Cost of Depression Among Adults in Japan

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Objective: The aim of this study was to estimate the annual national cost of major depressive disorder among adults 20 years and older in Japan in 2008.

Method: The analysis used was a top-down costing approach based on national health statistics. From the societal perspective, the costs examined were direct medical costs, depression-related suicide costs, and workplace costs for all members of society. Direct medical costs included both inpatient and outpatient medical costs, while workplace costs included both absenteeism and presenteeism costs. The authors performed 1-way sensitivity analyses to examine the extent to which results were affected by the choice of parameters used in the cost calculation. All costs were expressed in 2008 US dollar terms.

Results: The economic burden of depression in Japan was approximately \$11 billion, with \$1,570 million relating to direct medical costs, \$2,542 million to depression-related suicide costs, and \$6,912 million to workplace costs. Compared to previously published studies, this study adopted conservative key assumptions; this may have resulted in a conservative estimate of the annual national cost of depression.

Conclusions: Depression imposes a substantial economic burden on Japanese society, which highlights the urgent need for policymakers to allocate resources toward implementing strategies that prevent and manage depression in the Japanese population. *Prim Care Companion CNS Disord 2011;13(3):e1-e9*

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A gior depressive disorder constitutes a major public health concern. The Global Burden of Disease study has revealed that overcoming depression is a high priority in all areas of the world.^{1,2} Depression has been projected to become the second leading cause of disease burden in the world by the year 2030,¹ due to its high prevalence, high impact on functioning, and early-age onset.² Furthermore, the disease burden of depression also produces an economic burden on society. A systematic review of 24 cost-of-illness studies of depression has reported that depression has substantial economic consequences on society.³ These cost-of-illness studies can not only quantify the economic burden of diseases but also help both the general public and policymakers to better understand the need to invest in health care and drive decisions about future insurance benefits, efforts in curbing and controlling diseases, and development of interventions.^{4,5} Over time, estimates from cost-of-illness studies have been used in cost-benefit and cost-effectiveness analyses to evaluate more effective interventions.^{4,5}

Luppa et al³ have systematically reviewed studies estimating the annual national cost of depression, while pointing out some of the limitations of previous studies. First, most of the previous studies focused on only a narrow array of cost components, although cost-ofillness studies should consider such cost components as direct medical costs, depression-related suicide costs, and workplace costs; there are especially few studies that estimate depression-related suicide costs. Second, most of the studies were conducted in the United States or the United Kingdom; little information is available from central or eastern Europe, Africa, or Asia. To our knowledge, only 1 study has estimated the annual national cost of depression in Asia.⁶

The aim of the present study was to estimate direct medical costs, depression-related suicide costs, and workplace costs of major depressive disorder among adults 20 years and older in Japan in 2008.

METHOD

Cost-of-Illness Methodology

A top-down costing approach carried out on the basis of national health statistics was applied to estimate the annual national cost of depression among adults 20 years and older in Japan in 2008. We provide brief descriptions of major national health statistics in Appendix 1 to help readers better understand the methods used to estimate the annual national cost. From the societal perspective, the costs examined in the present study were direct medical costs, depression-related suicide costs, and workplace costs for all members of society. Direct medical costs, while workplace costs included those related to both absenteeism (ie, productivity loss due to absence from the workplace) and presenteeism (ie,

CLINICAL POINTS

- Major depressive disorder imposes a substantial economic burden on Japanese society.
- Indirect costs (ie, depression-related suicide costs and workplace costs) comprise 86% of the total costs.
- Researchers and policymakers need to pay more attention to implementing more effective strategies that prevent and manage depression in order to reduce indirect costs.

reduced productivity at the workplace due to depression). To compare the results of this study to the relevant findings of published cost-of-illness studies of depression, we calculated the annual national cost as costs per country and as costs per depressed individual based on the prevalence of depression^{7–9} and population size of individuals 20 years and older.¹⁰ All costs reported here are in 2008 US dollars, which were calculated using purchasing power parity (US\$1.00 = JPN¥117).¹¹ All data and R syntax¹² used to calculate costs are available from the first author upon request.

Direct Medical Costs

Inpatient medical costs were estimated as the product of 2 components: the annual number of inpatient admissions and the average costs per day of inpatient depression treatment. The annual number of inpatient admissions was calculated by multiplying the estimated number of inpatients per day by the 366 days in 2008. First, the estimated number of inpatients with a primary diagnosis of major depressive disorder (ICD-10 diagnostic code: F32-F33) per day across all age groups was retrieved from the Patient Survey 2008,¹³ conducted by the Ministry of Health, Labor and Welfare (MHLW). The estimated number of inpatients by age and specific diagnosis of depression is not available from the Patient Survey (ie, we could only obtain the estimated number of inpatients by age group with any mood disorder rather than with major depressive disorder); therefore, we estimated the percentage of inpatients 20 years and older with a primary diagnosis of any mood disorder (ICD-10 diagnostic code: F30–F39) from the Patient Survey and applied this percentage to the estimated number of inpatients with major depressive disorder. Second, the average costs, including nonpharmacy and pharmacy costs, per day for inpatient depression treatment were retrieved from the Survey of Medical Care Activities in Public Health Insurance 2008 (SMCA-PHI),¹⁴ conducted by the MHLW. Because the average costs per day are not reported in the SMCA-PHI 2008 by either age group or specific diagnosis of depression,¹⁴ we retrieved the average costs arising from inpatients with a primary diagnosis of any mood disorder across all age groups.

Outpatient medical costs were the product of the annual number of outpatient admissions and the average

costs per day for outpatient depression treatment. The annual number of outpatient admissions was calculated as the product of the estimated number of outpatients per day and the 247 working days in 2008. As with the inpatient medical costs, we retrieved the estimated number of outpatients per day from the Patient Survey 2008¹³ and the average nonpharmacy costs per day for outpatient depression treatment from the SMCA-PHI 2008.¹⁴ For patients who take prescriptions from an outside pharmacy, the average pharmacy costs per day are not reported by type of illness in the SMCA-PHI 2008¹⁴; hence, we retrieved the average pharmacy costs arising from outpatients who take prescriptions from an in-house pharmacy and who have a primary diagnosis of any mood disorder across all age groups.

Depression-Related Suicide Costs

Depression-related suicide costs were estimated as the product of 2 components: the annual number of suicides due to depression and the net present value (NPV) of an individual's future earnings with gender and age taken into account. First, the annual number of suicides was retrieved from the Criminal Statistics in 2008^{15,16} and data were stratified by gender and age. The annual number of suicides due to depression is available only for individuals with an established cause of death in the Criminal Statistics in 2008.¹⁶ Therefore, we estimated the percentages of suicides due to depression by gender and age, using information from individuals with an established cause; we then applied this percentage to the annual number of suicides.

Second, we computed the NPV of an individual's future earnings by age group for both men and women using the following formula:

$$NPV_{q} = \sum_{n=q}^{100} \frac{P_{q}(n)X_{n}W_{n}}{(1+i)^{n-q}}$$

where q is the age of the individual at death, n is the age if the individual had survived, $P_q(n)$ is the probability that a person of age q will survive to age n, X_n is the average labor force participation rate in the age group with midyear age n, W_n is the average annual earnings in an age cohort with the midpoint n, and i is the annual discount rate. The NPV was estimated based

Table 1. Di	irect Medical Co	sts of Depressio	n in Japan				
	Estimated MDD		Average Cost	s per Day	Direct Medical	Costs (US\$ 2008 in millions	s) ^c
Туре	Admissions per	% of Patients	(US\$ 20	08) ^b	Nonpharmacy ^d	Pharmacy ^d	Total
of Cost	Day ^a [1]	Aged≥20 y ^a [2]	Nonpharmacy [3]	Pharmacy [4]	$[5] = [1] \times [2] / 100 \times X \times [3]$	$[6] = [1] \times [2] / 100 \times X \times [4]$	[7] = [5] + [6]
Inpatient	16,000	99.3	106.50	5.71	619	33	653
Outpatient	53,900	98.4	38.21	31.87	500	417	918
Total ^c					1,120	451	1,570
aThe estime	ted number of pati	ente with major d	apressive disorder p	or doy [1] and t	he percentage of patients wit	h any mood disorder aged	20 years [2]

^aThe estimated number of patients with major depressive disorder per day [1] and the percentage of patients with any mood disorder aged \geq 20 years [2] are from the Patient Survey 2008.¹³

^bThe average costs per day for patients with any mood disorder, [3] and [4], are from the Survey of Medical Care Activities in Public Health Insurance 2008.¹⁴

^cNumbers may not add up to subtotals/totals due to rounding.

^dX refers to the 366 days for inpatient and the 247 working days for outpatient medical costs.

on life expectancies from the Abridged Life Tables for Japan 2008,¹⁷ the average labor force participation rate from the Labor Force Survey 2008,¹⁸ the average annual earnings from the Basic Survey on Wage Structure 2008,¹⁹ and the annual discount rate of 6% from the previous cost-of-illness studies of depression.^{20,21}

Workplace Costs

We computed the absenteeism costs by age group for both men and women using the following formula:

 $Absenteeism = N_{pop} \times Pr_{dep} \times [0.271 \times 33_{days} + (1 - 0.271) \times 60.2_{days}] \times 247_{days}/366_{days} \times X \times W$

where N_{pop} is the population size, Pr_{dep} is the 12-month prevalence of depression, 0.271 is the treatment rate for depression, 33_{days} is the lost days due to treatment for depression among those treated, 60.2_{days} is the lost days at home in bed among those untreated, $247_{days}/366_{days}$ is the proportion of working days in 2008, *X* is the average labor force participation rate, and *W* is the average wage per day. In addition, we computed presenteeism costs as follows:

 $\begin{aligned} \text{Presenteeism} = N_{\text{pop}} \times \text{Pr}_{\text{dep}} \times [0.272 \times 51_{\text{days}} + (1 - 0.271) \times 65.8_{\text{days}}] \times 247_{\text{days}}/366_{\text{days}} \times X \times W \times 0.20 \end{aligned}$

where 51_{days} is the reduced productivity days among those treated, 65. 8_{days} is the reduced productivity days among those untreated, and 0.20 is the impairment rate, which equals the proportion of income loss due to depression.

Workplace costs were estimated using the following sources. First, the population size (N_{pop}) was retrieved from the Population Estimates 2008^{10} and data were stratified by gender and age. Second, the 12-month prevalence (Pr_{dep}) and the treatment rate (0.271) for *DSM-IV* major depressive disorder were retrieved from the World Mental Health Japan Survey 2002-2003.^{7–9} Because the 12-month prevalence in the World Mental Health Japan Survey is not available by gender and age group (ie, we could only obtain the 12-month prevalence by gender and the 12-month prevalence by age group), we assume that the same gender distribution for major depressive disorder can be applied to each age group (ie, 23.9% male and 76.1% female).⁷⁻⁹ Third, with regard to lost days (33_{days} for treated individuals and 60.2_{days} for untreated individuals), reduced productivity days (51_{days} for treated individuals and 65.8_{days} for untreated individuals), and impairment rate of 0.20, we maintained the same assumptions used in the previous cost-of-illness studies of depression.^{20,21} Fourth, the average labor force participation rates (*X*) were retrieved from the Labor Force Survey 2008.¹⁸ Finally, the average wage per day (*W*) was retrieved from the Basic Survey on Wage Structure 2008.¹⁹

Sensitivity Analyses

We performed 1-way sensitivity analyses to examine the extent to which results are affected by the choice of parameters used in the cost calculation. In more detail, we evaluated the sensitivity of the annual national cost of depression to different 12-month prevalence rates for depression (3.7% and 2.2%), treatment rates for depression (41.4% and 27.1%), percentages of suicides due to depression (60% and 27.6%), alternative discount rates (3% and 6%), different definitions of depression (any mood disorder and major depressive disorder), and target age ranges (all ages and age \geq 20 years).

RESULTS

The annual national cost of depression in Japan was estimated at approximately \$11 billion, in 2008 US dollar terms. This total cost corresponds to a cost of \$4,836 per depressed individual.

Direct medical costs of depression in 2008 amounted to \$1,570 million, or 14.2% of the total cost associated with this disease (Table 1). The costs of outpatient depression treatment (\$918 million) were higher than those of inpatient treatment (\$653 million). Pharmacy costs were estimated at \$451 million, accounting for 28.7% of direct medical costs.

Depression-related suicide costs in 2008 amounted to \$2,542 million, or 23.1% of the total cost (Table 2). A total of 31,414 suicides occurred in 2008 among adults aged \geq 20 years. While the annual number of

Table 2. Depression-Related Suicide Costs

	No. of S	Suicidesª 1]	% of a di Depi	Suicides ue to ression ^a [2]	Es of to [3]:	stimated N Suicides d Depression = [1] × [2]/	lo. lue on 100	Labo Partic %	or Force cipation, ^b [4]	An Earr (US\$ 20	nual nings 008)° [5]	Present Lifetime (US\$ 20	Value of Earnings 008) ^d [6]	Depr Su (US\$ 2 [,	ession-Re uicide Cos 008 in mi 7] = [3] × [0	lated sts llions) ^e 6]
Age (y)	Male	Female	Male	Female	Male	Female	Total	Male	Female	Male	Female	Male	Female	Male	Female	Total
20-29	2,373	1,065	23.9	44.7	567	476	1,043	76.6	68.5	31,747	26,705	642,061	316,452	364	151	515
30-39	3,396	1,454	25.5	50.6	864	736	1,600	92.9	62.0	44,958	31,850	694,467	302,747	600	223	823
40-49	3,852	1,118	22.4	47.9	863	535	1,398	94.1	70.7	56,967	33,318	589,651	242,545	509	130	639
50-59	4,986	1,377	18.1	48.0	905	660	1,565	90.8	64.3	56,689	30,883	343,909	135,539	311	89	401
60-69	4,096	1,639	18.1	46.1	742	755	1,497	60.9	34.4	35,989	24,244	128,913	50,332	96	38	134
≥70	3,543	2,515	17.8	34.5	631	867	1,498	20.2	8.5	34,422	25,999	32,300	12,784	20	11	31
Total	22,246	9,168			4,572	4,029	8,601							1,900	642	2,542

^aThe annual number of suicides [1] and the percentage of suicides due to depression [2] are from the Criminal Statistics in 2008.^{15,16}

^bThe average labor force participation rates [4] are from the Labor Force Survey 2008.

"The average annual earnings [5] are from the Basic Survey on Wage Structure 2008.¹⁹

^dThe net present value of an individual's future earnings [6] are estimated based on life expectancies from the Abridged Life Tables for Japan 2008,¹⁷

the average annual earnings [5], the average labor force participation rate [4], and the annual discount rate of 6%.

"Numbers may not add up to subtotals/totals due to rounding.

Table 3.	Workplac	e Costs											
	Popu (in tho	llation usands)ª	12-J Prev for Dep	Month valence Major pressive	Labo Partio	or Force cipation,	Wage j	per Day	Wo	orkplace Cos	ts (US\$ 20	008 in millio	ns) ^e
	[1]	Disor	der ^b [2]	%	o ^c [3]	(US\$ 20	008) ^d [4]	Absent	eeism [5]	Present	teeism [6]	
Age (y)	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Total ^f
20-34	12,107	11,624	2.4	6.3	82.6	65.9	104.54	88.86	892	1,532	209	358	2,990
35-44	9,096	8,921	0.8	2.0	93.7	65.2	147.63	105.18	345	443	81	104	972
45-54	7,811	7,791	1.4	3.7	93.5	71.3	172.04	101.87	632	751	148	176	1,706
55-64	9,241	9,556	1.1	2.8	81.4	51.7	148.66	92.27	423	456	99	107	1,085
≥65	12,044	16,170	0.4	1.2	29.0	12.9	107.77	82.52	59	71	14	17	159
Total ^f	50,299	54,062							2,351	3,251	550	761	6,912

^aFrom the Population Estimates 2008.¹⁰

^bFrom the World Mental Health Japan Survey 2002–2003.^{7–9}

^cFrom the Labor Force Survey 2008.¹⁸

^dFrom the Basic Survey on Wage Structure 2008.¹⁹

¹Estimated based on the population size [1], the 12-month prevalence [2], and the treatment rate of 27.1% for major depressive disorder from the World Mental Health Japan Survey 2002–2003^{7–9}; the lost days, the reduced productivity days, and the impairment rates of 20% from the previous cost-of-illness studies of depression^{20,21}; the average labor force participation rates [3]; and the average wage per day [4].

"Numbers may not add up to totals due to rounding	5.
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Table 4. One-Wa	y Sensitivit	y Analyses on Ke	y Assumptio	ns
			Total Costs	
	Changed		(US\$ 2008	
Assumption	Case	Base Case	in millions)	$\Delta\%$
Base case			11,025	
12-mo prevalence	3.7% ^a	2.2%	16,385	+48.6
Treatment rate	41.4% ^b	27.1%	10,567	-4.1
% of suicides due to depression	60.0% ^c	27.6%	14,399	+30.6
Discount rate	3%	6%	11,912	+8.0
Definition of depression	Any mood disorder	Major depressive disorder	16,013	+45.2

Target age rangeAll ages ≥ 20 y11,082 ± 0.5 "The 12-month prevalence of 3.7% is retrieved from the upper 95%
confidence interval in the World Mental Health Japan Survey."

The treatment rate of 41.4% is retrieved from the upper 95% confidence interval in the World Mental Health Japan Survey.⁸

^cThe percentage of suicides due to depression of 60.0% is used in the previous cost-of-illness studies of depression.^{20,21}

suicides was higher in men (22,246) than in women (9,168), the estimated annual number of suicides due to depression was about the same for men (4,572) and women (4,029). The male population aged 30–49 years constituted 43.6% of all depression-related suicide costs, because of the relatively high annual number of suicides due to depression within this demographic and the NPV of these individuals' future earnings.

Workplace costs in 2008 amounted to \$6,912 million, or 62.7% of the total cost (Table 3). Among workplace costs, absenteeism costs comprised \$5,602 million or 81.0% of workplace costs, while presenteeism costs were estimated at \$1,311 million (19.0%). The population aged 20–34 years constituted 43.3% of workplace costs, because of the relatively high prevalence of depression within this demographic.

Table 4 shows the results of 1-way sensitivity analyses that considered the impact of varying the key

	4					Costs	per Depr	essed						
			Costs per Cc	untry ^a (US\$ 2008	in millions)	Individ	lual ^a (US\$	2008)			Key A	ssumpti	ons	
Study	Country	Year	D (%)	S (%)	W (%)	D	s	Μ	\Pr_{dep}	$\mathrm{Pr}_{\mathrm{trt}}$	$\mathrm{Pr}_{\mathrm{sui}}$	i	Definition ^b	Age (y)
This study	Japan	2008	1,570 (14.2)	2,542 (23.1)	6,912 (62.7)	689	1,115	3,032	2.2%	27%	28%	6%	I	+20
Thomas and Morris, 2003 ²²	United Kingdom	2000	702 (4.1)	1,067(6.2)	15,422 (89.7)	264	401	5,794	4.5%	NA	70%	6%	I	+15
Jönsson and Bebbington, 1994 ²³	United Kingdom	1990	541	NA	NA	NA	NA	NA	NA	NA	NA	NA	+	NA
Kind and Sorensen, 1993 ²⁴	England and Wales	1991	1,030	NA	7,349	509	NA	3,635	3.5%	NA	60%	NA	+	+15
Greenberg et al, 2003 ^{20,c}	United States	2000	30,939(31.4)	6,464~(6.6)	61,130 (62.0)	1,260	263	2,490	8.7%	44%	60%	6%	+	+18
Rice and Miller, 1995 ^{25,c}	United States	1990	31,917 (66.1)	12,729 (26.4)	3,646(7.5)	1,195	477	137	10.7%	NA	60%	6%	+	+18
Greenberg et al, 1993 ²¹	United States	1990	20,617(28.4)	12,493 (17.2)	39,433 (54.4)	1,400	848	2,677	5.9%	67%	60%	6%	+	+18
Stoudemire et al, 1986 ²⁶	United States	1980	4,829(12.9)	9,598 (25.7)	22,916 (61.4)	507	1,008	2,407	4.2%	67%	60%	6%	I	+18
Sobocki et al, 2007 ^{27,c}	Sweden	2005	661(14.2)	308 (6.6)	3,693 (79.2)	NA	NA	NA	NA	NA	60%	3%	+	+18
Sobocki et al, 2006 ^{28,d}	Spain	2004	1,992(28.6)	260 (3.7)	4,702 (67.6)	1,166	152	2,753	4.0%	NA	NA	NA	+	NA
Hu et al, 2007^6	China	2002	1,256(12.3)	1,143(11.2)	7,844 (76.6)	47	42	291	2.1%	10%	40%	3%	+	+18
^a Costs reported in the published v parities. ^{11,30}	vorks were (1) inflated	to the year	c 2008 using cour	try-specific gross	s domestic produc	ct inflator	; ^{29,30} ; they	were the	1 (2) conve	rted into	US dolla	ars using	g purchasing po	wer
$^{b}(+)$ Indicates that the definition c	of depression includes b	ipolar dise	order or dysthym	ia. (–) Indicates t	hat the definition	of depres	sion exclı	ides bipola	ar disordeı	and dys	thymia.			
^c We retrieved the latest statistics f	rom the studies that ase	eced the	development of t	he cost of denress	ion over time	I		1						

 $Pr_{\rm sui}$ = percentage of suicides due to depression, $Pr_{\rm trt}$ = treatment rate for We retrieved the cost of depression in Spain from those in Europe, because costs per depressed individual were lowest in Spain among 13 countries for which 12-month prevalence of depression was $Pr_{dep} = 12$ -month prevalence for depression, veropment of the rate, NA = not available, cost bbreviations: D = direct medical costs, *i* = annual discount rate, l depression, S = depression-related suicide costs, W = workplace Abbreviations: D = direct medical available

assumptions involved. The most sensitive assumption was the 12-month prevalence for depression: in varying the prevalence from 2.2% to 3.7%, the total cost increased from \$11 billion to \$16 billion (ie, a 48.6% increase). The second most sensitive assumption was the definition of depression. We changed the definition of depression from major depressive disorder to any mood disorder, and doing so resulted in a total cost of \$16 billion, or a 45.2% increase. The third most sensitive assumption was the percentage of suicides due to depression; we changed the percentage from 27.6% to 60.0%, which resulted in a total cost of \$14 billion, or a 30.6% increase. DISCUSSION

The economic burden of depression in Japan in 2008 was approximately \$11 billion, with \$1,570 million relating to direct medical costs, \$2,542 million to depression-related suicide costs, and \$6,912 million to workplace costs. To compare the results of the present study to relevant findings from other published works, we conducted a MEDLINE review of English-language cost-of-illness studies published from 1966 to 2010 that estimate the annual national cost of depression using the following keywords: burden-of-illness or cost-of-illness or economic burden and depression or depressive disorder. We also screened the reference lists of all selected articles. Table 5 provides an overview of 10 published studies, together with the results of the present study.^{6,20–28} To establish comparability, costs reported in the published works were (1) inflated to the year 2008 using countryspecific gross domestic product inflators^{29,30} and then (2) converted into US dollars using purchasing power parities.^{11,30} In addition, because countries differ in terms of prevalence for depression, we calculated the annual national cost as costs per depressed individual, based on the prevalence of depression reported in the studies and the country's population size in the year of pricing.^{30,31} Although these adjustments may improve comparability of several annual national costs, the results of these adjustments must be interpreted with caution because any changes in parameters used to estimate costs in each study may influence current annual national cost (eg, changes in treatment rates or annual number of inpatient admissions).

Compared to previously published studies, we adopted conservative key assumptions; this may have resulted in a conservative estimate of the annual national cost of depression (Table 5). First, we assumed a relatively low prevalence of depression.^{7,9} Although epidemiologic studies revealed lower prevalence estimates of depression in Asian countries than in Western countries, these prevalence estimates are likely to be conservative because of sample selection bias and reporting bias.³² Second, we used a strict definition of

depression as major depressive disorder. In contrast, most other studies estimated the annual national cost of depression by including individuals who exhibited any mood disorder. Third, we assumed a relatively low percentage of suicides due to depression, based on information regarding individuals with an established cause of death.¹⁶ In any case, the estimated percentage of suicides due to depression would be conservative, due to the generally low treatment rate and underdiagnosis of depression.^{8,33} In addition, the sensitivity analyses revealed that the aforementioned assumptions had a large impact on the annual national cost of depression.

In the present study, direct medical costs per depressed individual amounted to \$689 (Table 5). This result is much lower than those reported in the United States (\$1,195 to \$1,400),^{20,21,25} with the exception of the study by Stoudemire et al (\$507).²⁶ One possible explanation for the discrepancy is that, on the one hand, health price levels in the United States are 25% higher than the Organization for Economic Cooperation and Development (OECD) average, while on the other hand, health price levels in Japan are 25% below that average.³⁴ In addition, pharmacy costs in the present study represented 28.7% of direct medical costs; this share is higher than those reported in Europe (22%)²⁸ and Sweden (19%),²⁷ but lower than those in the United States (40%),²⁰ China (59%),⁶ or the United Kingdom (84%).²² It is not clear why the share of pharmacy costs varies so widely. However, there are several potential explanations to account for the discrepancies of the pharmacy costs' share. One possibility is that changes in patterns of care are associated with a shift wherein the highest contributor to costs became pharmacy costs, rather than inpatient treatment costs.^{20,22} Other possibilities are that higher prices of patented drugs may increase the share of pharmacy costs, while higher utilization rates of generic drugs may reduce the share. These possibilities, however, are too complicated to explain the discrepancies of the pharmacy costs' share (ie, 40% of direct medical costs in the United States and 29% in Japan), because the average ex-manufacturer prices of patented drugs in the United States are 18% higher than those in Japan and the utilization rates of generic drugs in the United States (86%) are also higher than those in Japan (13%).³⁵

In the present study, depression-related suicide costs per depressed individual amounted to \$1,115, which is higher than the amount reported in the other countries—even while making conservative key assumptions in the present study (Table 5). One possible explanation for the discrepancy is that suicide rates per 100,000 individuals are much higher in Japan (28.1 for men and 10.4 for women) than the OECD average (17.6 for men and 5.2 for women).³¹

In the present study, workplace costs per depressed individual amounted to \$3,032, which accounted for

62.7% of the total cost (Table 5). Despite underlying differences in key assumptions, workplace costs are the single largest cost category: they comprise 54%–90% of the total costs in previous studies, with the exception of the study by Rice and Miller (7.5%).²⁵ The workplace costs per depressed individual ranged from \$2,400 to \$5,800, when ignoring outliers (Table 5). Our results suggest that strategies for identifying depressed workers and promoting effective treatment may reduce substantial workplace costs.³⁶ In addition, educational campaigns for depression would have an important role in improving treatment rates and adherence rates,³⁷ because individuals have less ability to recognize depression and have greater negative attitudes toward depression in Japan than in Australia.^{38,39}

The results of the present study also point to the annual national cost of depression and underscore the importance of depression to Japanese society, especially compared to the economic burden posed by other diseases. Nonetheless, little has been reported on the annual national cost-of-illness in Japan.^{40,41} Nishimura and Zaher⁴⁰ estimated that the annual national cost of chronic obstructive pulmonary disease was \$6.8 billion, with \$5.5 billion and \$1.4 billion due to direct medical costs and workplace costs, respectively. In addition, Toyokawa et al⁴¹ reported that the annual direct medical costs of all liver diseases amounted to \$6.2 billion. The estimated annual national cost of depression (\$11 billion) is much higher than those of chronic obstructive pulmonary disease or of liver diseases.

The present study has several potential limitations. First, we excluded from estimations of direct medical costs patients with a secondary diagnosis of depression. Several epidemiologic studies have identified depression as commonly cooccurring with chronic physical health problems such as diabetes, hypertension, heart problems, stroke, cancer, arthritis, chronic obstructive pulmonary disease, asthma, kidney disease, liver disease, end-stage renal disease, and multiple sclerosis.⁴² In nonpsychiatric settings, less than half of the patients with depression are recognized by their physicians.³³ Therefore, including only individuals with a primary diagnosis of depression may lead to an underestimation of direct medical costs. Second, we could not separate psychotherapy costs from nonpharmacy costs because of the lack of available data. Psychotherapy is one of the most effective treatments for depression in the international treatment guidelines.^{42,43} The share of psychotherapy costs in direct medical costs, however, may be negligible because only 28% of the Japanese medical institutions that employed 1 or more psychiatrists adequately provide psychotherapy.44 Third, by using a top-down costing approach based on Japanese national health statistics, it is difficult to include outside medical services such as those involving private counseling rooms, telephone counseling lifelines, or

mental health welfare centers. Fourth, we used somewhat ambiguous assumptions in estimating workplace costs, due to data unavailability. We made the same assumptions used in previous studies^{20,21} concerning lost days due to depression, reduced productivity days due to depression, and impairment rates. In addition, we assumed the same 12-month prevalence and treatment rate for depression in 2002–2003 as in the year 2008.^{7–9}

In conclusion, major depressive disorder imposes a substantial economic burden on Japanese society. This heavy economic burden highlights the urgent need for policymakers to allocate resources toward implementing strategies that prevent and manage depression in the Japanese population.

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Appendix 1 appears on page e9.

Appendix 1. Characteristics	of Main Studies Used to Estimate Costs
Patient Survey ¹³	
Aim	To investigate the actual situation of diseases and injuries of the patients who use hospitals and clinics
Design	Cross-sectional study of a stratified random sample of Japanese medical institutions
Setting	The nationwide medical institutions, including 6,543 hospitals, 5,825 general clinics, and 1,266 dental clinics
Participants	2,047,000 Patients receiving treatment in the hospitals and 307,000 patients in the clinics in October 2008, and 967,000 patients discharged from the medical institutions in September 2008
Measurements	Gender, birth date, type of hospitalization/outpatient visit, and primary diagnosis
Retrieved information	Estimated numbers of inpatients and outpatients with a primary diagnosis of major depressive disorder per day across all age groups Percentages of inpatients and outpatients aged 20 years and older with a primary diagnosis of any mood disorder
Limitation	Estimated numbers of inpatients and outpatients by age group and specific diagnosis of depression are not reported
Survey of Medical Care Activiti	es in Public Health Insurance ¹⁴
Aims	To investigate the situation of medical treatment, diseases and injuries, and dispensing and use of drugs concerning those provided under the government-managed health insurance, society-managed employment-based health insurance, national health insurance, and long-life medical care system and to obtain basic data for administration of medical insurance
Design	Cross-sectional study of a 2-stage stratified random sample of Japanese medical institutions
Setting	Nationwide medical institutions, including 1,414 hospitals, 9,720 clinics, 972 dental institutions, and 4,679 outside pharmacies
Subjects	373,738 Detailed statements of medical fees, 29,592 of dental fees, and 73,715 of pharmacy dispensing fees in June 2008
Measurements	Gender, birth date, type of hospitalization/outpatient visit, primary diagnosis, actual number of days for treatment during the month, and medical fees by type of medical practice during the month
Retrieved information	Average nonpharmacy and pharmacy costs arising from inpatients with a primary diagnosis of any mood disorder across all age groups Average nonpharmacy costs per day arising from outpatients with a primary diagnosis of any mood disorder across all age groups Average pharmacy costs per day arising from outpatients who take prescriptions from an in-house pharmacy and who have a primary diagnosis of any mood disorder across all age groups
Limitations	For inpatients and outpatients, the average costs per day by either age group or specific diagnosis of depression are not
Linitations	For outpatients who take prescriptions from an outside pharmacy, the average pharmacy costs per day by type of illness are not reported
Criminal Statistics ^{15,16}	
Aim	To summarize the total number of cases known to the police as crimes and the number of arrests
Design	Nationwide database reported from each prefectural police headquarters in Japan
Measurements	Annual number of suicides and annual number of suicides for individuals with an established cause of death in 2008
Retrieved information	Annual number of suicides by gender and age Percentages of suicides due to depression by gender and age among individuals with an established cause of death
Limitation	Annual number of suicides due to depression is available only for individuals with an established cause of death
Labor Force Survey ¹⁸	
Aim	To investigate the current state of employment and unemployment in Japan every month
Design	Cross-sectional study of a stratified 2-stage cluster sampling of the population in Japan in 2008
Participants	Approximately 1,000,000 individuals aged 15 years and older
Measurements	Gender, birth date, and employment status
Retrieved information	Average labor force participation rate by gender and age
Basic Survey on Wage Structure	,19
Aim	To obtain a clear picture of the wage structure of employees in major industries
Design	Cross-sectional study of a stratified 2-stage sampling of employees in Japan
Participants	Approximately 1,600,000 employees hired by about 78,000 business establishments in June 2008
Measurements	Gender, age, contractual cash earnings in June 2008, actual number of scheduled and overtime hours worked in June 2008, and annual special cash earnings in 2007
Retrieved information	Average annual earnings and average wage per day by gender and age
World Mental Health Japan Sur	vey ⁷⁻⁹
Aim	To estimate prevalence, severity, and treatment of mental disorders
Design	Cross-sectional study
Participants	1,663 Individuals living in 4 areas of Japan
Measurements	12-Month prevalence and treatment rate for DSM-IV major depressive disorder measured in the structured interview
Retrieved information	12-Month prevalence for <i>DSM-IV</i> major depressive disorder by age group Gender distribution for <i>DSM-IV</i> major depressive disorder Treatment rate for <i>DSM-IV</i> major depressive disorder
Limitations	12-Month prevalence by gender and age group is not reported Survey conducted in 2002–2003

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