respondents, 467 participants (11.3%) reported that they had ever accessed a professional for a mental health problem. In the past 12 months, 146 had consulted a professional for a mental health problem, 130 felt as if they may have needed to access a professional, 36 did not seek help, 64 delayed accessing a professional, and 24 had dropped out of care.

The characteristics of the total sample ($n = 4130$) are provided in Table 1. Approximately 60% of the respondents were ≥50 years old. The number of women was slightly higher (54.8%) than that of men. Approximately one-third of the respondents had an education higher than high school.

Table 2. Reasons for not seeking mental health treatment even though they felt they might have needed professional assistance for a mental health problem ($n = 36$)

	<i>n</i>	%
1 My health insurance would not cover this type of treatment.	2	5.6
2 The problem went away by itself, and I did not really need help.	23	63.9
3 I thought the problem would get better by itself.	3	8.3
4 I was concerned about how much money it would cost.	0	0
5 I was unsure about where to go or who to see.	7	19.4
6 I didn't think treatment would work.	1	2.8
7 I was concerned about what others might think if they found out I was in treatment.	3	8.3
8 I thought it would take too much time or be inconvenient.	6	16.7
9 I wanted to handle the problem on my own.	4	11.1
10 I could not get an appointment.	0	0
11 I was scared about being put into a hospital against my will.	0	0
12 I was not satisfied with the available services.	0	0
13 I received treatment before and it did not work.	0	0
14 The problem didn't bother me very much.	3	8.3
15 I had problems with things like transportation, child care, or scheduling that would have made it hard to get to treatment.	6	16.7

Reasons for lack of access, delayed access, or ceasing mental health care (Tables 2, 3 and 4)

Reasons for not seeking mental health services

The most frequently reported reason for not seeking treatment was 'The problem went away by itself, and

I did not really need help' by 63.9%, followed by 'I was unsure about where to go or who to see' by 19.4%, 'I thought it would take too much time or be inconvenient' by 16.7%, and 'I had problems with things like transportation, child care, or scheduling that would have made it hard to get to treatment' by 16.7%.

Table 3. Reasons for delayed access to mental health treatment even though they felt they might have needed professional assistance for mental health problem ($n = 64$)

	<i>n</i>	%
1 My health insurance would not cover this type of treatment.	5	7.8
2 I thought the problem would get better by itself.	31	48.4
3 The problem didn't bother me very much.	30	46.9
4 I wanted to handle the problem on my own.	44	68.8
5 I didn't think treatment would work.	15	23.4
6 I received treatment before and it did not work.	7	10.9
7 I was concerned about how much money it would cost.	9	14.1
8 I was concerned about what others might think if they found out I was in treatment.	18	28.1
9 I had problems with things like transportation, child care, or scheduling that would have made it hard to get to treatment.	14	21.9
10 I was unsure about where to go or who to see.	26	40.6
11 I thought it would take too much time or be inconvenient.	16	25.0
12 I could not get an appointment.	2	3.1
13 I was scared about being put into a hospital against my will.	1	1.6
14 I was not satisfied with the available services.	1	1.6

Table 4. Reasons for dropping out of mental health treatment before the professional wanted them to stop ($n = 24$)

	<i>n</i>	%
1 I got better.	10	41.7
2 I didn't need help anymore.	13	54.2
3 I was not getting better.	7	29.2
4 I wanted to handle the problem on my own.	6	25.0
5 I had bad experiences with the treatment providers.	2	8.3
6 I was concerned about what people would think if they found out I was in treatment.	2	8.3
7 I was treated badly or unfairly.	0	0.0
8 The therapist or counselor left or moved away.	1	4.2
9 I felt out of place.	2	8.3
10 The policies were a hassle.	0	0
11 There were problems with lack of time, schedule change, or lack of transportation.	1	4.2
12 I moved.	0	0
13 Treatment was too expensive.	1	4.2
14 My health insurance would not pay for more treatment.	0	0
15 My family wanted me to stop.	1	4.2

Reasons for delay in accessing mental health services

The most common reasons reported for delayed access to mental health care were 'I wanted to handle the problem on my own' by 68.8%, 'I thought the problem would get better by itself' by 48.4%, and 'The problem didn't bother me very much' by 46.9%.

Reasons for dropping out of mental health services

The most commonly reported reasons for ceasing care were 'I didn't need help anymore' by 54.2%, 'I got better' by 41.7%, 'I was not getting better' by 29.2%, and 'I wanted to handle the problem on my own' by 25.0%.

Demographic correlates of barriers to mental health services (Tables 5, 6 and 7)

Reasons for not seeking mental health services

The proportion of the respondents who reported, 'I was unsure about where to go or who to see' was significantly higher among women than among men ($P < 0.01$).

Reasons for a delay in accessing mental health services

By age, participants aged 20–49 years represented a significantly larger proportion of the respondents

who felt structural barriers, including 'I was concerned about how much money it would cost' ($P < 0.01$), and 'I had problems with things like transportation, child care, or scheduling that would have made it hard to get to treatment' ($P < 0.01$).

Reasons for dropping out of mental health services

There were no significant differences in the reasons for dropping out of mental health services by sociodemographic characteristics.

DISCUSSION

The present study demonstrated that low perceived need was the primary and most common reason for not seeking, delayed access to, and dropping out of mental health care services in Japan. Although attitudinal barriers are the ones most commonly reported in Western developed countries,^{8,9} in the present study, more frequently reported were low perceived need and structural barriers, such as lack of information about access to services, the presence of other inconveniences, and difficulties in finding time to access care, than attitudinal barriers. But an exception was a desire to handle the problem on one's own, which was also the major reason for delayed access to and dropout from mental health services.

Similar to previous findings,⁷ the present study demonstrated that a low perceived need for care was

Table 5. Reasons for not seeking mental health treatment even though they felt they might have needed professional assistance for a mental health problem ($n = 36$)

	Age (years)			Sex			Education (years)		
	20–49	≥50	<i>P</i>	Men	Women	<i>P</i>	0–12	≥13	<i>P</i>
	%	%		%	%		%	%	
1 My health insurance would not cover this type of treatment.	3	3	0.48	3	3	1.00	0	6	0.49
2 The problem went away by itself, and I did not really need help.	44	19	0.44	25	39	1.00	31	33	0.73
3 I thought the problem would get better by itself.	8	0	1.00	8	0	0.04	6	3	0.51
4 I was concerned about how much money it would cost.	0	0		0	0		0	0	
5 I was unsure about where to go or who to see.	14	6	0.46	0	19	<0.01*	8	11	1.00
6 I didn't think treatment would work.	3	0	1.00	0	3	1.00	0	3	1.00
7 I was concerned about what others might think if they found out I was in treatment.	6	3	0.25	3	6	1.00	6	3	0.24
8 I thought it would take too much time or be inconvenient.	17	0	0.46	6	11	1.00	3	14	0.27
9 I wanted to handle the problem on my own.	11	0	1.00	6	6	1.00	3	8	1.00
10 I could not get an appointment.	0	0		0	0		0	0	
11 I was scared about being put into a hospital against my will.	0	0		0	0		0	0	
12 I was not satisfied with the available services.	0	0		0	0		0	0	
13 I received treatment before and it did not work.	0	0		0	0		0	0	
14 The problem didn't bother me very much.	6	3	0.42	6	3	0.51	6	3	0.51
15 I had problems with things like transportation, child care, or scheduling that would have made it hard to get to treatment.	17	0	0.46	3	14	0.27	3	14	0.27

* $P < 0.05$, Fisher's exact test.

a particularly important barrier for seeking services. Low perceived need may be associated with a lack of awareness of mental health problems and treatment effectiveness for these problems. This is concordant with the fact that Japanese people are more likely to attribute the cause of schizophrenia and depression to personality traits, such as nervousness or weakness.²² In addition, low perceived need may be partly related to people's negative perception of mental health service in Japan.

Delayed access to and dropping out of mental health care services were also related to a desire to handle the problem on one's own (68.8% and 25%, respectively). As a reason for the delayed access, it may represent both people's ignorance and negative attitude toward mental health treatment. A similar interpretation could apply to another frequent reason of delayed access, 'I didn't think treatment would

work' (23.4%). Jorm also reported a similar tendency in Japan that medication was poorly recognized as an effective treatment for mental illness.²³ We asked about respondents' attitudes to mental health care in general but the latter report specifically addressed pharmaceutical medication. As a reason of dropping out from treatment, a desire to handle the problem on one's own may arise from poor therapist-patient communication, in addition to a negative attitude towards treatment. In addition, the perceived improvement in one's mental health was a common reason for dropping out ('I got better', 41.7%; 'I didn't need help anymore', 54.2%), which again may indicate a poor therapist-patient communication.

Moreover, although these were less frequent reasons, some reasons should be given attention in their clinical implications: 'I received treatment before and it did not work' (10.9%) for delayed

Table 6. Reasons for delayed access to mental health treatment even though they felt they might have needed professional assistance for mental health problem ($n = 64$)

	Age (years)			Sex			Education (years)		
	20–49	≥50	<i>P</i>	Men	Women	<i>P</i>	0–12	≥13	<i>P</i>
	%	%		%	%		%	%	
1 My health insurance would not cover this type of treatment.	8	0	0.06	2	6	1.00	3	5	1.00
2 I thought the problem would get better by itself.	25	23	0.62	8	41	0.09	23	25	1.00
3 The problem didn't bother me very much.	22	25	0.21	13	34	1.00	27	20	0.21
4 I wanted to handle the problem on my own.	38	31	0.79	11	58	<0.01*	33	36	1.00
5 I didn't think treatment would work.	16	8	0.39	2	22	0.05	11	13	1.00
6 I received treatment before and it did not work.	8	3	0.45	3	8	1.00	6	5	0.70
7 I was concerned about how much money it would cost.	14	0	<0.01*	2	13	0.42	8	6	0.72
8 I was concerned about what others might think if they found out I was in treatment.	20	8	0.16	8	20	1.00	13	16	1.00
9 I had problems with things like transportation, child care, or scheduling that would have made it hard to get to treatment.	20	2	<0.01*	2	20	0.09	6	16	0.14
10 I was unsure about where to go or who to see.	30	11	0.04	13	28	0.57	14	27	0.13
11 I thought it would take too much time or be inconvenient.	20	5	0.02	5	20	0.53	8	17	0.25
12 I could not get an appointment.	3	0	0.50	0	3	1.00	0	3	0.49
13 I was scared about being put into a hospital against my will.	2	0	1.00	0	2	1.00	0	2	1.00
14 I was not satisfied with the available services.	0	2	0.50	0	2	1.00	2	0	0.49

* $P < 0.01$, Fisher's exact test.

access; 'I was not getting better' (29.2%); and 'I had bad experiences with the treatment providers' (8.3%) for dropping out. These responses may reflect poor quality of community mental health care in Japan, often considered as a tendency of polypharmacy¹⁵ and dominant long-term hospital-based care.¹⁴

Structural barriers to seeking mental health care services, such as a lack of information about access to services, the presence of other inconveniences, and difficulties in finding time, were also commonly reported as reasons for not seeking mental health care services in the present study. On the other hand, the attitudinal barriers are the most commonly reported in studies conducted in Western studies.^{8,9} This discrepancy in the findings between Japan and Western countries^{8,9} may be caused by lack of information about access to mental health care.

Being a woman and of younger age were found to be key sociodemographic factors relating to the barriers to the use of mental health services for the fol-

lowing reason: women were more likely to report a lack of information about access to services than men were, and this influenced whether they sought help and how quickly they sought help. In addition, younger participants (<50 years old) reported that structural barriers delayed their access to services, including financial problems, difficulties finding time for care, lack of information about access to services, and the presence of other inconveniences. This finding is also supported by a previous report where individuals aged <50 years were more likely to report structural barriers to seeking services.⁷ Therefore, women and younger people may be target groups for disseminating information and education in terms of the use of mental health services. There were no differences in the barriers by years of education. However, dropping out of care owing to a perceived improvement in mental health was more likely among the participants aged <50 years than their older counterparts.

Table 7. Reasons for dropping out of mental health treatment before the professional wanted them to stop ($n = 24$)

	Age (years)			Sex			Education (years)		
	20–49	≥50	<i>P</i>	Men	Women	<i>P</i>	0–12	≥13	<i>P</i>
	%	%		%	%		%	%	
1 I got better.	42	0	0.02	8	33	0.24	25	17	0.41
2 I didn't need help anymore.	42	13	0.62	21	33	1.00	29	25	0.40
3 I was not getting better.	21	8	0.21	4	25	0.50	13	17	1.00
4 I wanted to handle the problem on my own.	17	8	0.79	4	21	0.55	4	21	0.24
5 I had bad experiences with the treatment providers.	8	0	1.00	4	4	0.49	0	8	0.49
6 I was concerned about what people would think if they found out I was in treatment.	8	0	1.00	4	4	0.49	4	4	1.00
7 I was treated badly or unfairly.	0	0		0	0		0	0	
8 The therapist or counselor left or moved away.	4	0	1.00	4	0	0.27	4	0	0.36
9 I felt out of place.	8	0	1.00	0	8	1.00	4	4	1.00
10 The policies were a hassle.	0	0		0	0		0	0	
11 There were problems with lack of time, schedule change, or lack of transportation.	4	0	1.00	0	4	1.00	0	4	1.00
12 I moved.	0	0		0	0		0	0	
13 Treatment was too expensive.	4	0	1.00	0	4	1.00	0	4	1.00
14 My health insurance would not pay for more treatment.	0	0		0	0		0	0	
15 My family wanted me to stop.	4	0	1.00	0	4	1.00	4	0	1.00

* $P < 0.01$, Fisher's exact test.

This study has certain limitations. First, a selection bias may affect the findings. The participants who had greater attitudinal barriers, such as stigma towards mental illness, may have been less willing to participate in the study. In addition, previous poor treatment experience may have made people reluctant to participate in the survey. Therefore, the attitudinal barriers may be underestimated in the study. In addition, people with severe mental illness may not wish to participate; more severe illness eventually facilitates problem recognition and prompts help-seeking.²⁴ Therefore, owing to the presence of less severe symptoms and problems, participants might not have felt that professional help was necessary, and this may explain the lack of a perceived need for mental health care. Second, the sample size was relatively small. The analysis of barriers for the use of health services likely suffered from low power owing to the small number of respondents. And the number of older people who did not seek care was only nine. The findings from this small number of participants may be unstable or biased. Third, the study did not determine the clinical diagnosis of respondents when they felt a need to see a professional or when they

dropped out from the treatment. It was not clear that all these respondents really needed mental health care. Fourth, responses to the survey may have been biased by the use of a retrospective self-report. Recall bias may result in either an underestimation or overestimation of symptoms and barriers. Furthermore, self-evaluation for the need for mental health services may not be concordant with the evaluation by professionals. The reasons for low perceived need could be divided into an absence of a problem (e.g. presence of subthreshold symptoms) and low expectations for care (e.g. a perceived ineffectiveness of care or disappointment in the results of care).

The present study found that low perceived need was a major reason for not seeking, delay in using, and dropout from mental health care services in Japan. Low perceived need for care and structural barriers were more frequently reported than attitudinal barriers, with the exception of a desire to handle the problem on one's own. Better recognition of mental health issues, improved understanding of the early signs and symptoms of mental health issues, and increased knowledge of the availability and location of effective care may improve access to care for

people with mental health conditions. In addition, some findings indicate a need to improve therapist-patient communication and quality of care in the community mental health service in Japan.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table S1. Classification of the barriers to accessing mental health services, reasons for delaying access to mental health services, and reasons for dropping out of mental health services by those related to low perceived need, structural barriers, or attitudinal barriers.

Table S2. Questions used in the interview with the sample of respondents with perceived barriers to mental health treatment in the World Mental Health Japan Survey 2002–2006.

Original Investigation

Associations Between Subjective Social Status and *DSM-IV* Mental Disorders

Results From the World Mental Health Surveys

Kate M. Scott, PhD; Ali Obaid Al-Hamzawi, DM, FICMS; Laura H. Andrade, MD, PhD; Guilherme Borges, DrSc; Jose Miguel Caldas-de-Almeida, MD, PhD; Fabian Fiestas, MD, PhD; Oye Gureje, MD, PhD; Chiyi Hu, MD, PhD; Elie G. Karam, MD; Norito Kawakami, MD, DMSc; Sing Lee, MB, BS; Daphna Levinson, PhD; Carmen C. W. Lim, MSc; Fernando Navarro-Mateu, MD, PhD; Michail Okoliyski, PhD; Jose Posada-Villa, MD; Yolanda Torres, DrHC; David R. Williams, PhD; Victoria Zakhosha, MA; Ronald C. Kessler, PhD

IMPORTANCE The inverse social gradient in mental disorders is a well-established research finding with important implications for causal models and policy. This research has used traditional objective social status (OSS) measures, such as educational level, income, and occupation. Recently, subjective social status (SSS) measurement has been advocated to capture the perception of relative social status, but to our knowledge, there have been no studies of associations between SSS and mental disorders.

OBJECTIVES To estimate associations of SSS with *DSM-IV* mental disorders in multiple countries and to investigate whether the associations persist after comprehensive adjustment of OSS.

DESIGN, SETTING, AND PARTICIPANTS Face-to-face cross-sectional household surveys of community-dwelling adults in 18 countries in Asia, South Pacific, the Americas, Europe, and the Middle East (N = 56 085). Subjective social status was assessed with a self-anchoring scale reflecting respondent evaluations of their place in the social hierarchies of their countries in terms of income, educational level, and occupation. Scores on the 1 to 10 SSS scale were categorized into 4 categories: low (scores 1-3), low-mid (scores 4-5), high-mid (scores 6-7), and high (scores 8-10). Objective social status was assessed with a wide range of fine-grained objective indicators of income, educational level, and occupation.

MAIN OUTCOMES AND MEASURES The Composite International Diagnostic Interview assessed the 12-month prevalence of 16 *DSM-IV* mood, anxiety, and impulse control disorders.

RESULTS The weighted mean survey response rate was 75.2% (range, 55.1%-97.2%). Graded inverse associations were found between SSS and all 16 mental disorders. Gross odds ratios (lowest vs highest SSS categories) in the range of 1.8 to 9.0 were attenuated but remained significant for all 16 disorders (odds ratio, 1.4-4.9) after adjusting for OSS indicators. This pattern of inverse association between SSS and mental disorders was significant in 14 of 18 individual countries, and in low-, middle-, and high-income country groups but was significantly stronger in high- vs lower-income countries.

CONCLUSIONS AND RELEVANCE Significant inverse associations between SSS and numerous *DSM-IV* mental disorders exist across a wide range of countries even after comprehensive adjustment for OSS. Although it is unclear whether these associations are the result of social selection, social causation, or both, these results document clearly that research relying exclusively on standard OSS measures underestimates the steepness of the social gradient in mental disorders.

Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: Kate M. Scott, PhD, Department of Psychological Medicine, University of Otago, PO Box 913, Dunedin, New Zealand (kate.scott@otago.ac.nz).

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Decades of research¹⁻⁴ have established that socioeconomic status is inversely associated with many mental disorders. Most of this research has used traditional indicators of socioeconomic status, such as educational level, income, and occupation, referred to herein as measures of objective social status (OSS). However, a recent development in the research on the associations between socioeconomic status and health has been the evaluation of subjective social status (SSS). Most studies⁵⁻¹⁴ have found that SSS is associated with physical health and psychological distress even after controlling for OSS, a finding that has been explained by the idea that SSS captures subjective judgment of relative social position.^{7,14} Relative social position has become a topic of great interest based on striking findings from the income inequality and physical health literature, such as that African American men with a 4-fold higher income than Costa Rican men nonetheless have a 9-year shorter life expectancy.¹⁵ This shorter life expectancy has been attributed in part to the psychosocial effects of relative deprivation and status anxiety caused by the lower relative social position of African Americans.^{15,16} More recently, greater income inequality among wealthy countries has been associated with a higher prevalence of mental disorders.¹⁷

Although the use of SSS measures in mental health research has been advocated,¹⁸ prior studies have typically used measures of psychological distress, such as the 36-Item Short Form Health Survey¹⁹ or General Health Questionnaire,²⁰ and, to our knowledge, research on SSS and individual mental disorders has not been carried out. Examining a range of mental disorders is important because much of the past research on social stratification and mental health has measured depression as the outcome, but concepts of relative deprivation and status insecurity imply a wide range of emotional responses including anger, frustration, hostility, and anxiety.¹⁸ The present study used data from 20 of the World Health Organization World Mental Health (WMH) surveys to examine associations of SSS with 16 DSM-IV disorders, with the aim of determining whether these associations persist after controlling for multiple fine-grained measures of OSS. Because prior research^{19,21} has suggested that SSS associations with health vary by culture we estimated SSS associations with mental disorders in individual countries. In addition, because the association between income inequality and mental disorders has only been found in wealthy countries,¹⁷ we examined associations in countries grouped by income level and tested whether associations vary across high-, middle-, and low-income countries.

Methods

Samples and Procedures

This study used data from 20 surveys in 18 countries (Table 1). All respondents provided written informed consent, and procedures for protecting respondents were approved and monitored for compliance by the institutional review boards in each country.²² A stratified, multistage, clustered area probability sampling strategy was used to select adult respondents. Most of the surveys were based on nationally representative house-

hold (or population register) samples; surveys in Colombia, Mexico, and Shenzhen were based on nationally representative household samples in urbanized areas. The weighted mean response rate across all surveys included in this article was 75.2% (Table 1). The surveys listed in Table 1 are grouped by World Bank country income classification into categories of low to lower-middle income, upper-middle income, and high income. For ease of reference these are referred to as *low-*, *middle-*, and *high-*income country groups in the text, although in the tables they retain the full descriptive labels.

The central WMH staff trained bilingual supervisors in each country. The World Health Organization translation protocol was used to translate instruments and training materials. Some surveys were carried out in bilingual form and others were carried out exclusively in the country's official language. Translation, back-translation, and harmonization of the WMH interview used standardized procedures that are discussed elsewhere.²² In most countries, internal subsampling was used to reduce respondent burden and mean interview time by dividing the interview into 2 parts. All respondents completed part 1, which included the core diagnostic assessment of most mental disorders. All part 1 respondents who met lifetime criteria for any mental disorder and a probability sample of respondents without mental disorders were administered part 2 of the survey (at the same interview sitting), which assessed the remaining mental disorders and collected a range of other information. Part 2 respondents were weighted by the inverse of their probability of selection for part 2 of the interview to adjust for differential sampling, resulting in an unbiased sample. The analyses in this study are based on the part 2 subsample (n = 56 085).

Additional weights were used to adjust for differential probabilities of selection within households, to adjust for nonresponse, and to match the samples to population sociodemographic distributions. Measures taken to ensure data accuracy, cross-national consistency, and protection of the respondents are described in detail elsewhere.^{22,23}

Measures

Mental Disorders

All surveys used the WMH survey version of the World Health Organization Composite International Diagnostic Interview, 3.0,²³ a fully structured interview administered to assess lifetime history and 12-month prevalence of DSM-IV mental disorders. The disorders included in the present article were anxiety disorders (panic disorder, agoraphobia without panic, specific phobia, social phobia, posttraumatic stress disorder, generalized anxiety disorder, and obsessive-compulsive disorder), mood disorders (major depressive disorder/dysthymia as well as bipolar broad [I, II] and subthreshold), substance use disorders (alcohol abuse and dependence and drug abuse and dependence), and impulse control disorders (intermittent explosive disorder, bulimia nervosa, and binge-eating disorder).

Subjective Social Status

The SSS was measured with the MacArthur subjective social status scale, which is the most widely used indicator of SSS and has good reliability and validity.^{5,8,14,24} Participants were given a drawing of a ladder with 10 rungs described as follows: "Think

Table 1. World Mental Health Sample Characteristics by World Bank Income Categories

Country	Survey	Sample Characteristics	Field Dates	Age Range, y	Sample Size, No.		Response Rate, %
					Part 1	Part 2	
Low to Lower-Middle Income							
Colombia	NSMH	All urban areas of the country (approximately 73% of the total national population)	2003	18-65	4426	2381	87.7
Colombia (Medellín)	MMHHS	Medellín metropolitan area	2011-2012	18-65	3261	1673	97.2
PRC (Shenzhen)	Shenzhen	Shenzhen metropolitan area; included temporary residents as well as household residents	2006-2007	≥18	7132	2475	80.0
Iraq	IMHS	Nationally representative	2006-2007	≥18	4332	4332	95.2
PRC (Beijing/Shanghai)	Beijing and Shanghai WMH	Beijing and Shanghai metropolitan areas	2002-2003	≥18	5201	1628	74.7
Nigeria	NSMHW	21 Of the 36 states in the country, representing 57% of the national population; surveys were conducted in the Yoruba, Igbo, Hausa, and Efik languages	2002-2003	≥18	6752	2143	79.3
Ukraine	CMDPSD	Nationally representative	2002	≥18	4724	1719	78.3
Upper-Middle Income							
Mexico	M-NCS	All urban areas of the country (approximately 75% of the total national population)	2001-2002	18-65	5782	2362	76.6
Peru	EMSMP	Nationally representative	2004-2005	18-65	3930	1801	90.2
Brazil	São Paulo Megacity	São Paulo metropolitan area	2005-2007	≥18	5037	2942	81.3
Bulgaria	NSHS	Nationally representative	2003-2007	≥18	5318	2233	72.0
South Africa	SASH	Nationally representative	2003-2004	≥18	4315	4315	87.1
Lebanon	Lebanon	Nationally representative	2002-2003	≥18	2857	1031	70.0
High Income							
Japan	WMHJ 2002-2006	11 Metropolitan areas	2002-2006	≥20	4129	1682	55.1
New Zealand	NZMHS	Nationally representative	2003-2004	≥18	12790	7312	73.3
Northern Ireland	NISHS	Nationally representative	2004-2007	≥18	4340	1986	68.4
Portugal	NMHS	Nationally representative	2008-2009	≥18	3849	2060	57.3
Israel	NHS	Nationally representative	2002-2004	≥21	4859	4859	72.6
United States	NCS-R	Nationally representative	2002-2003	18	9282	5692	70.9
Spain (Murcia)	PEGASUS-Murcia	Murcia region	2010-2012	≥18	2621	1459	67.4
Total					104 937	56 085	
Weighted mean response rate (%)							75.2

Abbreviations: CMDPSD, Comorbid Mental Disorders During Periods of Social Disruption; EMSMP, La Encuesta Mundial de Salud Mental en el Peru; IMHS, Iraq Mental Health Survey; MMHHS, Medellín Mental Health Household Study; M-NCS, Mexico National Comorbidity Survey; NCS-R, National Comorbidity Survey Replication; NHS, Israel National Health Survey; NISHS, Northern Ireland Study of Health and Stress; NMHS, Portugal National Mental Health Survey;

NSHS, Bulgaria National Survey of Health and Stress; NSMH, Colombian National Study of Mental Health; NSMHW, Nigerian Survey of Mental Health and Well-being; NZMHS, New Zealand Mental Health Survey; PEGASUS, Psychiatric Enquiry to General Population in Southeast Spain; PRC, People's Republic of China; SASH, South Africa Stress and Health Study; WMH, World Mental Health; WMHJ, The World Mental Health Japan.

of this ladder as representing where people stand in [country of interview]. At the top of the ladder are the people who are the best off—those who have the most money, the most education, and the most respected jobs. At the bottom are the people who are the worst off—those who have the least money, least education, and the least respected jobs or no job. The higher up you are on the ladder, the closer you are to the people at the very top; the lower you are, the closer you are to the people at the very bottom. Please place a large X on the rung where you think you stand at this time in your life, relative to the other people in [country of interview]. What is the number to the right of the rung where you placed the X?"

Objective Social Status

Educational level was assessed by self-report of the number of years of schooling completed. Three education variables

were created for each respondent. These were the number of years of education, country-relative education score (number of years of education divided by the weighted median education [in years] for the respondent's country), and neighborhood-relative education score (number of years of education divided by the weighted median education [in years] for each neighborhood [primary sampling unit] in the respondent's country).

Income was assessed by asking respondents to estimate their total family household income from all sources in the past 12 months, before tax or any other deductions were applied, with show cards providing multiple income brackets in the currency of their country from which they could select the appropriate response. Respondents were also asked about personal income, but household income was used in the present analysis. Four income variables were

Table 2. Distribution of SSS 10-Point Scale by Country Income Category

Income Category	SSS Score, No. (%) ^a										
	1	2	3	4	5	6	7	8	9	10	Other ^b
Income countries											
Low to lower middle ^c	662 (3.4)	923 (5.0)	1635 (9.1)	1929 (11.6)	3944 (24.4)	2444 (15.1)	1967 (13.1)	1289 (8.3)	406 (2.8)	417 (2.8)	735 (4.3)
Upper middle ^d	623 (3.7)	713 (4.4)	1360 (8.4)	2008 (13.4)	3335 (23.4)	2167 (15.1)	1757 (12.6)	1182 (8.9)	311 (2.5)	293 (1.8)	935 (5.8)
High ^e	603 (2.0)	771 (2.4)	1679 (5.6)	2602 (9.4)	6307 (24.6)	4617 (19.6)	4272 (18.0)	2431 (10.9)	642 (3.0)	371 (1.7)	755 (2.9)
All countries combined	1888 (2.9)	2407 (3.7)	4674 (7.4)	6539 (11.1)	13 586 (24.2)	9228 (17.1)	7996 (15.2)	4902 (9.6)	1359 (2.8)	1081 (2.1)	2425 (4.1)

Abbreviation: SSS, subjective social status.

^a Relative standings in terms of money, educational level, and job. The denominator used for these data is the percentage of all respondents in that group of countries.

^b Did not know, refused to answer, missing answer, and outliers.

^c Colombia, Colombia (Medellín), People's Republic of China (PRC) Shenzhen, PRC Beijing/Shanghai, Iraq, Nigeria, and Ukraine.

^d Mexico, Peru, Brazil, Bulgaria, South Africa, and Lebanon.

^e Japan, New Zealand, Northern Ireland, Portugal, Israel, United States, and Spain (Murcia).

created for each respondent: income percentile, income adjusted for household size, country-relative income score, and neighborhood-relative income score. These 2 latter scores were created in a manner analogous to the educational level scores.

Occupational type was based on the respondent's information about occupation at the time of the interview and classified into one of 28 occupation types or as not working at the time of the interview. Occupational status was categorized as working (weighted percentage, 59.2%), student (4.9%), homemaker (12.6%), retired (11.5%), and other (11.9%).

Statistical Analysis

Scores on the 1 to 10 SSS scale were grouped into 4 categories: low (scores 1-3), low-mid (scores 4 and 5), high-mid (scores 6 and 7), and high (scores 8-10). The high group was the reference group in all of the regression models. Participants who did not answer the question (for all countries combined, 3.6% [range across all countries, 0.3%-10.1%]), as well as those with missing data or outlying scores greater than 10 (0.6% [range, 0%-2.8%]) were excluded from the analyses. Country-specific logistic regression models estimated the associations of SSS with the aggregated indicator of any 12-month mental disorder controlling for current age, age squared, sex, and country. Models then estimated associations of SSS with any mental disorder in pooled country income groups, additionally adjusting for all of the OSS variables (income percentile score, income adjusted for household size, years of education, occupational type, occupational status, neighborhood-relative income score, country-relative income score, neighborhood-relative years of education, and country-relative years of education, plus squared versions of the income and education variables). We tested whether there were differences in strength of associations between SSS and mental disorders across low-, middle-, and high-income country groups by including cross-product terms for the interaction of SSS with dummy variables representing high-income countries and middle-income countries (low-income countries used as the reference) without and then with adjustment for OSS.

In all countries combined, logistic regression models estimated the associations of SSS with specific 12-month mental disorders, controlling for current age, age squared, sex, and country and then for all the OSS indicators. Sex moderation of associations was investigated, but the associations did not vary materially for men and women. Significant age moderation of associations was found whereby associations were strongest for the 2 middle-aged groups. However, because the inverse SSS to mental disorder gradient was evident for all age groups, we report results for all ages combined, controlling for current age and including age squared in the models to capture some of the nonlinearities in the relationship between SSS, age, and mental disorders.

Because the WMH data are both clustered and weighted, the design-based Taylor series linearization method²⁵ was implemented. The SUDAAN, version 11, software system (RTI International) was used to estimate SEs and evaluate the statistical significance of coefficients.

Results

SSS Distributions

The distributions of the original 10-point scale (Table 2) and 4 derived SSS categories (Table 3) are reported by country income groupings. The scores were approximately normally distributed, with all scores on the 10-point scale observed in each country income group. However, both the 10-point scale and 4-category distributions differed significantly across country income groups ($\chi^2 = 25.1$, $P < .001$; and $\chi^2 = 57.8$, $P < .001$, respectively). The nature of the differences is clearest in the 4-category distribution, where it can be seen that the proportions scoring low (in the 1-3 range) are larger in the lower-middle-income countries (18.3%) and upper-middle-income countries (17.6%) than in the high-income countries (10.3%).

Country-Specific Associations of SSS With Any 12-Month Mental Disorder

Table 4 reports the associations of the 3 lower categories of SSS (relative to the highest category) with the aggregated indica-

Table 3. Distribution of 4 Derived SSS Categories by Country Income Category

Income Category	SSS Score, No. (%) ^a			
	Low (1-3)	Low-Mid (4-5)	High-Mid (6-7)	High (8-10)
Low to lower middle ^b	3220 (18.3)	5873 (37.6)	4411 (29.5)	2112 (14.6)
Upper middle ^c	2696 (17.6)	5343 (39.0)	3924 (29.4)	1786 (14.0)
High ^d	3053 (10.3)	8909 (35.0)	8889 (38.6)	3444 (16.1)
All countries combined	8969 (14.5)	20 125 (36.8)	17 224 (33.6)	7342 (15.1)

Abbreviation: SSS, subjective social status.

PRC Beijing/Shanghai, Iraq, Nigeria, and Ukraine.

^a Relative standings in terms of money, educational level, and job. The denominator used for these data is the percentage of all respondents in that group of countries.^c Mexico, Peru, Brazil, Bulgaria, South Africa, and Lebanon.^d Japan, New Zealand, Northern Ireland, Portugal, Israel, United States, and Spain (Murcia).^b Colombia, Colombia (Medellín), People's Republic of China (PRC) Shenzhen,Table 4. Associations Between SSS and Any 12-Month Mental Disorder by Country^a

Country	SSS Score, OR (95% CI)		
	Low ^b	Low-Mid ^c	High-Mid ^d
Low to lower-middle income (pooled) ^e	2.0 (1.6-2.5) ^e	1.5 (1.2-1.8) ^e	1.2 (1.0-1.5)
Colombia	1.6 (1.1-2.4) ^e	1.6 (1.0-2.5) ^e	1.2 (0.8-1.8)
PRC Shenzhen	2.1 (0.9-4.7)	1.4 (0.9-2.0)	1.5 (1.0-2.3)
Iraq	1.9 (1.1-3.1) ^e	1.1 (0.7-1.7)	0.8 (0.5-1.2)
PRC Beijing/Shanghai	3.8 (1.7-8.1) ^e	2.7 (1.4-5.1) ^e	1.2 (0.6-2.4)
Nigeria	1.9 (0.8-4.4)	2.0 (1.0-4.1) ^e	1.8 (0.8-4.0)
Colombia (Medellín)	2.3 (1.4-3.9) ^e	1.4 (0.9-2.4)	1.3 (0.8-2.2)
Ukraine	1.4 (0.4-4.7)	1.1 (0.3-3.2)	0.9 (0.3-2.7)
Upper-middle income (pooled) ^e	2.0 (1.6-2.5) ^e	1.5 (1.2-1.8) ^e	1.3 (1.1-1.5) ^e
Mexico	2.1 (1.3-3.4) ^e	1.8 (1.3-2.6) ^e	1.1 (0.8-1.5)
Brazil	2.8 (1.8-4.6) ^e	1.7 (1.2-2.5) ^e	1.5 (1.0-2.3) ^e
Bulgaria	1.9 (0.8-4.5)	1.6 (0.7-3.6)	1.5 (0.6-3.7)
Lebanon	3.2 (1.3-7.7) ^e	2.0 (0.9-4.4)	1.7 (0.8-3.6)
Peru	2.1 (1.3-3.4) ^e	1.1 (0.7-1.7)	1.0 (0.6-1.5)
South Africa	1.4 (1.0-2.0) ^e	1.3 (0.9-1.8)	1.2 (0.8-1.6)
High income (pooled) ^e	3.1 (2.6-3.7) ^e	1.9 (1.7-2.2) ^e	1.3 (1.1-1.5) ^e
Japan	2.7 (0.9-8.6)	1.2 (0.4-3.1)	1.7 (0.7-4.4)
New Zealand	3.2 (2.5-4.1) ^e	2.0 (1.6-2.4) ^e	1.2 (1.0-1.6)
Northern Ireland	5.2 (2.6-10.5) ^e	2.6 (1.6-4.0) ^e	1.3 (0.8-2.0)
Portugal	2.4 (1.3-4.3) ^e	2.1 (1.2-3.7) ^e	1.7 (0.9-3.1)
Israel	4.7 (3.2-6.7) ^e	2.1 (1.5-3.0) ^e	1.8 (1.3-2.6) ^e
United States	2.6 (1.8-3.7) ^e	1.7 (1.4-2.0) ^e	1.1 (0.9-1.3)
Spain (Murcia)	1.5 (0.6-3.6)	1.4 (0.7-2.8)	1.3 (0.7-2.1)
All countries combined	2.5 (2.2-2.8) ^e	1.7 (1.6-1.9) ^e	1.3 (1.2-1.4) ^e
Adjusted for OSS ^f			
Low to lower-middle income (pooled)	1.9 (1.5-2.4) ^e	1.5 (1.2-1.8) ^e	1.2 (1.0-1.5)
Upper-middle income (pooled)	2.0 (1.6-2.5) ^e	1.5 (1.2-1.8) ^e	1.3 (1.1-1.5) ^e
High income (pooled)	2.7 (2.2-3.2) ^e	1.8 (1.6-2.1) ^e	1.3 (1.1-1.5) ^e
All countries combined	2.3 (2.0-2.5) ^e	1.7 (1.5-1.8) ^e	1.3 (1.2-1.4) ^e

Abbreviations: OR, odds ratio; OSS, objective social status; PRC, People's Republic of China; SSS, subjective social status.

^a Models controlled for current age, age squared, and sex using SSS (reference group, high scores [8-10]) to predict the odds of respondents' having any 12-month mental disorder.^b Having SSS scores of 1 to 3 on the original 1- to 10-item scale.^c Having SSS scores of 4 to 5 on the original 1- to 10-item scale.^d Having SSS scores 6 to 7 on the original 1- to 10-item scale.^e Significant at the $P = .05$ level, using a 2-tailed test.^f Models controlled for current age, age squared, sex, country, OSS (income percentile, 1-100), income percentile adjusted for household size (1-100), occupational type, occupational status, education (number of years), country-relative income score, neighborhood-relative income score, country-relative education score, neighborhood-relative education score, and the squared version of all OSS variables (except for the occupation variables) using SSS (reference group, high scores [8-10]) to predict the odds of respondents' having any 12-month mental disorder.

tor of any 12-month mental disorder in individual countries, in low-, middle-, and high-income country groups and among all countries combined. For all countries combined, there was a graded inverse association of SSS with any mental disorder, with ORs for low, low-mid, and high-mid SSS categories of 2.5, 1.7, and 1.3, respectively. This inverse gradient was evident in all countries except Japan and Nigeria and was significant in 14 of 18 countries and in 15 of 20 individual surveys.

The associations between SSS and any mental disorder for each pooled set of countries grouped by income level were stronger for the high-income countries (ORs for low, low-mid, and high-mid SSS categories, 3.1, 1.9, and 1.3, respectively) compared with upper-middle-income countries (ORs, 2.0, 1.5, and 1.3, respectively) and low-income countries (ORs, 2.0, 1.5, and 1.2, respectively). This country income group difference was statistically significant ($\chi^2_6 = 22.2$; $P = .001$). This

Table 5. Associations Between SSS and 12-Month Mental Disorders, All Countries Combined

Type of Disorder	Adjusted OR (95% CI)					
	SSS Without OSS ^a			SSS With OSS ^b		
	Low	Low-Mid	High-Mid	Low	Low-Mid	High-Mid
Any mood disorder	3.0 (2.6-3.5) ^c	1.8 (1.6-2.0) ^c	1.3 (1.2-1.5) ^c	2.7 (2.3-3.2) ^c	1.7 (1.5-2.0) ^c	1.3 (1.2-1.5) ^c
Major depressive episode/dysthymia	3.2 (2.7-3.7) ^c	1.9 (1.6-2.2) ^c	1.3 (1.2-1.5) ^c	2.9 (2.5-3.4) ^c	1.9 (1.6-2.1) ^c	1.3 (1.2-1.5) ^c
Bipolar disorder (broad)	2.9 (2.2-3.7) ^c	1.4 (1.1-1.9) ^c	1.1 (0.9-1.5)	2.2 (1.7-3.0) ^c	1.3 (1.0-1.6)	1.1 (0.8-1.4)
Any anxiety disorder	2.5 (2.2-2.9) ^c	1.7 (1.5-1.9) ^c	1.2 (1.1-1.4) ^c	2.4 (2.1-2.7) ^c	1.7 (1.5-1.9) ^c	1.2 (1.1-1.4) ^c
Panic disorder	3.9 (2.9-5.2) ^c	1.9 (1.4-2.5) ^c	1.3 (0.9-1.7)	2.8 (2.0-3.8) ^c	1.6 (1.2-2.1) ^c	1.2 (0.9-1.6)
Generalized anxiety disorder	3.5 (2.8-4.4) ^c	2.2 (1.8-2.7) ^c	1.4 (1.1-1.7) ^c	3.0 (2.3-3.9) ^c	2.1 (1.7-2.6) ^c	1.4 (1.1-1.7) ^c
Social phobia	2.7 (2.2-3.5) ^c	1.7 (1.4-2.0) ^c	1.2 (1.0-1.5)	2.5 (1.9-3.2) ^c	1.6 (1.3-2.0) ^c	1.2 (1.0-1.5)
Specific phobia	2.0 (1.7-2.3) ^c	1.6 (1.4-1.8) ^c	1.2 (1.0-1.4) ^c	1.8 (1.5-2.1) ^c	1.5 (1.3-1.8) ^c	1.2 (1.0-1.4) ^c
Agoraphobia without panic	2.5 (1.8-3.5) ^c	1.6 (1.2-2.2) ^c	1.1 (0.8-1.6)	2.0 (1.4-2.9) ^c	1.4 (1.0-2.0) ^c	1.1 (0.8-1.6)
Posttraumatic stress disorder	4.4 (3.3-5.9) ^c	2.3 (1.8-3.0) ^c	1.3 (1.0-1.8)	3.7 (2.7-5.1) ^c	2.1 (1.6-2.8) ^c	1.3 (1.0-1.7)
Obsessive-compulsive disorder	1.8 (1.1-2.9) ^c	1.3 (0.8-1.9)	1.1 (0.8-1.6)	2.1 (1.2-3.5) ^c	1.4 (0.9-2.1)	1.2 (0.8-1.7)
Any impulse control disorder	2.0 (1.5-2.5) ^c	1.7 (1.3-2.1) ^c	1.2 (1.0-1.5)	2.0 (1.5-2.6) ^c	1.7 (1.4-2.2) ^c	1.2 (1.0-1.5)
Intermittent explosive disorder	1.8 (1.3-2.6) ^c	1.7 (1.3-2.2) ^c	1.2 (1.0-1.6)	1.8 (1.3-2.5) ^c	1.7 (1.3-2.3) ^c	1.3 (1.0-1.6)
Bulimia nervosa	3.0 (1.4-6.7) ^c	1.6 (0.8-3.3)	1.1 (0.5-2.4)	2.5 (1.1-5.9) ^c	1.6 (0.8-3.5)	1.3 (0.6-3.0)
Binge-eating disorder	2.7 (1.7-4.5) ^c	1.6 (1.0-2.6) ^c	1.2 (0.7-1.9)	2.5 (1.5-4.2) ^c	1.6 (1.0-2.7) ^c	1.2 (0.7-2.0)
Any substance use disorder	2.2 (1.7-2.8) ^c	1.6 (1.3-2.1) ^c	1.1 (0.9-1.5)	1.6 (1.2-2.0) ^c	1.3 (1.1-1.7) ^c	1.1 (0.8-1.4)
Alcohol abuse	1.9 (1.4-2.5) ^c	1.5 (1.2-2.0) ^c	1.2 (0.9-1.5)	1.4 (1.1-1.9) ^c	1.3 (1.0-1.7)	1.1 (0.8-1.4)
Alcohol dependence	3.2 (2.1-4.9) ^c	2.0 (1.3-2.9) ^c	1.4 (0.9-2.1)	1.8 (1.2-2.8) ^c	1.4 (0.9-2.1)	1.2 (0.8-1.9)
Drug abuse	3.8 (2.4-6.0) ^c	2.5 (1.6-3.8) ^c	1.6 (1.0-2.5) ^c	2.2 (1.4-3.6) ^c	1.9 (1.2-3.0) ^c	1.5 (0.9-2.3)
Drug dependence	9.0 (3.9-20.8) ^c	4.2 (1.9-9.3) ^c	2.4 (1.0-5.7)	4.9 (2.0-11.7) ^c	3.1 (1.4-6.8) ^c	2.1 (0.9-5.0)

Abbreviations: OR, odds ratio; OSS, objective social status; SSS, subjective social status.

^a Models controlled for sex, current age, age squared, and country using SSS (reference, high) to predict the odds of respondents' having any 12-month mental disorders in separate logistic regression models.

^b Models controlled for sex, current age, age squared, country, OSS (income percentile, 1-100), income percentile adjusted for household size (1-100),

occupational type, occupational status, education (number of years), country-relative income score, neighborhood-relative income score, country-relative education score, neighborhood-relative education score, and the squared version of all OSS variables (except for the occupation variables) to predict the odds of respondents' having any 12-month mental disorders in separate logistic regression models.

^c Significant at the $P = .05$ level, using a 2-tailed test.

interaction effect remained significant after inclusion of OSS in the models ($\chi^2_6 = 16.1$; $P = .01$); the results from models adjusted for OSS are also presented in Table 4.

Associations of SSS With Individual Mental Disorders

In all countries combined, a graded, inverse pattern of association was found with all mental disorders unadjusted for OSS (Table 5). Odds ratios for the lowest SSS category relative to the highest ranged from 1.8 for intermittent explosive disorder and obsessive-compulsive disorder to 9.0 for drug dependence, with the ORs for most disorders falling between 2.0 and 4.0.

Adjustment for OSS attenuated associations to a variable degree across disorders but most strongly for the substance use disorders and some of the anxiety disorders. Despite this attenuation, SSS remained significantly associated with all disorders, with most ORs remaining greater than 2.0. Odds ratios for the lowest SSS category relative to the highest ranged from 1.4 for alcohol abuse to 4.9 for drug dependence. Of individual disorders, SSS was most strongly associated with drug dependence, but when considering associations between SSS and disorder groups, these were smallest in magnitude for any substance use disorder (OR, 1.6 for the lowest SSS category relative to the highest) and

largest for any mood disorder (OR, 2.7 for the lowest SSS category relative to the highest).

Discussion

In this general population sample from 18 countries, graded inverse associations were found between SSS and all mental disorders, where SSS was measured as a subjective perception of position in the country-specific hierarchy in terms of income, educational level, and occupation. This pattern of association between SSS and mental disorders was evident in 18 of 20 surveys, significant in 15 of 20 surveys, and was significantly stronger in high- than in lower-income countries. Subjective social status remained associated with all mental disorders after adjustment for a large set of fine-grained OSS indicators.

Limitations of the study include the likelihood that sample selection biases (whereby respondents with the most severe mental disorders and the lowest socioeconomic status are less likely to be included in the sample) may have restricted the range of measures and so attenuated the strength of associations. A further limitation is that our measures of OSS were restricted to educational level, income, and occupation; inclu-

sion of other measures of OSS, such as wealth (assets), may have reduced the independent effects of SSS. Finally, the cross-sectional design of the study prevents clarification of the temporal nature of the associations so that social causation and selection effects cannot be disentangled.

Within the context of these limitations, to our knowledge, this study provides the first investigation of the relationship between SSS and diagnostic measures of a wide range of mental disorders. Most prior research on SSS has been limited to measures of psychological distress,^{5,7,14} and the present study shows that low SSS is associated with higher risk of all 16 mental disorders investigated. Moreover, we found that associations between SSS and mental disorders persisted after more comprehensive adjustment for OSS than was achieved in most prior studies. The major explanation advanced for why there are independent associations of SSS with health outcomes after controlling for OSS is that SSS measures subjective perception of relative social position.¹⁴ Perception of lower relative social position has been hypothesized to increase the risk of mental illness through a sense of relative deprivation and status insecurity, with associated feelings of shame, distrust, frustration, and anxiety.^{7,14,17,26,27} Our findings of inverse associations between SSS and all mental disorders appear to offer considerable support for this hypothesis, although as noted above we cannot determine the relative contribution of social causation vs social selection processes.

The stronger association between SSS and mental disorders in the high- relative to lower-income countries is interesting in light of a recent research¹⁷ finding that greater income inequality was associated with a higher prevalence of mental disorders in a group of high-income countries. In the present study, the stronger association between SSS and mental disorders in the high-income countries persisted even after adjustment for objective differences in absolute and relative household income, so this finding cannot be attributed to higher levels of income inequality in high- relative to lower-income countries. Indeed, income inequality was highest in

some of the middle-income countries included in this study. Considering other explanations for our finding of a steeper SSS-mental disorder gradient in high-income countries, one contributing factor could be that advertising and media are more influential in high-income countries and that this has the effect of making social inequalities more visible and encouraging social comparisons¹⁷; this effect in turn could heighten status competition and status insecurity^{17,27} leading to stronger associations between SSS and mental disorders in high-income countries. Another possibility is that lower SSS may be more detrimental to mental health in high-income countries owing to values that are more common in wealthy countries, where success is evaluated in terms of individual achievement and prestige.^{28,29} In this regard it is interesting that Japan, considered a collectivist culture with a strong ethos of social relativism,²⁹ was the only high-income country in this study with no clear SSS-mental disorder gradient.³⁰ However, most countries, including many generally considered collectivist, exhibited associations between SSS and mental disorders.

Conclusions

This study found inverse graded associations between SSS and 16 DSM-IV mental disorders that remained strong after adjustment for a large set of detailed OSS indicators. This pattern of association was evident in almost all countries but was significantly stronger in high- than in lower-income countries. Although interpretation of the associations between SSS and mental disorders is far from clear cut, the strength and consistency of these associations suggests that further research is warranted and should use prospective designs that can help distinguish between social causation and selection processes. The study findings indicate that research into the social gradient in mental health that relies on the standard OSS measures of income, educational levels, and occupation will underestimate the steepness of the gradient.

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Author Affiliations: Department of Psychological Medicine, University of Otago, Dunedin, New Zealand (Scott, Lim); Department of Medicine, College of Medicine, Al-Qadisia University, Diwania, Iraq (Al-Hamzawi); Section of Psychiatric Epidemiology-LIM 23 Department and Institute of Psychiatry, University of São Paulo Medical School, São Paulo, Brazil (Andrade); Division of Epidemiological and Psychosocial Research, Department of Intervention Models, National Institute of Psychiatry, Mexico City, Mexico (Borges); Department of Health Services, Metropolitan Autonomous University, Mexico City, Mexico (Borges); Chronic Diseases Research Center and Department of Mental Health, Faculdade de Ciências Médicas, Universidade Nova de Lisboa, Lisbon, Portugal (Caldas-de-Almeida); National

Institute of Health of Peru, Evidence Generation Research Unit, Lima, Peru (Fiestas); World Health Organization Collaborating Centre for Research and Training in Mental Health, Neurosciences, and Drug and Alcohol Abuse, Ibadan, Nigeria (Gureje); Department of Psychiatry, College of Medicine, University of Ibadan, University College Hospital, Ibadan, Nigeria (Gureje); Shenzhen Institute of Mental Health and Shenzhen Kangning Hospital, Guangdong Province, PR China (Hu); St George Hospital University Medical Center, Balamand University, Institute for Development, Research, Advocacy, Beirut, Lebanon (Karam); Applied Care, Medical Institute for Neuropsychological Disorders, Beirut, Lebanon (Karam); School of Public Health, University of Tokyo, Tokyo, Japan (Kawakami); Department of Psychiatry, The Chinese University of Hong Kong, Shatin, Hong Kong (Lee); Mental Health Services, Ministry of Health, Jerusalem, Israel (Levinson); Subdirección General de Salud Mental y Asistencia Psiquiátrica, Servicio Murciano de Salud, El Palmar, Murcia, Spain (Navarro-Mateu); National Centre of Public Health and Analyses, Ministry of Health, Sofia, Bulgaria (Okoliyski);

Colegio Mayor de Cundinamarca University, Bogota, DC, Colombia (Posada-Villa); Salud Mental, Universidad CES, Medellín, Colombia (Torres); Department of Social and Behavioral Sciences, Harvard School of Public Health, Boston, Massachusetts (Williams); Kiev International Institute of Sociology, Kiev, Ukraine (Zakhosha); Department of Health Care Policy, Harvard Medical School, Boston, Massachusetts (Kessler).

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Study concept and design: Scott, Kessler.

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RESEARCH REPORT

How well can post-traumatic stress disorder be predicted from pre-trauma risk factors? An exploratory study in the WHO World Mental Health Surveys

RONALD C. KESSLER¹, SHERRI ROSE¹, KARESTAN C. KOENEN², ELIE G. KARAM³, PAUL E. STANG⁴, DAN J. STEIN⁵, STEVEN G. HEERINGA⁶, ERIC D. HILL¹, ISRAEL LIBERZON⁷, KATIE A. McLAUGHLIN⁸, SAMUEL A. McLEAN⁹, BETH E. PENNELL⁶, MARIA PETUKHOVA¹, ANTHONY J. ROSELLINI¹, AYELET M. RUSCIO¹⁰, VICTORIA SHAHLY¹, ARIEH Y. SHALEV¹¹, DERRICK SILOVE¹², ALAN M. ZASLAVSKY¹, MATTHIAS C. ANGERMEYER¹³, EVELYN J. BROMET¹⁴, JOSÉ MIGUEL CALDAS DE ALMEIDA¹⁵, GIOVANNI DE GIROLAMO¹⁶, PETER DE JONGE¹⁷, KOEN DEMYTTENAERE¹⁸, SILVIA E. FLORESCU¹⁹, OYE GUREJE²⁰, JOSEP MARIA HARO²¹, HRISTO HINKOV²², NORITO KAWAKAMI²³, VIVIANE KOVESS-MASFETY²⁴, SING LEE²⁵, MARIA ELENA MEDINA-MORA²⁶, SAMUEL D. MURPHY²⁷, FERNANDO NAVARRO-MATEU²⁸, MARINA PIAZZA²⁹, JOSE POSADA-VILLA³⁰, KATE SCOTT³¹, YOLANDA TORRES³², MARIA CARMEN VIANA³³

¹Department of Health Care Policy, Harvard Medical School, 180 Longwood Ave., Boston, MA 02115, USA; ²Mailman School of Public Health, Columbia University, New York, NY, USA; ³Balamand University Medical School and Institute for Development, Research, Advocacy and Applied Care (IDRAAC), Beirut, Lebanon; ⁴Janssen Research & Development, Titusville, NJ, USA; ⁵University of Cape Town, Cape Town, South Africa; ⁶Institute for Social Research, University of Michigan, Ann Arbor, MI, USA; ⁷Department of Psychology, University of Michigan, Ann Arbor, MI, USA; ⁸University of Washington, Seattle, WA, USA; ⁹University of North Carolina at Chapel Hill, Chapel Hill, NC, USA; ¹⁰University of Pennsylvania, Philadelphia, PA, USA; ¹¹Hadassah University Hospital, Jerusalem, Israel; ¹²University of New South Wales and Liverpool Hospital, Sydney, Australia; ¹³Center for Public Mental Health, Gösingam Wagram, Austria; ¹⁴State University of New York at Stony Brook, Stony Brook, NY, USA; ¹⁵Universidade Nova de Lisboa, Lisbon, Portugal; ¹⁶IRCCS Centro San Giovanni di Dio Fatebenefratelli, Brescia, Italy; ¹⁷University of Groningen, Groningen, The Netherlands; ¹⁸University Hospital Gasthuisberg, Leuven, Belgium; ¹⁹National School of Public Health Management and Professional Development, Bucharest, Romania; ²⁰University of Ibadan, Ibadan, Nigeria; ²¹Parc Sanitari Sant Joan de Déu, Sant Boi de Llobregat, Spain; ²²National Center for Public Health Protection, Sofia, Bulgaria; ²³University of Tokyo, Tokyo, Japan; ²⁴Université Paris Descartes and EHESP School for Public Health, Paris, France; ²⁵Chinese University of Hong Kong, Hong Kong SAR, China; ²⁶Instituto Nacional de Psiquiatria Ramon de La Fuente Muñiz, Tlalpan, Mexico City, Mexico; ²⁷University of Ulster, Londonderry, Northern Ireland, UK; ²⁸Servicio Murciano de Salud and CIBER de Epidemiología y Salud Pública (CIBERESP), El Palmar, Spain; ²⁹Universidad Peruana Cayetano Heredia, Lima, Peru; ³⁰Universidad Colegio Mayor de Cundinamarca, Bogota, Colombia; ³¹University of Otago, Dunedin, New Zealand; ³²University Center of Excellence on Mental Health Research, Medellín, Colombia; ³³Federal University of Espirito Santo (UFES), Vitoria, Brazil

Post-traumatic stress disorder (PTSD) should be one of the most preventable mental disorders, since many people exposed to traumatic experiences (TEs) could be targeted in first response settings in the immediate aftermath of exposure for preventive intervention. However, these interventions are costly and the proportion of TE-exposed people who develop PTSD is small. To be cost-effective, risk prediction rules are needed to target high-risk people in the immediate aftermath of a TE. Although a number of studies have been carried out to examine prospective predictors of PTSD among people recently exposed to TEs, most were either small or focused on a narrow sample, making it unclear how well PTSD can be predicted in the total population of people exposed to TEs. The current report investigates this issue in a large sample based on the World Health Organization (WHO)'s World Mental Health Surveys. Retrospective reports were obtained on the predictors of PTSD associated with 47,466 TE exposures in representative community surveys carried out in 24 countries. Machine learning methods (random forests, penalized regression, super learner) were used to develop a model predicting PTSD from information about TE type, socio-demographics, and prior histories of cumulative TE exposure and DSM-IV disorders. DSM-IV PTSD prevalence was 4.0% across the 47,466 TE exposures. 95.6% of these PTSD cases were associated with the 10.0% of exposures (i.e., 4,747) classified by machine learning algorithm as having highest predicted PTSD risk. The 47,466 exposures were divided into 20 ventiles (20 groups of equal size) ranked by predicted PTSD risk. PTSD occurred after 56.3% of the TEs in the highest-risk ventile, 20.0% of the TEs in the second highest ventile, and 0.0-1.3% of the TEs in the 18 remaining ventiles. These patterns of differential risk were quite stable across demographic-geographic sub-samples. These results demonstrate that a sensitive risk algorithm can be created using data collected in the immediate aftermath of TE exposure to target people at highest risk of PTSD. However, validation of the algorithm is needed in prospective samples, and additional work is warranted to refine the algorithm both in terms of determining a minimum required predictor set and developing a practical administration and scoring protocol that can be used in routine clinical practice.

Key words: Post-traumatic stress disorder, predictive modeling, machine learning, penalized regression, random forests, ridge regression

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Post-traumatic stress disorder (PTSD) is a commonly occurring and seriously impairing disorder (1). Many people exposed to the traumatic experiences (TEs) that lead to PTSD come to the attention of the criminal justice or health care system short-

ly after exposure and could be targeted through these systems for early preventive interventions. In recognition of this fact, an increasing amount of research has been carried out to develop and evaluate early preventive interventions for PTSD.

While the interventions developed for delivery in the first few hours after TE exposure have so far proven ineffective (2), cognitive-behavioral (3) and prolonged exposure (4) therapies delivered within a few weeks after TE exposure have been shown to be moderately effective in preventing chronic PTSD. In addition, ongoing research suggests that a wider range of potentially cost-effective preventive interventions might become available in the future (5).

Importantly, though, these preventive interventions for PTSD are labor-intensive, making them infeasible to offer cost-effectively to all people exposed to TEs (1). Prediction rules that successfully target people at highest PTSD risk shortly after TE exposure could improve intervention cost-effectiveness.

Meta-analyses (6-8) and reviews (9-11) of studies that searched for these predictors point to six especially promising predictor classes: type-severity of TE (highest PTSD risk associated with physical or sexual assault) (7,12); socio-demographics (e.g., female gender and young age) (6,8,9); cumulative prior TE exposure (including exposure to childhood family trauma) (6,7,10); prior mental disorders (especially anxiety, mood, and conduct disorders) (10,11); acute emotional and biological responses (6,7,11,13); and proximal social factors occurring in the days and weeks *after* TE exposure (e.g., low social support, heightened life stress) (6,7).

This literature offers no guidance on how to combine information about these predictors into an optimal PTSD risk algorithm. Machine learning methods have been used to develop similar algorithms in other areas of medicine (14,15). However, most studies using information obtained shortly after TE exposure to predict PTSD are based on samples too small (typically N=100-300) to apply these methods. This limitation could be overcome if future prospective studies were either much larger or used much more consistent measures (to allow individual-level data pooling for secondary analysis) than studies carried out up to now.

Prior to that time, a preliminary PTSD risk algorithm could be developed from the first four classes of predictors enumerated above (i.e., socio-demographics, type of focal TE, prior TE exposure, prior psychopathology), based on analysis of existing cross-sectional community epidemiological studies. The latter studies tend to be quite large, which means that machine learning methods could be applied. Although limited by being cross-sectional and relying on retrospective reports to examine associations of putative predictors with subsequent PTSD, these preliminary prediction algorithms could be validated in small prospective studies (that are themselves too small for algorithm development).

The current report presents the results of developing a preliminary PTSD risk algorithm from cross-sectional data in the World Health Organization (WHO)'s World Mental Health (WMH) Surveys (www.hcp.med.harvard.edu/WMH), a series of community epidemiological surveys in 24 countries that included retrospective assessments of PTSD associated with 47,466 lifetime TE exposures. The large and geographically

dispersed sample, coupled with the great variety of TEs and predictors assessed, make this database attractive for developing a preliminary PTSD risk algorithm. If the algorithm appears to perform well, it could subsequently be validated in smaller prospective studies and used as a starting point for data collection in future prospective studies.

METHODS

Samples

The WMH surveys were conducted in thirteen countries classified by the World Bank (16) as high income (Australia, Belgium, France, Germany, Israel, Italy, Japan, Spain, The Netherlands, New Zealand, Northern Ireland, Portugal, United States), seven upper-middle income (São Paulo in Brazil, Bulgaria, Lebanon, Mexico, Romania, South Africa, Ukraine), and four lower-middle income (Colombia, Nigeria, Beijing and Shanghai in the People's Republic of China, Peru). Most surveys were based on national household samples, the exceptions being surveys of all urbanized areas in Colombia and Mexico, specific metropolitan areas in Brazil, China and Spain, a series of cities in Japan, and two regions in Nigeria. Response rates were in the range 45.9-97.2% and averaged 70.4%. More detailed sample descriptions are presented elsewhere (17).

Interviews were administered face-to-face in two parts after obtaining informed consent using procedures approved by local institutional review boards. Part I, administered to all respondents (N=126,096), assessed core DSM-IV mental disorders. Part II, administered to all Part I respondents with any lifetime Part I disorder plus a probability subsample of other Part I respondents (N=69,272), assessed additional disorders, including PTSD, and correlates. Part II respondents were weighted by the inverse of their probability of selection from Part I. More details about WMH sample designs and weighting are presented elsewhere (17). The 42,634 Part II respondents who reported lifetime TEs included a sub-sample of 13,610 subjects who were exposed only once to only a single TE and an additional sub-sample of 29,024 subjects who reported multiple TE exposures.

PTSD was assessed for each of the 13,610 exposures in the first sub-sample. The 29,024 respondents with multiple TEs were asked to select a "worst" TE using a two-part question sequence. The first of the two-part sequence asked: "Let me review. You had (two/three/quite a few) different traumatic experiences. After an experience like this, people sometimes have problems like upsetting memories or dreams, feeling emotionally distant or depressed, trouble sleeping or concentrating, and feeling jumpy or easily startled. Did you have any of these reactions after (either/any) of these experiences?"

The 9,791 respondents answering "yes" were then asked the second question in the two-part series: "Of the experiences

you reported, which one caused you the most problems like that?”. PTSD was assessed for each exposure reported in response to this question. However, as these “worst” TEs cannot be taken to describe all TEs these respondents experienced, we also assessed PTSD for one exposure selected at random for a probability sub-sample of respondents with multiple exposures (N=4,832). The observational record for each “worst” exposure was assigned a weight of 1, while that for each randomly selected exposure was assigned a weight of $1/tp$ (t =number of TEs reported by the respondent other than the worst TE; p =probability of case selection), in order to make the total sample of 47,466 exposures assessed representative of all lifetime TE exposures of all respondents.

PTSD diagnosis

Mental disorders were assessed with the Composite International Diagnostic Interview (CIDI, 18), a fully-structured lay-administered interview yielding DSM-IV diagnoses. A clinical reappraisal study carried out in several WMH Surveys (19), assessing the CIDI concordance for DSM-IV PTSD with the Structured Clinical Interview for DSM-IV (SCID) (20) used as the gold standard, found an area under the curve (AUC) of 0.69, a sensitivity of 38.3, and a specificity of 99.1. The resulting likelihood ratio positive (LR+) of 42 is well above the threshold of 10 typically used to consider screening scale diagnoses definitive. Consistent with the high LR+, positive predictive value was 86.1%, suggesting that the vast majority of CIDI cases would be judged to have PTSD in independent clinical evaluations.

Predictors of PTSD

Socio-demographics

Socio-demographics included gender along with age, education, and marital status at focal TE exposure.

Traumatic experiences

WMH Surveys assessed 29 TE types, including 27 specific types from a list, one open-ended question about TEs not included in the list, and a final yes-no question about any other lifetime TE that respondents did not wish to describe concretely (referred to as a “private event”). Respondents were probed separately about number of lifetime occurrences and age at first occurrence of each TE type reported.

Exploratory factor analysis found that the vast majority of TE types loaded on one of five broad factors (Table 1) referred to below as “exposure to organized violence”, “participation in organized violence”, “interpersonal violence”, “sexual-relationship violence”, and “other life-threatening TEs”. Predictors of PTSD included a separate dummy variable for each focal TE type in addition to 29 dummy variables for prior life-

time exposure to the same types. Temporal clustering among TEs was captured by creating counts of prior lifetime exposure to TEs in each factor and of other TEs in each factor in the same year as exposure to the focal TE.

Prior mental disorders

The CIDI assessed seven lifetime DSM-IV internalizing disorders in addition to PTSD (separation anxiety disorder, specific phobia, social phobia, agoraphobia and/or panic disorder, generalized anxiety disorder, major depressive disorder and/or dysthymia, bipolar disorder I-II) and six lifetime externalizing disorders (attention-deficit/hyperactivity disorder (ADHD), intermittent explosive disorder, oppositional-defiant disorder (ODD), conduct disorder (CD), alcohol abuse with or without dependence, drug abuse with or without dependence).

Age of onset of each disorder was assessed using special probing techniques shown experimentally to improve recall accuracy (21). DSM-IV organic exclusion rules and diagnostic hierarchy rules were used other than for ODD (defined with or without CD) and substance abuse (defined with or without dependence). As detailed elsewhere (19), generally good concordance was found between diagnoses based on the CIDI and blinded clinical diagnoses based on the SCID (20).

Analysis methods

Conventional multiple regression (with all predictors in the model) (22) and four machine learning algorithms were used to predict PTSD. The machine learning algorithms included random forests (23) and three elastic net penalized logistic regressions (24) designed to address two problems in conventional multiple regression: that coefficients are unstable when high correlations exist among predictors, which is the case for the predictors considered here, leading to low replication of predictions in independent samples (25); and that conventional regression assumes additivity, whereas the predictors considered here might have non-additive effects (7,8,10).

Random forests is an ensemble machine learning method that generates many regression trees to detect interactions, each based on a separate bootstrapped pseudo-sample to protect against over-fitting, and assigns individual-level predicted probabilities of outcomes based on modal values across replicates (23). The algorithm was implemented in the R-package randomForest (26). The R-package r-part (27) was also used to examine the distribution of higher-order interactions underlying the data.

Elastic net penalized regression is an approach that trades off bias to decrease standard errors of estimates, reducing instability caused by high correlations among predictors using a mixing parameter penalty (MPP) that varies in the range 0-1. The three penalties we used included: the lasso penalty (MPP=1.0), which favors sparse models that force coefficients for all but one predictor in each strongly