



# Trajectory and Socioeconomic Predictors of Depression in a Prospective Study of Residents of New York City

JOHN R. BEARD, MBBS, PHD, MELISSA TRACY, MPH, DAVID VLAHOV, PHD, AND SANDRO GALEA, MD, DRPH

**PURPOSE:** Past research has demonstrated the high prevalence of depression in the general population. However, few longitudinal studies have characterized the patterns of depression in a large, representative sample of the general population. We monitored symptoms of depression and assessed the factors associated with changing symptoms of depression in a population-based cohort over a 30 month period.

**METHODS:** Using telephone surveys, we recruited 2752 adult residents of New York City in 2002. Persons were re-contacted after baseline for telephone interviews at 6 months, 18 months, and 30 months.

**RESULTS:** Among study participants, symptoms of depression were common, often resolved within 6 months, but tended to recur. Participants with a past history of depressive symptoms were more at risk of later developing depression, even if they were asymptomatic at baseline. Factors significantly associated with subsequent symptoms included less social support at baseline, income below a threshold of \$50,000, life stressors, poor health, and being separated. Lower levels of social support and lifetime stressors were only significantly associated with symptoms in participants with multiple episodes of depression. The influence of recent stressful events was also higher among participants with multiple episodes of depression.

**CONCLUSION:** In the general population depression has a good immediate prognosis but a recurring nature. Poor physical health and low levels of social support appear to increase the risk of later episodes of depression. The influence of social risk factors may be greater for persons with higher susceptibility to depression.

*Ann Epidemiol* 2008;18:235–243. © 2008 Elsevier Inc. All rights reserved.

**KEY WORDS:** Mental Illness, Trajectories, Urban Health, Risk Factors.

## INTRODUCTION

Over the past 20 years, a number of large surveys have confirmed the high prevalence of depression in the general population (1–5). Population-based research of this sort is particularly important since these studies have also shown that many people with affective disorders do not seek appropriate care (6–8) and such individuals will be overlooked by studies drawn from clinical populations. However, cross-

sectional research needs to be complemented by longitudinal studies that can better characterize how symptoms of depression change in individuals over time and that can identify the factors that may be associated with these changes.

A number of longitudinal, population-based studies have identified a range of risk factors for depression, including life stressors (9, 10), genetic inheritance (11–14), the experience of major adverse events in childhood (15), and personality traits (9, 15). However, few of these have been able to characterize patterns of depression in a large representative sample of the general population over more than 3 assessments.

In this study, we prospectively followed a sample of residents of the New York City (NYC) metropolitan area over a 30-month period, administering telephone interviews on 4 separate occasions. We aimed to characterize changing symptoms of depression in a population-based cohort over a 30-month period and to determine the influence of social factors such as income and social support on the later development, or recurrence, of depression. We also hypothesized that depression is a heterogeneous entity and that the influence of external factors on depressive symptomatology may vary between persons with recurring episodes and those with an isolated episode.

From the Center for Urban Epidemiologic Studies, New York Academy of Medicine; New York City (J.R.B., D.V., S.G.), Departments of Epidemiology, Columbia University Mailman School of Public Health, New York, NY (S.G.), University of Michigan School of Public Health, Ann Arbor (M.T.), and Johns Hopkins Bloomberg School of Public Health, Baltimore, MD (D.V.); School of Public Health, University of Sydney, NSW (J.R.B.) and Faculty of Health and Applied Science, Southern Cross University, Lismore, NSW (J.R.B.), Australia.

Address correspondence to: Sandro Galea MD, DrPH, Associate Professor, Department of Epidemiology, University of Michigan School of Public Health, 1214 South University, Room 243, Ann Arbor, MI 48104-2548. Tel.: (734) 647-9741; fax: (734) 998-0006. E-mail: [sgalea@umich.edu](mailto:sgalea@umich.edu).

This research was supported in part by grants MH66081, MH66391, DA13146-S2, and DA017642, DA022720 from the National Institutes of Health, Bethesda, MD. Aditi Sagdeo provided invaluable editorial assistance in the preparation of this article.

Received July 25, 2007; accepted October 1, 2007.

---

**Selected Abbreviations and Acronyms**

NYC = New York City  
CATI = computer-assisted telephone interviews  
SCID = Structured Clinical Interview for *DSM-III-R*  
BSI = Brief Symptom Index  
*DSM III* = *Diagnostic and Statistical Manual of Mental Disorders, Third Edition*  
*DSM IV* = *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*  
GEE = generalized estimating equations

---

**MATERIAL AND METHODS****Sample**

We recruited 2752 participants to a prospective, population-based cohort by conducting a telephone survey of adult residents of the NYC metropolitan area between March and July 2002. The study was designed to monitor mental health after the September 11, 2001 terrorist attacks in NYC; the methods are described in more detail elsewhere.<sup>(16)</sup> The cohort was established through a simple, area probability, random-digit dial sampling procedure. The overall cooperation rate was 56% and the overall response rate was 34%, both well within the accepted range for comparable surveys<sup>(17)</sup>. Up to 10 attempts were made to conduct an interview, and adults in each household were randomly selected by choosing the adult whose birthday was closest to the interview date. Computer-assisted telephone interviews (CATI) were conducted in English, Spanish, Mandarin, and Cantonese by trained interviewers using translated and back-translated questionnaires, with households screened for eligibility by location. We conducted follow-up telephone interviews approximately 6, 18, and 30 months after baseline. Studies of both in-person and telephone interview surveys have found that there are no substantial differences in accuracy of self-reported conditions by method of survey<sup>(18, 19)</sup>. Indeed, internal consistency between responses may be higher in telephone surveys than in in-person surveys. Studies specific to mental health have shown that telephone assessment of depression and anxiety disorders produced nearly identical results to in-person assessments using a variety of instruments<sup>(20)</sup>.

**Measures**

Survey measures comprised reliable instruments that have been validated or used in comparable research in the past. The interview collected standard demographic information about respondents, including age, gender, marital status, educational achievement, racial status, and household income. A list of major life events that could have proven stressful in a person's life was used to measure stressors between each assessment<sup>(21)</sup>. This measure was supplemented by questions about major traumatic episodes over

the previous 12 months consistent with *Diagnostic and Statistical Manual* criterion A traumatic events for diagnosis of posttraumatic stress disorder. Since the cohort was recruited approximately 6 months after the World Trade Center disaster, for baseline interviews we further distinguished between life events occurring before or after September 11, 2001 and included event experiences directly related to September 11 as a separate traumatic event. A brief instrument was used to measure social support at baseline<sup>(22)</sup>. This asked about emotional (e.g., "having someone to love you and make you feel wanted"), instrumental (e.g., "someone to help you if you were confined to bed"), and appraisal (e.g., "someone to give you good advice in a crisis") support prior to the September 11, 2001 terrorist attacks. Physical health in the past month was assessed with the question "Thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?"

We assessed episodes of major depression using a modified version of the *Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised* (SCID) major depressive disorder subscale<sup>(23)</sup>. This is a validated approach that captures symptoms of major depression consistent with *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV) criteria<sup>(24)</sup>. Respondents were asked about the presence for over 2 weeks of any of 10 symptoms of depression representing criterion A for major depression in DSM-IV. At the baseline interview, the presence of symptoms at any time in the past, in the previous year, or since the September 11 attacks was assessed; symptoms since the previous interview were assessed at each subsequent survey wave. Participants with an episode of depression at baseline were not questioned about their lifetime history of depression. To meet the criteria for a depressive episode, respondents had to report 5 or more symptoms for a period of at least 2 weeks, one of which was depressed mood or loss of pleasure or interest. The Cronbach alpha for the scale in our sample was 0.79<sup>(25)</sup>. Furthermore, in a validation study comparing our instrument to the Brief Symptom Inventory (BSI)<sup>(26)</sup>, a widely used depression scale, the BSI depression scale had a sensitivity of 73% and specificity of 87% as classified by our instrument<sup>(27)</sup>. In a receiver operating characteristic analysis<sup>(28)</sup>, the BSI depression cutoff score of  $\geq 65$  best predicted depression using our instrument (area under the curve = 0.89)<sup>(27)</sup>.

**Statistical Analyses**

Sampling weights were developed and applied to the data to correct for potential selection bias relating to the number of household telephones, persons in the household, and oversampling. Poststratification weights were also developed to make the follow-up survey samples demographically similar

to the NYC metropolitan area population according to the 2000 U.S. Census (29).

We used generalized estimating equations (GEE) to assess bivariate and multivariable relations between participant characteristics and depression classification at each follow-up survey wave (30). The following variables were measured only during the baseline assessment and as such were modeled as invariant: gender, race/ethnicity, educational attainment, social support, lifetime traumatic events (occurred prior to September 11, 2001), baseline traumatic events (occurred between September 11, 2001 and the baseline interview), lifetime stressors, baseline stressors, and lifetime history of depression. Other variables were measured at all time points and were modeled as time-varying covariates.

Finally, we categorized all participants as persons who had either never met criteria for depression during any point in the follow-up, had depression at only one point during the follow-up period, or who had depression during two or more time-points. We used polytomous logistic regression to assess the relationship between possible determinants and symptoms of depression in these groups at any time over the study period using the category of never meeting criteria of depression as the reference group. All

analyses were carried out using SAS and SUDAAN software (31).

## RESULTS

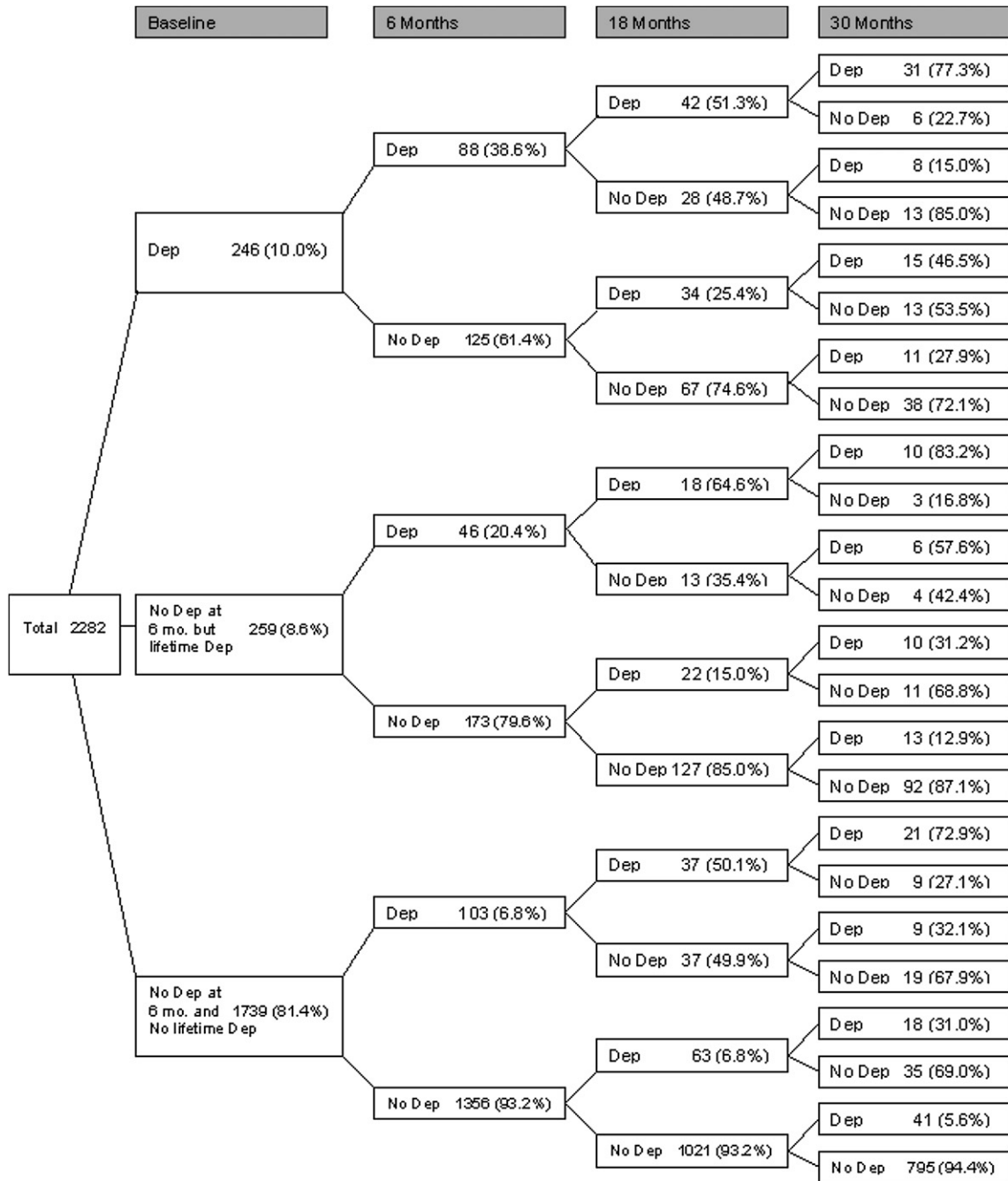
For the purposes of this analysis, we limited the sample to the 2282 (82.9%) respondents who were interviewed at least twice. There were no significant differences in the distribution of key demographic characteristics between the sample included in this analysis and the general population of the NYC metropolitan area at the 2000 U.S. Census (Table 1). Respondents excluded from the analysis were younger and more likely to be Hispanic than participants who were interviewed in at least two waves; however, there was no significant differential loss to follow-up by either lifetime or baseline depression status or by gender.

Depression patterns among respondents participating in at least one follow-up wave are shown in Fig 1. Percentages were calculated using participants not lost to follow-up as the denominator and after weighting for number of household telephones, persons in the household, and oversampling in geographic areas closest to the World Trade Center site; poststratification weights were also applied to estimates from the follow-up survey waves (6-month,

**TABLE 1.** Comparison of full baseline sample, sample included and excluded in the analysis, and demographics from 2000 U.S. Census

Characteristics	Full sample (%)	Included sample* (%)	Excluded sample (%)	U.S. Census 2000 (%)	Chi-square test <i>p</i> values		
					Full sample vs. Census	Included vs. Census	Included vs. Excluded
Total (N)	2752	2282	470				
Age (yr)							
18–24	13.7	13.0	17.0	11.7	0.64	0.84	<0.01
25–34	24.1	21.4	35.8	20.4			
35–44	20.5	21.0	18.6	21.9			
45–54	18.9	19.8	15.3	17.7			
55–64	12.2	13.2	7.6	11.8			
65+	10.5	11.6	5.8	16.5			
Gender							
Male	46.1	45.2	49.9	46.9	0.87	0.73	0.18
Female	53.9	54.8	50.2	53.1			
Race/ethnicity							
White	53.2	55.5	43.1	54.8	0.74	0.82	<0.01
Asian	5.4	5.4	5.4	7.7			
African American	16.7	16.6	17.1	16.5			
Hispanic	20.6	18.5	29.8	18.5			
Other	4.2	4.1	4.6	2.6			
Past 6-month depression at baseline							
No	90.6	90.9	89.4				0.48
Yes	9.4	9.2	10.6				
Lifetime depression							
No	82.1	81.8	83.5				0.53
Yes	17.9	18.2	16.6				

\*Sample included in the analysis participated in at least two survey waves.



**FIGURE 1.** Depression patterns among participants in at least one follow-up wave ( $N = 2282$ ) Numbers at each wave do not add up to numbers at previous wave because all participants did not complete all survey waves. Percentages are calculated using participants not lost to follow-up as the denominator and after weighting for number of household telephones, persons in the household, and oversampling in geographic areas closest to the World Trade Center site; poststratification weights were also applied to estimates from the follow-up survey waves (6-month, 18-month, and 30-month) to make the sample demographically similar to the NYC metropolitan area population according to the 2000 U.S. Census.

18-month, and 30-month) to make the sample demographically similar to the NYC metropolitan area population according to the 2000 U.S. Census. Using percentages calculated after weighting, 68.4% of the cohort did not

meet criteria for depression at any time over the 30-month study, whereas 1.7% of the cohort met criteria for depression at every interview. Of 605 participants with an episode of depression at any time in the study period, 339 (61.1%)

had an episode at only one interview, while the remaining participants had more than one nonconsecutive or consecutive episode.

For participants with neither depression at baseline nor a prior history, 6.8% had a positive diagnosis 6 months later, and the longer this group continued without an episode of depression, the less likely they were to develop incident depression. Among those who had no episode of depression in any of the first 3 rounds, 5.6% met criteria for depression in the final interview. Participants with no baseline episode, but a prior history of depression had higher rates of depression at subsequent interviews, but showed the same pattern of falling risk with increasing duration of absence of symptoms. Participants with one or more observed episodes of depression, but who had become episode free, had a much higher risk of recurrence (range 15.0%–27.9%). Of those with a baseline episode, 60.2% had a further episode during the study period.

Table 2 shows bivariate and multivariate GEE analyses for an episode of depression at any interview. A number of variables were associated with episodes in bivariate analysis. Multivariable analysis showed that the risk of an episode of depression significantly increased for participants with low baseline levels of social support (odds ratio [OR] = 1.70 vs. high levels of support, 95% confidence interval [CI] = 1.15–2.51), who were separated (OR = 2.44 vs. married, 95% CI = 1.13–5.23), with household income below \$50,000 (OR = 2.01 for \$40,000–\$49,999 vs. \$100,000+, 95% CI = 1.05–3.85; OR = 1.93 for \$30,000–\$39,999, 95% CI = 1.03–3.62; OR = 2.05 for <\$20,000, 95% CI = 1.12–3.77), with a recent history of traumatic events (OR for one vs. none = 2.56, 95% CI = 1.76–3.72; OR for two or more = 3.42, 95% CI = 2.18–5.37), with recent life stressors (OR for one vs. none = 2.32, 95% CI = 1.57–3.43; OR for two or more = 3.71, 95% CI = 2.41–5.70), with poor physical health in the month prior to the interview (OR = 2.61, 95% CI = 1.80–3.79), with a lifetime history of depression (OR = 1.82, 95% CI = 1.28–2.59), and with an episode of depression at the previous interview (OR = 2.92, 95% CI = 1.97–4.31).

Table 3 shows the results of multivariate polytomous logistic regression models between individuals categorized into those with no episodes or history, those with a single depression episode during the study, and those with two or more episodes. When compared with participants with no history of depression, low baseline levels of social support were a significant predictor only of having depression at two or more waves (OR = 2.71 for low vs. high levels of support, 95% CI = 1.35–5.42). While the direction of the relationships for most other variables was similar for participants reporting one episode of depression and those with two or more episodes, recent traumatic and stressful events had notably higher odds ratios for participants with

recurring depression, and lifetime stressors were only significant for this outcome (OR = 2.36 for two or more stressors vs. none, 95% CI = 1.02–5.51).

---

## DISCUSSION

While several studies have followed the symptom trajectory of individuals diagnosed with depression in a clinical setting (32, 33), this study is one of very few to chart the natural course of depression over 4 waves in a large population-based cohort. Symptoms of depression were common across the 30-month study period, with a good short-term prognosis but high likelihood of recurrence. Our findings highlight the importance of life stressors and poor physical health as risk factors for affective disorders, but also identify a number of key social factors as predictive of episodes of depression, notably baseline income below a threshold of \$50,000 and low baseline levels of social support. However, these relationships varied according to the depressive history of a subject, suggesting the heterogeneity of depressive symptoms and that the influence of social factors may not be consistent for all depression subtypes.

Almost three fourths of respondents never met criteria for depression and fewer than 2% reported symptoms that were persistent over the study period. However, over one fourth of respondents met criteria for depression at one point in time and, of these, about 40% met the criteria more than once. The risk of later depression was lowest for participants with neither a baseline diagnosis nor lifetime history, higher for those without a baseline diagnosis but who reported a lifetime history, and highest for those with a baseline diagnosis.

Consistent with other studies, we identified several factors that were associated in multivariate analysis with the presence of depression during the 4 study phases. Having depression at the previous interview, a history of symptoms consistent with a diagnosis of depression prior to baseline, and life stressors or traumatic events occurring in the 12 months prior to the interview were all significantly associated with depression.

Poor physical health over the previous month was also significantly associated with depression. A limited number of previous studies have suggested that poor physical health can either increase the risk of an individual developing depression (34) or contribute to the persistence of depressive episodes (35). However, the relationship between physical health and depression is not a simple one because depression is also likely to be an independent risk factor for poor physical health (36). To explore the direction of the relationship between depression and physical health in our cohort, we also included physical health status reported at the previous interview as an independent variable in an analysis of the last two waves of the study. This analysis demonstrated

**TABLE 2.** Unadjusted and adjusted GEE logistic regression models predicting depression

	Unadjusted		Adjusted	
	OR	95% CI	OR	95% CI
Gender				
Male	1.00	—	1.00	—
Female	0.64	0.48–0.86	0.83	0.59–1.15
Race/ethnicity				
White	1.00	—	1.00	—
Asian	0.33	0.11–0.98	0.51	0.13–1.96
Black	1.58	1.11–2.25	1.05	0.67–1.65
Hispanic	1.84	1.27–2.67	0.94	0.61–1.45
Other	1.63	0.91–2.94	0.63	0.29–1.37
Educational attainment				
Graduate work	1.00	—	1.00	—
Bachelor of arts degree	1.46	0.90–2.39	1.25	0.71–2.20
Some college	1.99	1.20–3.32	1.15	0.61–2.15
High school/GED	1.97	1.19–3.29	0.94	0.49–1.80
<High school	3.22	1.83–5.69	1.97	0.88–4.41
Social support				
High	1.00	—	1.00	—
Medium	1.84	1.29–2.62	1.45	0.98–2.14
Low	2.34	1.68–3.26	1.70	1.15–2.51
Marital status				
Married	1.00	—	1.00	—
Divorced	2.29	1.52–3.46	1.14	0.73–1.79
Separated	4.90	2.83–8.49	2.44	1.13–5.23
Widowed	1.93	1.19–3.16	1.21	0.56–2.60
Never been married	1.65	1.18–2.30	1.25	0.83–1.88
Member of an unmarried couple	1.63	0.96–2.77	1.55	0.80–3.02
Household income				
\$100,000+	1.00	—	1.00	—
\$75,000–\$99,999	1.27	0.69–2.33	1.05	0.56–1.97
\$50,000–\$74,999	1.67	0.96–2.88	0.97	0.53–1.78
\$40,000–\$49,999	3.46	1.92–6.22	2.01	1.05–3.85
\$30,000–\$39,999	4.22	2.39–7.45	1.93	1.03–3.62
\$20,000–\$29,999	3.39	1.96–5.86	1.72	0.90–3.28
<\$20,000	5.05	3.04–8.41	2.05	1.12–3.77
Lifetime traumatic events <sup>*,†</sup>				
0	1.00	—	1.00	—
1	1.09	0.72–1.65	1.16	0.75–1.79
2–3	1.38	0.93–2.04	1.02	0.65–1.60
4	2.77	1.84–4.19	1.11	0.66–1.84
Traumatic events in past 6 months at baseline <sup>†,‡</sup>				
0	1.00	—	1.00	—
1	1.51	1.10–2.06	1.13	0.79–1.60
2+	2.56	1.60–4.10	1.54	0.89–2.66
Traumatic events in past 12 months <sup>†</sup>				
0	1.00	—	1.00	—
1	3.97	3.02–5.23	2.56	1.76–3.72
2+	8.76	6.28–12.22	3.42	2.18–5.37
Lifetime stressors <sup>*,§</sup>				
0	1.00	—	1.00	—
1	1.95	1.43–2.67	0.96	0.68–1.37
2+	4.39	2.97–6.50	1.26	0.77–2.05
Stressors in past 6 months at baseline (including Sept 11–related) <sup>§,  </sup>				

(Continued)

**TABLE 2.** (Continued)

	Unadjusted		Adjusted	
	OR	95% CI	OR	95% CI
0	1.00	—	1.00	—
1	1.99	1.35–2.95	1.36	0.89–2.10
2+	7.32	3.68–14.53	1.95	0.95–4.04
Stressors in past 12 months <sup>§</sup>				
0	1.00	—	1.00	—
1	3.53	2.63–4.73	2.32	1.57–3.43
2+	10.18	7.29–14.20	3.71	2.41–5.70
No. of days physical health not good in past month <sup>¶</sup>				
0–6	1.00	—	1.00	—
7+	4.10	3.17–5.28	2.61	1.80–3.79
Lifetime history of depression <sup>*,**</sup>				
No	1.00	—	1.00	—
Yes (including unknown)	4.53	3.37–6.07	1.82	1.28–2.59
Depression during previous time period				
No	1.00	—	1.00	—
Yes	9.78	7.14–13.38	2.92	1.97–4.31

GEE = generalized estimating equations; OR = odds ratio; CI = confidence interval; GED = general educational development (test).

\*Occurred prior to September 11, 2001.

†Traumatic events include natural disaster; a serious accident at work, in a car, or somewhere else; being attacked with or without a weapon; unwanted sexual contact; other situations resulting in injury; situations in which the respondent feared being killed or injured; seeing someone killed or injured; other extraordinarily stressful situations and events.

‡In addition to traumatic events listed above, also includes being directly affected by the September 11th terrorist attacks (in the World Trade Center complex during the attacks; injured during the attacks; lost possessions or property; had a friend or relative killed; involved in the rescue efforts).

§Stressors include death of a spouse or mate; divorce or separation; death of a close family member; serious injury or illness; marriage; family problems with spouse or child; problems at work; unemployment.

||In addition to stressors listed above, also includes losing job as a result of the September 11th terrorist attacks.

¶Physical health was not available at the first time interval. Therefore, we modeled physical health as a time-varying covariate at the same interval as the outcome of interest (depression). To assess potential reverse causation in the case of physical health, we re-ran all models starting at the second follow-up wave, hence permitting us to lag physical health. Results of these latter models were essentially equivalent to those that used all follow-up waves; hence herein we present models that use all of the follow-up waves.

\*\*Participants with a positive diagnosis of depression at baseline were not questioned about lifetime history of depression prior to September 11, 2001. We conducted sensitivity analyses to assess the implications of modeling these participants as having had depression in the past, not having had depression in the past, and having an “unknown” lifetime history of depression. Lifetime history of depression was a significant predictor of current depression in all models and choice of assumptions about presence or absence of lifetime depression did not substantially alter any of the other parameters in the models. Recognizing that previous work has amply demonstrated that a lifetime history of depression is an important predictor of subsequent depression, herein we show the model with the assumption that all persons on whom lifetime depression status is unknown did have previous depression. This provides the highest estimate of the association between lifetime depression and current depression and conservatively estimates the contribution of other parameters in the model.

that poor physical health reported at the previous interview was a significant predictor of the later development of depression, even after adjusting for other factors.

After adjustment for other factors, having a household income of less than \$50,000 at baseline was significantly associated with symptoms of depression. While several previous studies have demonstrated an association between inadequate income and symptoms of depression in cross-

**TABLE 3.** Multivariable polytomous logistic regression models predicting categories of depression

	Depression at one wave*		Depression at two or more waves*	
	OR	95% CI	OR	95% CI
	Gender			
Male	1.00	—	1.00	—
Female	1.35	0.89–2.05	1.53	0.86–2.73
Race/ethnicity				
White	1.00	—	1.00	—
Asian	1.07	0.40–2.81	0.01	0.00–0.18
Black	1.20	0.69–2.08	0.87	0.37–2.08
Hispanic	1.11	0.61–2.02	1.13	0.53–2.38
Other	1.16	0.33–4.06	1.32	0.35–4.89
Educational attainment				
Graduate work	1.00	—	1.00	—
Bachelor of arts degree	1.63	0.82–3.21	1.42	0.53–3.81
Some college	1.65	0.80–3.40	1.36	0.47–3.91
High school/GED	1.52	0.72–3.20	1.31	0.43–3.98
<High school	2.84	1.10–7.31	3.76	0.90–15.74
Social support				
High	1.00	—	1.00	—
Medium	0.94	0.56–1.57	1.83	0.90–3.72
Low	1.10	0.66–1.82	2.71	1.35–5.42
Marital status				
Married	1.00	—	1.00	—
Divorced	0.67	0.30–1.46	0.73	0.28–1.88
Separated	0.66	0.19–2.26	0.90	0.17–4.63
Widowed	0.74	0.33–1.65	0.86	0.21–3.42
Never been married	1.02	0.64–1.64	0.97	0.50–1.87
Member of an unmarried couple	2.33	0.80–6.77	1.84	0.52–6.46
Household income				
\$100,000+	1.00	—	1.00	—
\$75,000–\$99,999	1.10	0.53–2.31	1.46	0.50–4.25
\$50,000–\$74,999	1.49	0.73–3.04	1.72	0.59–5.02
\$40,000–\$49,999	2.95	1.25–6.98	2.07	0.62–6.85
\$30,000–\$39,999	3.58	1.60–7.99	2.77	0.87–8.82
\$20,000–\$29,999	2.62	1.14–6.03	4.46	1.56–12.69
<\$20,000	2.37	1.05–5.31	2.49	0.86–7.21
Lifetime traumatic events <sup>†‡</sup>				
0	1.00	—	1.00	—
1	1.36	0.74–2.50	1.10	0.49–2.44
2–3	1.04	0.58–1.88	0.67	0.30–1.50
4	1.16	0.56–2.39	0.67	0.29–1.53
Traumatic events in past 6 months at baseline <sup>†,§</sup>				
0	1.00	—	1.00	—
1	1.46	0.94–2.26	1.70	0.94–3.05
2+	2.03	0.93–4.41	2.12	0.86–5.21
Traumatic events in past 12 months <sup>†</sup>				
0	1.00	—	1.00	—
1	1.95	1.17–3.25	1.66	0.74–3.74
2+	3.74	2.19–6.38	6.44	3.35–12.38
Lifetime stressors <sup>†,  </sup>				
0	1.00	—	1.00	—
1	0.70	0.44–1.12	1.53	0.85–2.74
2+	1.83	0.84–3.98	2.36	1.02–5.51

(Continued)

**TABLE 3.** (Continued)

	Depression at one wave*		Depression at two or more waves*	
	OR	95% CI	OR	95% CI
Stressors in past 6 months at baseline (including Sept 11–related) <sup>  ,¶</sup>				
0	1.00	—	1.00	—
1	0.77	0.39–1.50	1.72	0.82–3.61
2+	0.90	0.28–2.88	1.99	0.59–6.78
Stressors in past 12 months <sup>  </sup>				
0	1.00	—	1.00	—
1	1.23	0.69–2.22	1.44	0.47–4.44
2+	2.53	1.49–4.30	6.92	2.60–18.38
Lifetime history of depression <sup>†,¶</sup>				
No	1.00	—	1.00	—
Yes	8.21	5.09–13.24	37.89	20.02–71.68

For abbreviations, see legend for Table 2.

\*Compared to group with no depression at any survey wave.

†Occurred prior to September 11, 2001.

‡Traumatic events include natural disaster; a serious accident at work, in a car, or somewhere else; being attacked with or without a weapon; unwanted sexual contact; other situations resulting in injury; situations in which the respondent feared being killed or injured; seeing someone killed or injured; other extraordinarily stressful situations and events.

§In addition to traumatic events listed above, also includes being directly affected by the September 11th terrorist attacks (in the World Trade Center complex during the attacks; injured during the attacks; lost possessions or property; had a friend or relative killed; involved in the rescue efforts).

¶Stressors include death of a spouse or mate; divorce or separation; death of a close family member; serious injury or illness; marriage; family problems with spouse or child; problems at work; unemployment.

||In addition to stressors listed above, also includes losing job as a result of the September 11th terrorist attacks.

‡Participants with a positive diagnosis of depression at baseline were not questioned about lifetime history of depression prior to September 11, 2001. We conducted sensitivity analyses to assess the implications of modeling these participants as having had depression in the past, not having had depression in the past, and having an “unknown” lifetime history of depression. Lifetime history of depression was a significant predictor of current depression in all models and choice of assumptions about presence or absence of lifetime depression did not substantially alter any of the other parameters in the models. Recognizing that previous work has amply demonstrated that a lifetime history of depression is an important predictor of subsequent depression, herein we show the model with the assumption that all persons for whom lifetime depression status is unknown did have previous depression. This provides the highest estimate of the association between lifetime depression and current depression and conservatively estimates the contribution of other parameters in the model.

sectional analysis (7), few longitudinal studies have identified a predictive role for income on the later development of depression or demonstrated such a clear financial threshold for good mental health. A causative role for economic disadvantage in the development of depression seems plausible, as does a threshold beyond which increasing wealth might make little difference to one’s mental health status. An alternative explanation for our findings may be that individuals with recurring depression are less able to build sustainable careers and that the association simply reflects the higher likelihood of depression in this group. However, our analysis of participants with recurring and isolated episodes indicates that this association varied little between groups, suggesting that recurring psychopathology is unlikely to explain this relationship. In combination, these findings suggest that inadequate income, in this instance less than \$50,000 per annum for residents of NYC, is likely

to increase an individual's risk of later developing symptoms of depression. If this relationship were true, this threshold might be proportionately lower for areas with a lower cost of living than NYC.

We also found evidence that the extent of an individual's social networks may be predictive of future mental health, with individuals reporting lower baseline levels of social support at increased risk of depression. As with income, a number of cross-sectional studies have found low levels of social support to be associated with poorer mental health, but have had difficulty distinguishing between cause and effect (37, 38). Our prospective study shows that reported levels of baseline social support are predictive of later symptoms of depression for individuals facing similar levels of life stressors. This suggests that having fewer social resources to draw on makes an individual more vulnerable to symptoms of depression. However, this finding could also be explained by the failure of individuals with recurring depression to build or sustain social networks; this is supported by our analysis of participants with recurring and isolated episodes, which found that lower levels of social support played a greater role among those with recurring symptoms. An alternative explanation could be that levels of social support are not as important for less susceptible individuals in dealing with life stressors.

Another association that varied between participants with recurring or isolated episodes was the influence of recent adverse events (both traumatic and stressors). This would be consistent with individuals with repeated episodes tending to have increased vulnerability to these factors and is supported by a study of twins that suggested that the relationship between stressful life events and somatic disease is stronger in moderate than in mild depression (39). An alternative explanation may be that participants with repeated episodes of depression may overreport adversity, although, if anything, this group actually reported lower levels of lifetime traumatic events.

Our study has a number of limitations. First, while the cooperation and follow-up rates are less than ideal, they are reasonable for studies of this type. The lack of significant differences in the age, gender, or race structure of the sample when compared with the NYC metropolitan area population at the 2000 U.S. Census, and the maintenance of this structure during the 4 follow-up waves is also reassuring. Loss to follow-up was also nondifferential on psychopathology, suggesting that loss to follow-up is unlikely to have biased our findings. Second, our outcome instrument was developed specifically for the study. However, this measure was derived from the SCID major depressive disorder subscale and shows high internal reliability. Similar approaches have been used widely in other studies (40), although depression assessed in this manner cannot be equated to a full clinical diagnosis of major depressive disorder and

comparison to other studies that use different screening instruments for depression should be made judiciously. Third, our study was started approximately 6 months after the September 11, 2001 terrorist attacks. To ensure this did not influence our study findings, when assessing the influence of life events prior to baseline we distinguished between those occurring before and after September 11, 2001 and controlled for September 11 event experiences. These experiences were not significant predictors of depression when adjusting for other covariates in this sample. However, these findings may not be able to be generalized to the trajectory of depression in the nondisaster context. Fourth, several other risk factors have been associated with symptoms of depression, including family history and personality traits (15). Our interviews did not collect information on these factors and was unable to consider the effect they may have had on our models. Finally, our measure of depression took no account of comorbid mental conditions such as anxiety disorders. Anxiety and depressive disorders are closely linked, and it is likely that a number of the individuals with an episode of depression, as well as those without an episode, may have had symptoms of an anxiety disorder at that point in time (41). It would be fascinating to examine the relationship between symptoms of anxiety and symptoms of depression in the same manner and to determine the influence this may have on the relationships we have observed in this study.

---

## REFERENCES

1. Alonso J, Angermeyer MC, Bernert S, Bruffaerts R, Brugha TS, Bryson H, et al. Prevalence of mental disorders in Europe: results from the European Study of the Epidemiology of Mental Disorders (ESEMeD) project. *Acta Psychiatr Scand Suppl.* 2004;420:21–27.
2. Bijl RV, Ravelli A, van Zessen G. Prevalence of psychiatric disorder in the general population: results of The Netherlands Mental Health Survey and Incidence Study (NEMESIS). *Soc Psychiatry Psychiatr Epidemiol.* 1998;33:587–595.
3. Demyttenaere K, Bruffaerts R, Posada-Villa J, et al. Prevalence, severity, and unmet need for treatment of mental disorders in the World Health Organization World Mental Health Surveys [see comment] *JAMA.* 2004;291:2581–2590.
4. Kessler RC, McGonagle KA, Zhao S, Nelson CB, Hughes M, Eshleman S, et al. Lifetime and 12-month prevalence of DSM-III-R Psychiatric Disorders in the United States: results from the National Comorbidity Survey. *Arch Gen Psychiatry.* 1994;51:8–19.
5. Kessler RC, Chiu WT, Demler O, Merikangas KR, Walters EE. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication [see comment] *Arch Gen Psychiatry.* 2005;62:617–627 Erratum in *Arch Gen Psychiatry.* 2005;62:709. Note: Merikangas KR [added].
6. Andrews G, Sanderson K, Slade T, Issakidis C. Why does the burden of disease persist? Relating the burden of anxiety and depression to effectiveness of treatment. *Bull World Health Organ.* 2000;78:446–454.
7. Kessler RC, Berglund P, Demler O, Jin R, Koretz D, Merikangas KR, et al. The epidemiology of major depressive disorder: results from the National



- Comorbidity Survey Replication (NCS-R) [see comment] *JAMA*. 2003;289:3095–3105.
8. Kessler RC, Demler O, Frank RG, Olfson M, Pincus HA, Walters EE, et al. Prevalence and treatment of mental disorders, 1990 to 2003 [see comment] *N Engl J Med*. 2005;352:2515–2523.
  9. De Graaf R, Bijl RV, Ravelli A, Smit F, Vollebergh WA. Predictors of first incidence of DSM-III-R psychiatric disorders in the general population: findings from the Netherlands Mental Health Survey and Incidence Study. *Acta Psychiatr Scand*. 2002;106:303–313.
  10. Kendler KS, Neale MC, Kessler RC, Heath AC, Eaves LJ. A population-based twin study of major depression in women. *Arch Gen Psychiatry*. 1992;49:257–266.
  11. Caspi A, Sugden K, Moffitt TE, Taylor A, Craig IW, Harrington H, et al. Influence of life stress on depression: moderation by a polymorphism in the 5-HTT gene [see comment] *Science*. 2003;301:386–389.
  12. Gatz M, Pedersen NL, Plomin R, Nesselroade JR, McClearn GE. Importance of shared genes and shared environments for symptoms of depression in older adults. *J Abnormal Psychol*. 1992;101:701–708.
  13. Kendler KS, Kessler RC, Walters EE, MacLean C, Neale MC, Heath AC, et al. Stressful life events, genetic liability, and onset of an episode of major depression in women. *Am J Psychiatry*. 1995;152:833–842.
  14. Kendler KS. Major depression and generalised anxiety disorder. Same genes, (partly) different environments—revisited. *Br J Psychiatry*. 1996;168:68–75.
  15. Kendler KS, Gardner MD, Prescott CA. Toward a comprehensive developmental model for major depression in women. *Am J Psychiatry*. 2002;159:1133–1145.
  16. Nandi A, Galea S, Tracy M, Ahern J, Resnick H, Gershon R, et al. Job loss, unemployment, work stress, job satisfaction, and the persistence of posttraumatic stress disorder one year after the September 11 attacks. *J Occup Environ Med*. 2004;46:1057–1064.
  17. Galea S, Vlahov D, Tracy M, Hoover DR, Resnick H, Kilpatrick D. Hispanic ethnicity and post-traumatic stress disorder after a disaster: evidence from a general population survey after September 11, 2001. *Ann Epidemiol*. 2004;14:520–531.
  18. Aneshensel C, Frerichs R, Clark V, Yokopenic P. Telephone versus in-person surveys of community health status. *Am J Public Health*. 1982;72:1017–1021.
  19. Nelson D, Powell-Griner E, Town N, Kovar M. A comparison of national estimates from the National Health Interview Survey and the Behavioral Risk Factor Surveillance System. *Am J Public Health*. 2003;93:1335–1341.
  20. Dansky B, Saladin M, Brady K, Kilpatrick D, Resnick H. Prevalence of victimization and posttraumatic stress disorder among women with substance use disorders: comparison of telephone and in-person assessment samples. *Int J Addiction*. 1995;30:1079–1099.
  21. Boardman JD, Finch BK, Ellison CG, Williams DR, Jackson JS. Neighborhood disadvantage, stress, and drug use among adults. *J Health Soc Behav*. 2001;42:151–165.
  22. Sherbourne CD, Stewart AL. The MOS social support survey. *Soc Sci Med*. 1991;32:705–714.
  23. Spitzer RL, Williams JB, Gibbon M, First MB. The structured clinical interview for DSM-III-R (SCID). I: History, rationale, and description. *Arch Gen Psychiatry*. 1992;49(8):624–629.
  24. Kilpatrick DG, Ruggiero KJ, Acierno R, Saunders BE, Resnick HS, Best CL. Violence and risk of PTSD, major depression, substance abuse/dependence, and comorbidity: results from the National Survey of Adolescents. *J Consult Clin Psychol*. 2003;71:692–700.
  25. Boscarino JA, Galea S, Ahern J, Resnick H, Vlahov D. Utilization of mental health services following the September 11th terrorist attacks in Manhattan, New York City. *Int J Emerg Ment Health*. 2002;4:143–155.
  26. Derogatis L. Brief Symptom Inventory 18 (BSI-18) manual. Minnetonka (MN): NCS Assessments; 2001.
  27. Boscarino JA, Galea S, Adams RE, Ahern J, Resnick H, Vlahov D. Mental health service and medication use in New York City after the September 11, 2001, terrorist attack. *Psychiatr Serv*. 2004;55:274–283.
  28. Hosmer D, Lemeshow S. Applied logistic regression. New York: John Wiley & Sons; 2000.
  29. Bureau of the Census. Census Summary tape, File 3A (STF 3A). Washington (DC): US Department of Commerce; 2000.
  30. Zeger SL, Liang KY. Longitudinal data analysis for discrete and continuous outcomes. *Biometrics*. 1986;42:121–130.
  31. Shah B, Barnwell B, Bieler G. SUDAAN User's Manual, Release 7.5. Research Triangle Park (NC): Research Triangle Institute; 1997.
  32. Kanai T, Takeuchi H, Furukawa TA, Yoshimura R, Imaizumi T, Kitamura T, et al. Time to recurrence after recovery from major depressive episodes and its predictors [see comment] *Psychol Med*. 2003;33:839–845.
  33. Mueller TI, Leon AC, Keller MB, Solomon DA, Endicott J, Coryell W, et al. Recurrence after recovery from major depressive disorder during 15 years of observational follow-up. *Am J Psychiatry*. 1999;156:1000–1006.
  34. de Jonge P, Kempen GI, Sanderman R, Ranchor AV, van Jaarsveld CH, van Sonderen E, et al. Depressive symptoms in elderly patients after a somatic illness event: prevalence, persistence, and risk factors. *Psychosomatics*. 2006;47:33–42.
  35. Spijker J, de Graaf R, Bijl RV, Beekman AT, Ormel J, Nolen WA. Determinants of persistence of major depressive episodes in the general population. Results from the Netherlands Mental Health Survey and Incidence Study (NEMESIS). *J Affect Disord*. 2004;81:231–240.
  36. Lenze EJ, Rogers JC, Martire LM, Mulsant BH, Rollman BL, Dew MA, et al. The association of late-life depression and anxiety with physical disability: a review of the literature and prospectus for future research. *Am J Geriatr Psychiatry*. 2001;9:113–135.
  37. Chen R, Wei L, Hu Z, Qin X, Copeland JR, Hemingway H. Depression in older people in rural China. *Arch Intern Med*. 2005;165:2019–2025.
  38. Ostir GV, Eschbach K, Markides KS, Goodwin JS. Neighbourhood composition and depressive symptoms among older Mexican Americans. *J Epidemiol Commun Health*. 2003;57:987–992.
  39. Romanov K, Varjonen J, Kaprio J, Koskenvuo M. Life events and depressiveness—the effect of adjustment for psychosocial factors, somatic health and genetic liability. *Acta Psychiatr Scand*. 2003;107:25–33.
  40. Kendler KS, Kuhn J, Prescott CA. The interrelationship of neuroticism, sex, and stressful life events in the prediction of episodes of major depression. *Am J Psychiatry*. 2004;161:631–636.
  41. Wittchen HU, Kessler RC, Pfister H, Lieb M. Why do people with anxiety disorders become depressed? A prospective-longitudinal community study. *Acta Psychiatr Scand Suppl*. 2000;406:14–23.