



## META-ANALYSIS

### Socioeconomic Inequalities in Depression: A Meta-Analysis

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Low socioeconomic status (SES) is generally associated with high psychiatric morbidity, more disability, and poorer access to health care. Among psychiatric disorders, depression exhibits a more controversial association with SES. The authors carried out a meta-analysis to evaluate the magnitude, shape, and modifiers of such an association. The search found 51 prevalence studies, five incidence studies, and four persistence studies meeting the criteria. A random effects model was applied to the odds ratio of the lowest SES group compared with the highest, and meta-regression was used to assess the dose-response relation and the influence of covariates. Results indicated that low-SES individuals had higher odds of being depressed (odds ratio = 1.81,  $p < 0.001$ ), but the odds of a new episode (odds ratio = 1.24,  $p = 0.004$ ) were lower than the odds of persisting depression (odds ratio = 2.06,  $p < 0.001$ ). A dose-response relation was observed for education and income. Socioeconomic inequality in depression is heterogeneous and varies according to the way psychiatric disorder is measured, to the definition and measurement of SES, and to contextual features such as region and time. Nonetheless, the authors found compelling evidence for socioeconomic inequality in depression. Strategies for tackling inequality in depression are needed, especially in relation to the course of the disorder.

depression; meta-analysis; socioeconomic factors

Abbreviations: DSM, *Diagnostic and Statistical Manual of Mental Disorders*; SES, socioeconomic status.

Low socioeconomic status (SES) is generally associated with high psychiatric morbidity, disability, and poor access to health care. In countries where comparable epidemiologic studies have been carried out, the lowest educational group had a higher prevalence of psychiatric morbidity (1). Poorer coping styles, ongoing life events, stress exposure, and weaker social support are some examples of psychiatric risk factors that are more prevalent in lower SES groups (2). The outcomes of such higher mental morbidity have also been found to be unequally distributed. For the same level of severity, lower SES groups faced more disabilities (3) and a poorer prognosis (4). In countries providing less generous

welfare support, lower SES groups also faced less favorable access to health care (5); whatever the welfare coverage, they were less likely to use specialized mental care (6).

Among psychiatric disorders, depression exhibits a more controversial association with SES. Whereas 17 out of 20 studies examined in a review that included all types of psychiatric disorders (7) found higher rates of overall psychopathology in the lowest social class (on average, 2.6 times higher than in the highest class), the results for depressive neurosis were more ambiguous: Only five out of 11 specific studies showed a higher prevalence in the lower SES group (average rate ratio of 1.3). A more recent review (8)

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**TABLE 1. Quality criteria and scores for 44 prevalence, incidence, or persistence studies published after 1979 that examined the relation between socioeconomic factors and depression**

| Quality criterion  | Scoring*   |
|--|--|
| Was the response rate sufficient?  | 0 = <70%; 1 = ≥70%   |
| Was the sample nationwide or local?  | 0 = local, regional, or metropolitan; 1 = nationwide   |
| Was the information gathered by face-to-face interview?                      | 0 = not face-to-face interview; 1 = face-to-face interview                                     |
| Was psychiatric status assessed by means of a diagnostic schedule?           | 0 = symptom inventory; 1 = structured diagnostic schedule                                      |
| Was the case definition restricted to major depression?                      | 0 = common mental disorders or all mood disorders; 1 = depression or major depression          |
| Was the reference period short?  | 0 = >6 months, 1 = ≤6 months   |
| Was social stratification measured by more than one socioeconomic indicator? | 0 = 1 variable; 1 = ≥2 variables   |
| Were the socioeconomic variables categorized into more than two groups?      | 0 = ≤3 groups; 1 = ≥4 groups   |
| Were the results controlled for age and sex?                                 | 0 = no controlling or partial controlling; 1 = results controlled for sex and age              |
| Were standard errors and/or confidence intervals given for the estimates?    | 0 = only a <i>p</i> value or less given; 1 = confidence intervals and/or standard errors given |

\* Possible total scores ranged from 0 to 10.

also showed such controversial results for depression, suggesting that inequalities in depression should be further investigated.

Most of the early psychiatric epidemiologic studies shared three methodological weaknesses (9). First, several of the studies only included patients in the sample, making results vulnerable to variations in the help-seeking and referral process (10). Second, they conceptualized psychiatric disorder in general, with poor nomenclature and without adequate criteria for setting the threshold of psychiatric disorder (9, 11). Third, they used symptom-screening instruments that were insufficiently specific, because they mixed a wide range of psycho-physiologic problems as well as true psychiatric disorders (7). Since the early 1980s, important psychiatric epidemiologic surveys have been carried out on a wider geographic basis. Most of them have used structured diagnostic schedules and more specific psychiatric classifications such as those in the Third or Fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-III or -IV). However, they have not yielded consistent results for the direction, strength, or monotonicity of the relation between SES and mental disorder (1).

We decided to conduct a meta-analysis in order to measure the magnitude and shape of the association between SES and depression. Taking advantage of the methodological and geographic variety of previous studies, we also sought to shed light on the methodological and contextual factors which might explain the variability of the results related to the SES-depression association. Finally, longitudinal studies have allowed us to undertake a more dynamic study of the relation between SES and depression in terms of incidence (12), remission (13), response to treatment (14, 15), and long-term outcome (16, 17). Because those longitudinal studies helped in disentangling the relation between SES and episode onset, course, and duration (9), this review targets the socioeconomic gradient of depression in terms of prevalence, incidence, and persistence.

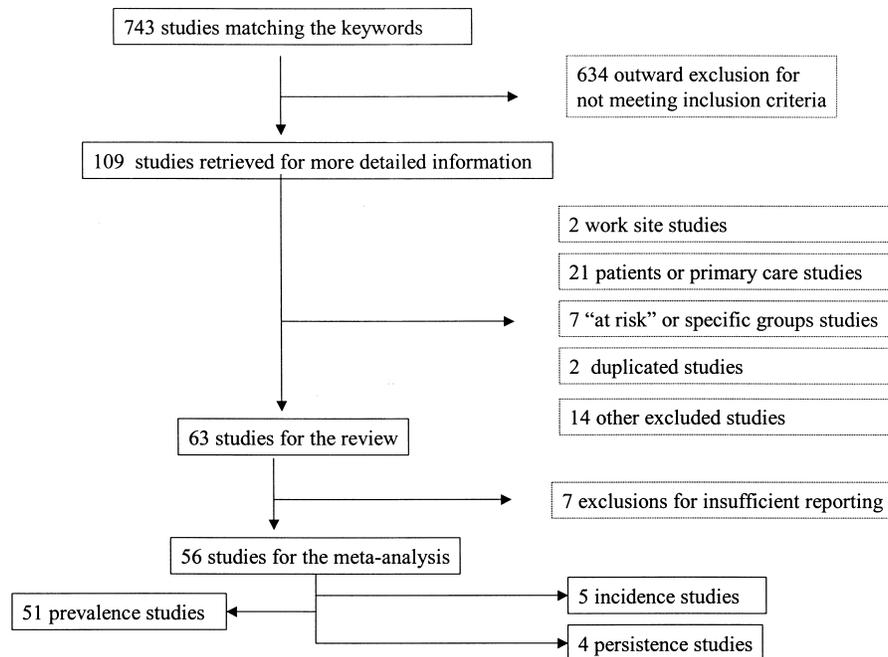
## MATERIALS AND METHODS

### Search

We looked for data on the prevalence, incidence, and persistence of major depression in population-based studies. Studies mainly related to substance abuse, schizophrenia, anxiety, or personality disorders were not included in the meta-analysis. Studies addressing common mental disorders (a mix of depression and anxiety) were included. Regarding SES, we retained studies providing a continuous individual level of stratification related to income, education, occupation, social class, or wealth (18). We excluded studies mainly devoted to neighborhood or regional levels of deprivation (or income inequality) (19–21).

Four selection criteria were defined in relation to date, language, setting, and population. We included studies published after 1979 (corresponding to the first publication of the DSM-III). We selected studies published in English, French, German, or Spanish, to avoid possible bias entailed by the use of linguistic criteria that were too stringent (22). Selection was limited to works in which a community sample was used, excluding those that relied on primary care or hospitalized patients. These exclusion criteria help to prevent the bias entailed by referral or help-seeking behavior (23). We restricted the review to studies of adults (aged ≥16 years); research devoted to young people or the elderly was excluded, particularly to avoid the confounding bias of poor physical health.

Because this topic is interdisciplinary, sources in psychiatry, psychology, sociology, medicine, and economics were considered. The search covered the following bibliographic databases: MEDLINE, PsychLit, Current Contents, the Social Science Citation Index, Sociological Abstracts, and EconLit. We also followed up with a snowball search (24), including references from the five most recent papers (21, 25–28), from two recent book chapters (23, 29) relating to this subject, and from previous reviews (8, 30). Finally, we searched for unpublished studies by contacting the various groups included on the International Consortium in Psychi-



**FIGURE 1.** Selection and exclusion of studies published after 1979 in a review and meta-analysis of the relation between socioeconomic factors and depression.

atric Epidemiology website (31). Only one unpublished study was obtained (32). The following terms were used in the search equation: “mood,” “affective,” “depression,” “depressive,” “mental,” “psychiatric,” “SES,” “social class,” “socio-economic,” “socioeconomic,” “education,” “social correlates,” “socio-demographic,” “income,” and “deprivation.”

### Data extraction

Most of the studies computed odds ratios comparing the lowest SES group with the highest. In some cases, only prevalence data were given, and we computed the odds ratio from the tables provided in the papers. Seven studies, mainly published in social science journals, treated depression (as well as SES in general) as a continuous variable by way of correlation or regression coefficients. Correlation coefficients were transformed into odds ratios using the following two formulae from Lipsey and Wilson (33), where  $r$  stands for the correlation coefficient and  $ES_r$  and  $ES_{OR}$  are the correlation effect size and the odds ratio effect size, respectively.

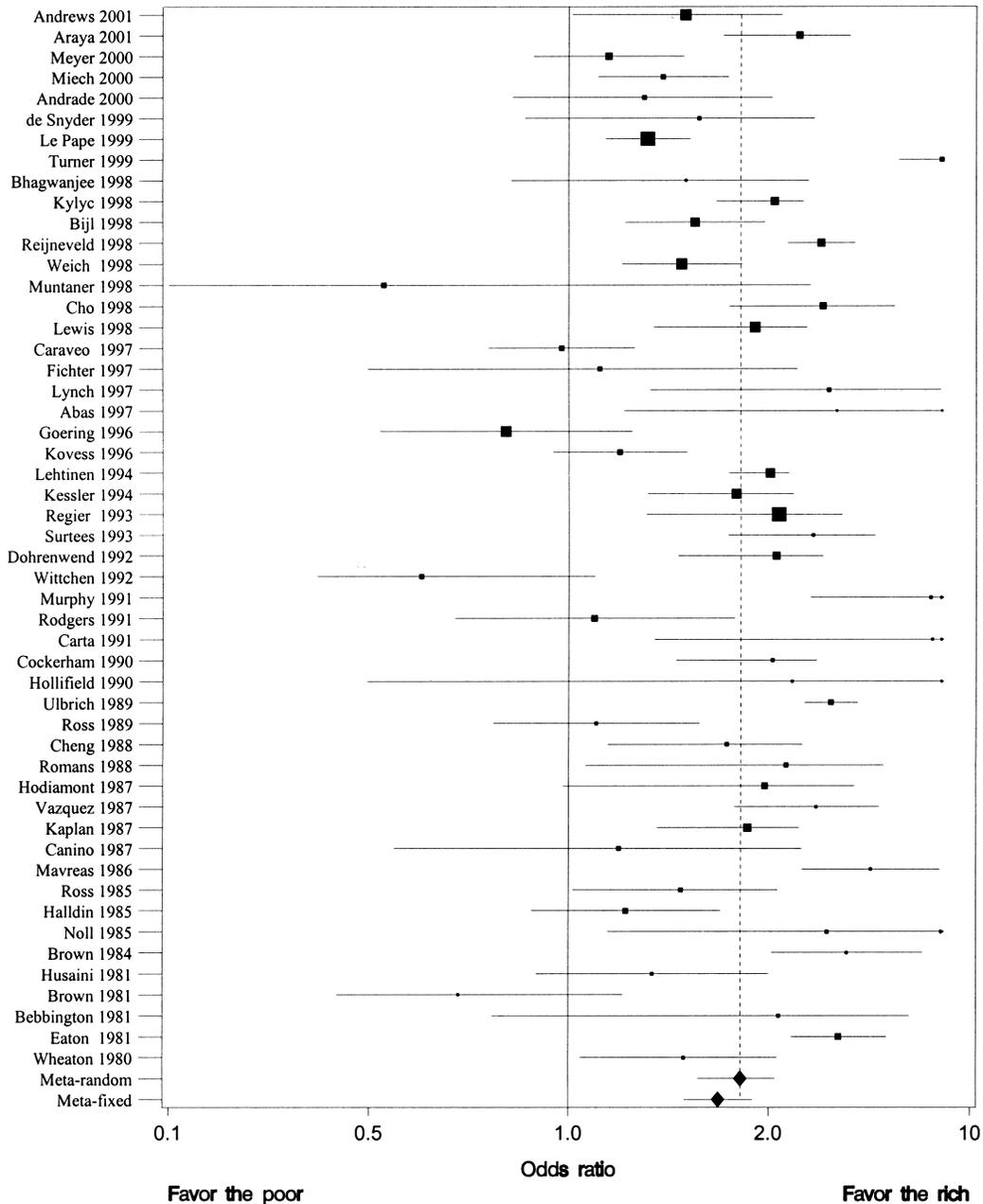
$$ES_r = 0.52 \ln \left[ \frac{1+r}{1-r} \right]$$

$$ES_{OR} = e^{\left( \frac{\pi ES_r}{\sqrt{3}} \right)}$$

It was not always possible to specify a dose-response relation because of the variety of socioeconomic indicators used (education, income, occupation, social class, assets) and because some socioeconomic variables were categorical

(e.g., low, medium, and high) or defined in terms of quintile income groups. In these cases, we used a strategy suggested by other researchers: Only the odds ratio comparing the lowest and highest socioeconomic categories was retained (34). Most studies examined the relation between depression and two socioeconomic variables, such as education and income. When data on several socioeconomic variables were available, educational status was retained, because it is continuous and it applies to all respondents, regardless of working status. When information on education was not available, income was considered next and then occupation.

Using such diverse studies in terms of population and methods, we anticipated heterogeneity in the results. We sought to investigate the heterogeneity to obtain a better understanding of the relation between SES and depression (35, 36). We extracted from the studies various contextual and methodological data that might explain variations in the relation's magnitude in the meta-regression. The covariates were chosen in accordance with the literature on socioeconomic inequalities in mental health. As contextual features, we collected information on the overall prevalence of the disorder, the mean age of the sample, the geographic location, and the field date. The literature suggests that the SES-depression relation might be affected by several features related to measurement and analysis. First, many instruments are available with which to assess the psychiatric status of adults, and they can be broadly divided into two groups: psychiatric scales and diagnostic schedules (37). Since symptom inventories have poor criterion validity and tap a mixture of anxiety, demoralization, and physical ill health (38), they might yield stronger socioeconomic gradi-



**FIGURE 2.** Odds ratios for major depression in the lowest socioeconomic status group in 51 prevalence studies published after 1979. Horizontal lines, 95% confidence interval. Squares show original estimates; diamonds show meta-analyzed results.

ents than the diagnostic schedules. Second, the strength of the relation may vary according to the clinical category. Incorporating all neurotic disorders, as was done in one United Kingdom study (39), may lead to a greater relation because the definition pools anxiety and substance disorder, variables that may have steeper socioeconomic slopes than affective disorders (40). Alternatively, the inclusion of all affective disorders may lower the slope, since dysthymia may be more equally distributed among the socioeconomic

strata than major depression (41). Third, the period of reference was considered as a possible explanatory factor because the prevalence rate may be more influenced by the duration of the episode for shorter periods of reference. With respect to SES measurement in public health studies, some standards have been suggested (18, 42). The studies were screened for two features: the number of social stratification variables and the number of SES groups. For analysis and reporting, two methodological criteria were defined with respect to the

**TABLE 2. Characteristics of 56 prevalence, incidence, or persistence studies published after 1979 that examined the relation between socioeconomic factors and depression**

| Author(s) and year of publication (ref. no.) | Country of study | Year of data collection | Sample size | Mean age (years) | Prevalence of disorder (%) | SES* variable | Instrument used to assess depression | Odds ratio for lowest SES group vs. highest | No. of SES groups | Quality score† |
|--|------------------|-------------------------|-------------|------------------|----------------------------|---------------|--------------------------------------|---|-------------------|----------------|
| <i>Prevalence studies</i>                    |                  |                         |             |                  |                            |               |                                      |   |                   |                |
| Cho et al., 1998 (46)                        | North Korea      | 1998                    | 3,711       | 37               | 8.7                        | Education     | CES-D*                               | 3.09  | 5                 | 6              |
| Bhagwanjee et al., 1998 (62)                 | South Africa     | 1998                    | 354         | 37               | 4.8                        | Education     | SRQ20*                               | 1.50  | 3                 | 3              |
| Andrews et al., 2001 (25)                    | Australia        | 1997                    | 10,641      | 46               | 7.0                        | Education     | CIDI*                                | 1.50  | 4                 | 8              |
| Abas and Broadhead, 1997 (63)                | Zimbabwe         | 1997                    | 172         | 40               | 31.0                       | Education     | PSE*                                 | 3.36  | 2                 | 4              |
| Le Pape and Lecompte, 1999 (64)              | France           | 1997                    | 18,288      | 38               | 14.9                       | Education     | Mini*                                | 1.32  | 4                 | 7              |
| Meyer et al., 2000 (65)                      | Germany          | 1997                    | 4,093       | 42               | 12.3                       | Education     | CIDI                                 | 1.15  | 3                 | 6              |
| Araya et al., 2001 (26)                      | Chile            | 1996                    | 3,870       | 37               | 5.5                        | Education     | CIS*                                 | 2.56  | 3                 | 7              |
| Bijl et al., 1998 (66)                       | The Netherlands  | 1996                    | 7,076       | 41               | 7.6                        | Education     | CIDI                                 | 1.55  | 4                 | 8              |
| de Snyder and Diaz, 1999 (67)                | Mexico           | 1996                    | 954         | 35               | 6.2                        | Education     | CIDI                                 | 1.57  | 3                 | 3              |
| Wittchen et al., 1992 (68)                   | Germany          | 1995                    | 1,626       | 37               | 6.8                        | Education     | CIDI                                 | 0.60  | 4                 | 5              |
| Caraveo-Anduaga et al., 1997 (69)            | Mexico           | 1995                    | 1,937       | 35               | 8.3                        | Other         | CIDI                                 | 0.98  | 2                 | 3              |
| Kýlýç, 1998 (32)                             | Turkey           | 1995                    | 5,489       | 36               | 4.0                        | Education     | CIDI                                 | 2.10  | 4                 | 6              |
| Lynch et al., 1997 (70)                      | United States    | 1994                    | 1,124       | 65               | 7.8                        | Income        | DSM-III-R*                           | 3.24  | 4                 | 5              |
| Andrade et al., 2000 (1)                     | Brazil           | 1994                    | 1,464       | 40               | 4.3                        | Education     | CIDI                                 | 1.30  | 4                 | 5              |
| Lewis et al., 1998 (39)                      | United Kingdom   | 1993                    | 9,570       | 41               | 16.0                       | Occupation    | CIS                                  | 1.91  | 6                 | 9              |
| Muntaner et al., 1998 (71)                   | United States    | 1993                    | 1,920       | 60               | 2.0                        | Education     | DIS*                                 | 0.53  | 5                 | 8              |
| Kessler et al., 1994 (40)                    | United States    | 1992                    | 8,098       | 33               | 11.3                       | Education     | CIDI                                 | 1.79  | 4                 | 8              |
| Kovess, 1996 (72)                            | France           | 1991                    | 2,260       | 42               | 19.2                       | Education     | CIDI                                 | 1.20  | 5                 | 5              |
| Carta et al., 1991 (73)                      | Italia           | 1991                    | 374         | 40               | 15.0                       | Education     | PSE                                  | 7.09  | 2                 | 5              |
| Weich and Lewis, 1998 (74)                   | United Kingdom   | 1991                    | 10,264      | 46               | 24.6                       | Income        | GHQ*                                 | 1.48  | 3                 | 6              |
| Turner and Lloyd, 1999 (2)                   | Canada           | 1990                    | 1,393       | 35               | 9.0                        | Social class  | CIDI                                 | 7.98  | 5                 | 8              |

Table continues

reported statistics and confounding variables: sex and age. An overall index of quality summing the scores of the 10 variables was computed (see table 1).

### Statistical analysis

Because the studies came from various geographic areas and used different methods, between-study variation was expected (43). In such circumstances, a random model was estimated with the SAS PROC MIXED restricted maximum likelihood estimation procedure (44). Weights were set equal to the reciprocal of the variance of the log estimate. Weighted linear meta-regressions were used to assess the effects of method and context on the heterogeneity. Variables reaching statistical significance ( $\alpha = 0.05$ ) in the univariate regression analyses were considered in the multivariate step. The sensitivity of the regression results was

assessed by removing the studies that had a Studentized residual above 2 (45).

Treating SES as a binary variable obscures the possibility that it might have a nonlinear effect on depression (41, 46, 47). Such nonlinearity should also be investigated in meta-analytical studies (48). We carried out a weighted regression of the log odds ratio on the educational status or income ranking (49, 50). For educational status, a mean-interval value for years of education (midpoint of the interval of years of education) was taken as the dose value. For income, we used the mean relative rank of each SES group. For example, the first educational group in the US National Comorbidity Survey (a group that had 0–11 years of education and accounted for the first 22.3 percent of the sample) had a mean-interval value of 5.5 years and a relative rank equal to 11.2 percent (22.3 percent/2 = 11.2 percent). We tested for nonlinearity by including quadratic terms in the regression.

TABLE 2. Continued

| Author(s) and year of publication (ref. no.) | Country of study | Year of data collection | Sample size | Mean age (years) | Prevalence of disorder (%) | SES variable | Instrument used to assess depression | Odds ratio for lowest SES group vs. highest | No. of SES groups | Quality score |
|--|------------------|-------------------------|-------------|------------------|----------------------------|--------------|--------------------------------------|---|-------------------|---------------|
| Reijneveld and Schene, 1998 (75)             | The Netherlands  | 1990                    | 4,892       | 46               | 32.3                       | Income       | GHQ                                  | 3.04  | 5                 | 5             |
| Miech and Shanahan, 2000‡ (76)               | United States    | 1990                    | 1,883       | 43               |                            | Education    | CES-D                                | 1.39  | 1                 | 6             |
| Goering et al., 1996 (77)                    | Canada           | 1990                    | 9,953       | 43               | 4.5                        | Education    | CIDI                                 | 0.81  | 3                 | 4             |
| Vazquez-Barquero et al., 1987 (78)           | Spain            | 1987                    | 452         | 48               | 14.7                       | Education    | PSE                                  | 2.93  | 2                 | 5             |
| Hodiamont et al., 1987 (79)                  | The Netherlands  | 1987                    | 3,245       | 37               | 7.3                        | Education    | PSE                                  | 1.97  | 9                 | 6             |
| Mavreas et al., 1986 (80)                    | Greece           | 1986                    | 489         | 42               | 16.0                       | Education    | PSE                                  | 4.53  | 3                 | 4             |
| Hollifield et al., 1990 (81)                 | Lesotho          | 1986                    | 356         | 43               | 12.0                       | Education    | DIS                                  | 2.41  | 4                 | 6             |
| Romans-Clarkson et al., 1988 (82)            | New Zealand      | 1985                    | 1,514       | 45               | 8.0                        | Occupation   | PSE                                  | 2.30  | 6                 | 5             |
| Noll and Dubinsky, 1985 (83)                 | United States    | 1985                    | 936         | 44               | 5.0                        | Education    | CES-D                                | 3.20  | 4                 | 4             |
| Cockerham, 1990‡ (84)                        | United States    | 1985                    | 775         | 42               |                            | Education    | Langner                              | 2.06  | 1                 | 4             |
| Ross and Mirowsky, 1989‡ (85)                | United States    | 1985                    | 809         | 42               |                            | Education    | CES-D                                | 1.10  | 1                 | 5             |
| Canino et al., 1987 (47)                     | Puerto Rico      | 1984                    | 1,551       | 38               | 2.9                        | Education    | DIS                                  | 1.19  | 4                 | 7             |
| Ulbrich et al., 1989‡ (86)                   | United States    | 1984                    | 2,115       | 52               |                            | Income       | HOS*                                 | 3.30  | 1                 | 4             |
| Surtees et al., 1983 (87)                    | United Kingdom   | 1983                    | 576         | 38               | 14.0                       | Occupation   | PSE                                  | 2.85  | 2                 | 4             |
| Cheng, 1988 (88)                             | Taiwan           | 1983                    | 1,044       | 40               | 24.0                       | Occupation   | CIS-CV*                              | 1.73  | 2                 | 4             |
| Rodgers, 1991 (89)                           | United Kingdom   | 1982                    | 3,322       | 36               | 6.0                        | Occupation   | PSE                                  | 1.09  | 3                 | 7             |
| Dohrenwend et al., 1992 (90)                 | Israel           | 1982                    | 4,914       | 29               | 5.6                        | Education    | SADS*                                | 2.13  | 3                 | 5             |
| Regier and Farmer, 1993 (41)                 | United States    | 1980                    | 18,368      | 44               | 2.3                        | Social class | DIS                                  | 2.17  | 4                 | 9             |
| Fichter et al., 1996 (91)                    | Germany          | 1980                    | 1,555       | 48               | 6.6                        | Social class | CPIS*                                | 1.11  | 5                 | 5             |

Table continues

We checked the robustness of the results in four ways: 1) by removing studies of low quality (table 1); 2) by rerunning the analysis with each study removed; 3) by applying a fixed model; and 4) by focusing on studies devoted exclusively to major depression (51).

Publication bias was considered using a funnel plot in which the log odds ratio was plotted against the sample size. A Kendall's tau correlation coefficient between the variance and the log odds ratio was also computed. A high correlation coefficient might reflect possible unpublished small studies with negative results (52).

## RESULTS

The search procedure yielded 109 references for which additional information was obtained (see figure 1). A few of these studies, however, did not meet the inclusion criteria. The complete list of the excluded studies is available on our website (<http://www.sesa.ucl.ac.be/matpub/meta>). Two

studies used work-site data (e.g., Stansfeld and Marmot (53)); 21 papers were excluded because they referred to an inpatient or primary care setting (e.g., Aro et al. (54)); a further seven studies were excluded because they targeted at-risk groups such as mothers of toddlers (55), the elderly (56), young people (57), or children (58); two studies were duplicates; and another 14 studies were excluded because they were reviews of or commentaries on previous studies (e.g., Kessler (59)) or because depression was treated as an exogenous variable (e.g., Cohen et al. (60)). Of the remaining 63 studies retained for the review, seven were eliminated because of insufficient reported data (e.g., Korten and Henderson (61)). The 56 remaining papers included 51 prevalence studies, five incidence studies, and four persistence studies. A few studies appeared in more than one category because they provided both incidence and persistence data. For example, Horwath et al. (12) provided incidence data from one of the Epidemiologic Catchment Area studies,

TABLE 2. Continued

| Author(s) and year of publication (ref. no.) | Country of study | Year of data collection | Sample size | Mean age (years) | Prevalence of disorder (%) | SES variable | Instrument used to assess depression | Odds ratio for lowest SES group vs. highest | No. of SES groups | Quality score |
|--|------------------|-------------------------|-------------|------------------|----------------------------|--------------|--------------------------------------|---|-------------------|---------------|
| Ross and Huber, 1985† (92)                   | United States    | 1978                    | 1,360       | 40               |                            | Education    | CES-D                                | 1.48  | 1                 | 3             |
| Lehtinen and Joukamaa, 1994 (93)             | Finland          | 1978                    | 7,217       | 55               | 5.1                        | Occupation   | PSE                                  | 2.03  | 3                 | 5             |
| Husaini and Neff, 1981 (94)                  | United States    | 1977                    | 713         | 35               | 11.0                       | Education    | CES-D                                | 1.34  | 1                 | 3             |
| Brown and Harris, 1984 (95)                  | United Kingdom   | 1976                    | 458         | 41               | 15.0                       | Occupation   | PSE                                  | 3.75  | 2                 | 4             |
| Bebbington et al., 1981 (96)                 | United Kingdom   | 1976                    | 800         | 40               | 10.9                       | Occupation   | PSE                                  | 2.17  | 2                 | 3             |
| Brown and Prudo, 1981 (97)                   | United Kingdom   | 1976                    | 355         | 41               | 11.0                       | Occupation   | PSE                                  | 0.68  | 2                 | 5             |
| Kaplan et al., 1987 (17)                     | United States    | 1974                    | 4,864       | 55               | 16.1                       | Education    | Other                                | 1.86  | 3                 | 6             |
| Eaton and Kessler, 1981 (98)                 | United States    | 1971                    | 2,867       | 47               | 16.0                       | Education    | CES-D                                | 3.51  | 4                 | 6             |
| Halldin, 1985 (99)                           | Sweden           | 1971                    | 2,283       | 42               | 25.6                       | Occupation   | Other                                | 1.22  | 3                 | 2             |
| Wheaton, 1980‡ (100)                         | United States    | 1966                    | 736         | 42               |                            | Education    | Langner                              | 1.49  | 1                 | 3             |
| Murphy et al., 1991 (101)                    | Canada           | 1952                    | 593         | 42               | 2.2                        | Assets       | DPAX*                                | 7.31  | 3                 | 4             |
| <i>Incidence studies</i>                     |                  |                         |             |                  |                            |              |                                      |   |                   |               |
| Eaton et al., 2001‡ (27)                     | United States    | 1996                    | 693         | 43               | 10.0                       | Education    | DIS                                  | 1.18  | 1                 | 6             |
| Weich and Lewis, 1998 (4)                    | United Kingdom   | 1991                    | 10,264      | 46               | 18.0                       | Income       | GHQ                                  | 1.11  | 4                 | 6             |
| Horwath et al., 1992 (12)                    | United States    | 1980                    | 9,900       | 42               | 1.0                        | Social class | DIS                                  | 1.16  | 4                 | 8             |
| Kaplan et al., 1987 (17)                     | United States    | 1974                    | 4,864       | 55               |                            | Education    | Other                                | 1.59  | 3                 | 5             |
| Murphy et al., 1991 (101)                    | Canada           | 1952                    | 593         | 42               | 5.3                        | Assets       | DPAX                                 | 5.31  | 3                 | 4             |
| <i>Persistence studies</i>                   |                  |                         |             |                  |                            |              |                                      |   |                   |               |
| Bracke, 2000 (102)                           | Belgium          | 1992                    | 2,223       | 42               | 68.0                       | Education    | HDL*                                 | 3.46  | 3                 | 4             |
| Weich and Lewis, 1998 (4)                    | United Kingdom   | 1991                    | 10,264      | 46               | 54.0                       | Income       | GHQ                                  | 1.73  | 4                 | 6             |
| Sargeant et al., 1990 (103)                  | United States    | 1980                    | 423         | 42               | 19.0                       | Education    | DIS                                  | 1.67  | 2                 | 7             |
| Murphy et al., 1991 (101)                    | Canada           | 1952                    | 593         | 42               | 80.0                       | Social class | DPAX                                 | 5.25  | 3                 | 4             |

\* SES, socioeconomic status; CES-D, Center for Epidemiologic Studies Depression Scale; SRQ20, Self Reporting Questionnaire; CID-I, Composite International Diagnostic Interview; PSE, Present State Examination; Mini, Mini-Mental State Examination; CIS, Clinical Interview Schedule; DSM-III-R, *Diagnostic and Statistical Manual of Mental Disorders*, Third Edition, Revised; DIS, Diagnostic Interview Schedule; GHQ, General Health Questionnaire; HOS, Health Opinion Survey; CIS-CV, Clinical Interview Schedule—Chinese Version; SADS, Schedule for Affective Disorders and Schizophrenia; CPIS, Clinical Psychiatric Interview, Semistructured; DPAX, Depression and Anxiety; HDL, Health and Daily Living Form.

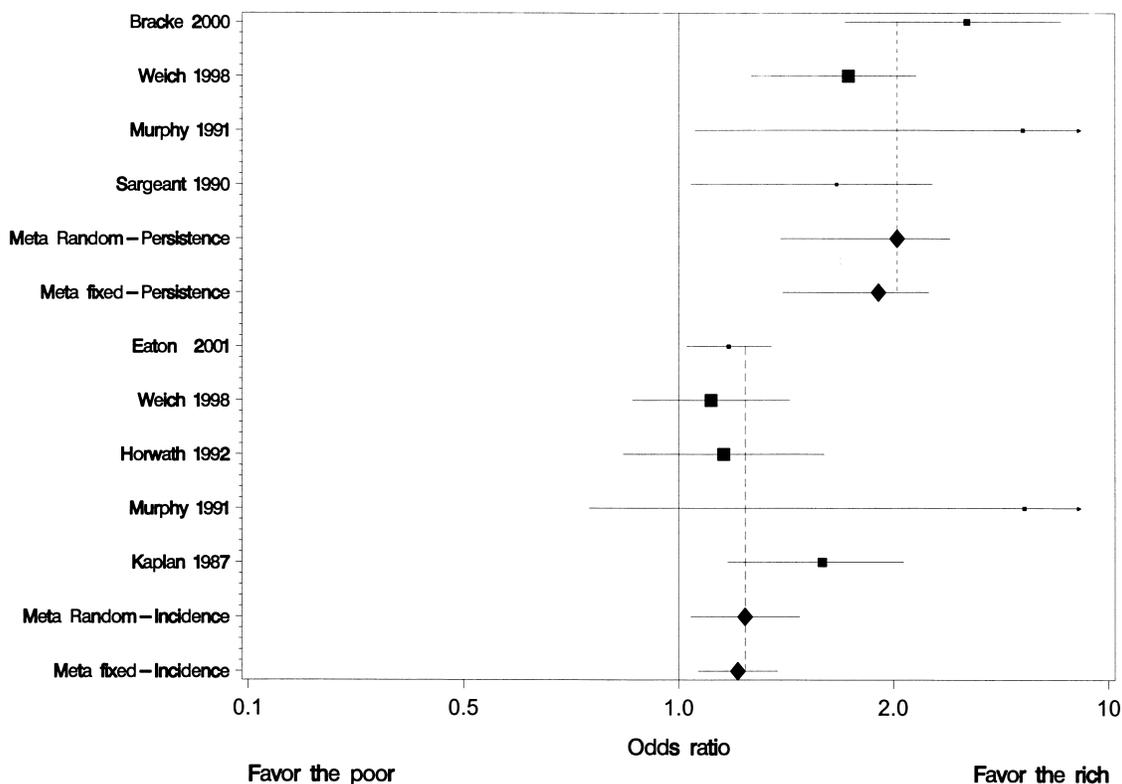
† Out of a possible score of 10.

‡ Depression or socioeconomic status was treated continuously.

while the prevalence data were given by Regier and Farmer (41)).

The characteristics of the studies included are presented in table 2. The majority of studies came from North America and Europe, were carried out around 1987, and yielded a mean prevalence of disorders of 9 percent. The samples were composed of individuals with an average age of 42 years, and the percentage of females averaged 60 percent (five studies included women only). In eight studies, the data were not collected by face-to-face interview, and in 19 cases the

population was defined on a very limited geographic scale (a village or a county). The mean response rate was 78 percent. Twenty-seven studies covered all common mental disorders, 10 referred to affective disorders, and the remaining 19 addressed major depression; 36 used a diagnostic interview schedule. The Composite International Diagnostic Interview and the Present State Examination were the most frequently used of the structured diagnostic schedules. The Center for Epidemiologic Studies Depression Scale, the General Health Questionnaire, and the Langner scale were the most popular



**FIGURE 3.** Odds ratios for major depression in the lowest socioeconomic status group in five incidence studies and four persistence studies published after 1979. Horizontal lines, 95% confidence interval. Squares show original estimates; diamonds show meta-analyzed results.

instruments among the symptom inventories. Thirty-seven studies used a short period of reference (<6 months), 14 used a period of 6–12 months, and the remaining five used a lifetime reference period.

The sample was usually divided into three SES groups. The mean relative rank of the lowest and highest SES groups corresponded to the 0.12 and 0.87 quantiles, respectively. The studies used, on average, 1.7 SES indicators (from one to five), the most popular being education (37 studies), income (23 studies), and occupation (19 studies). In 17 studies, the statistical processing controlled for both age and sex. Thirty-three studies provided only *p* values, with no standard deviations or confidence intervals for the estimates; only one study provided the results of a chi-squared trend test. Using an overall index of quality, the mean score across studies was 5 out of a possible 10 (standard deviation, 1.8).

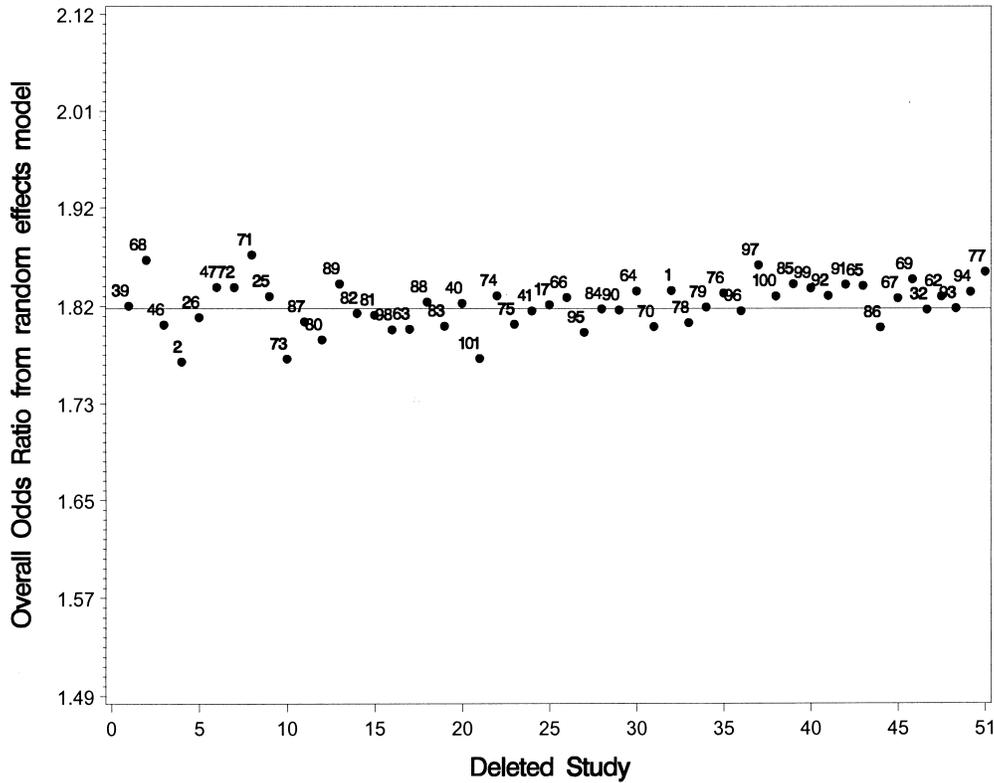
Most studies ( $n = 51$ ) reported an odds ratio greater than 1 (see figure 2), of which 35 were statistically significant. Five studies had nonsignificant odds ratios below 1. Individuals from lower SES groups had an overall odds ratio for being depressed of 1.81, as compared with the higher SES group (see table 3). Within the incidence studies (see figure 3), the lowest SES group turned out to have 1.24 times' greater odds of experiencing a new depressive episode than the highest group. Once depressed, lower SES individuals were much more likely to persist in depression (odds ratio = 2.06). As

shown by the forest plots (providing each study point and interval estimates), there was significant heterogeneity among the prevalence studies ( $\chi^2 = 333$ ,  $p < 0.001$ ). Homogeneity was not rejected for the incidence and persistence studies ( $\chi^2 = 5.9$  and  $\chi^2 = 4.9$ , respectively;  $p > 0.18$ ). However, the number of studies was low, yielding a lower power for the  $\chi^2$  test.

These estimates were lower when a fixed model was applied (table 3). Moreover, the overall odds ratio was hardly affected by the successive removal of each study (figure 4). When the seven prevalence studies with the lowest quality scores were excluded, the overall random odds ratio for the remaining 44 studies increased to 1.84.

The dose-response coefficients are shown in table 4. For each additional year of education, the log odds ratio of being depressed decreased by 3 percent. A 1 percent increase in relative ranking on income led to a 0.74 percent decrease in the log odds ratio of being depressed. Quadratic terms did not significantly improve the model; that is, the relation between SES and depression turned out to be mostly linear. Standardized coefficients indicated a stronger relation with income than with education (table 4).

The impact of covariates on the risk of depression is reported in table 5. Inequalities were greater for income than for education. Diagnostic schedules were more likely to show a stronger SES effect than inventories, although the



**FIGURE 4.** Sensitivity plot showing the change in the overall odds ratio for depression by socioeconomic status when each of 51 prevalence studies was removed. Numbers on the x-axis show the number of deleted studies. The number above each point on the figure is the reference number for the study in the text.

multivariate results were not consistent with the univariate ones. Collinearity diagnosis suggested that two covariates confounded the relation between the type of instrument and socioeconomic inequalities: the period of reference and the type of socioeconomic variable. First, inventories had a shorter period of reference than diagnostic schedules and thus a steeper socioeconomic gradient in depression. This is in line with the higher risk of persistence, as compared with incidence: If individuals of lower SES are more likely to remain in a depressed state than to experience a new episode, a shorter period of reference will reveal greater socioeconomic inequalities. Second, most inventory studies used income as the socioeconomic variable and hence showed

stronger inequalities. When income and shortness of the period were accounted for in the multivariate regression, diagnostic schedules evidenced a stronger socioeconomic gradient than inventories. Controlling the results for age and sex, as a final methodological covariate, led to a slight increase in the socioeconomic gradient.

Contextual features affected the socioeconomic gradient in depression. Studies from Europe showed a smaller gradient than others. Although North American studies had a steeper gradient than others in the univariate analysis, the coefficient was no longer significant in the multivariate regression, because of collinearity between the two main geographic dummies (accounting for 77 percent of all studies and having

**TABLE 3. Overall unadjusted odds ratios for major depression for the lowest socioeconomic status group versus the highest in prevalence, incidence, and persistence studies published after 1979**

| Type of study | No. of studies | Overall odds ratio in the random-effects model* | 95% confidence interval | p value | Overall odds ratio in the fixed-effects model | 95% confidence interval | p value | $\chi^2$ (Cochran's Q) |
|---------------|----------------|---|-------------------------|---------|---|-------------------------|---------|------------------------|
| Prevalence    | 51             | 1.81  | 1.57, 2.10              | < 0.001 | 1.68  | 1.49, 1.89              | < 0.001 | 332.655                |
| Incidence     | 5              | 1.24  | 1.04, 1.48              | 0.004   | 1.21  | 1.06, 1.38              | 0.001   | 5.928                  |
| Persistence   | 4              | 2.06  | 1.39, 3.05              | < 0.001 | 1.91  | 1.40, 2.60              | < 0.001 | 4.920                  |

\* No covariates were added.

**TABLE 4. Regression coefficients for the log odds ratio of major depression for two socioeconomic indicators (number of years of education and relative income rank)**

| Model                                | $\beta^*$ | SE† $\beta$ | $B\ddagger$ | $t$ test value§ |
|--------------------------------------|-----------|-------------|-------------|-----------------|
| Education (years) ( $n = 37$ )       | -0.03     | 0.006       | -0.34       | 5.31            |
| Education + education <sup>0.5</sup> | -0.01     | 0.020       | -0.15       | 0.73            |
| Education <sup>0.5</sup>             | -0.09     | 0.084       | -0.21       | 1.03            |
| Education + education <sup>2</sup>   | -0.03     | 0.023       | -0.34       | 1.49            |
| Education <sup>2</sup>               | 0.00      | 0.008       | 0.00        | 0.00            |
| Income (relative rank¶) ( $n = 23$ ) | -0.74     | 0.114       | -0.53       | 6.52            |
| Income + income <sup>0.5</sup>       | -0.26     | 0.807       | -0.19       | 0.33            |
| Income <sup>0.5</sup>                | -0.52     | 0.870       | -0.35       | 0.60            |
| Income + income <sup>2</sup>         | -1.04     | 0.464       | -0.75       | 2.25            |
| Income <sup>2</sup>                  | 0.42      | 0.622       | 0.22        | 0.67            |

\* Unstandardized estimate.

† SE, standard error.

‡ Standardized estimate =  $\beta \times \text{SE of regressor} / \text{SE of dependent variable}$ .

§ Ratio of  $\beta$  to SE  $\beta$ .

¶ Mean relative rank of group  $j = \sum_{i=1}^{j-1} f_i + 0.5 \times f_j$ , where  $f$  is the relative frequency of observations in group  $i$  (or  $j$ ).

a correlation of  $-0.75$ ) (table 5). Studies that focused on women yielded more inequality. Unexpectedly, relative rank difference was not significant. This could be explained by the limited variance of this covariate (coefficient of variation of 0.18). Finally, the socioeconomic gradient seems to be lowering over time. All of these factors account for one third of the variance in socioeconomic inequalities in depression. Removing the two studies with the greatest influence did not change the sign of the coefficients; it merely increased the significance of the coefficients related to North America, psychiatric instrument, and length of the reference period.

There was no evidence of publication bias. The funnel plot (figure 5) appears to converge and dispersion to decrease with a higher sample size. A slight "bite" was apparent in the lower left corner, suggesting a small underrepresentation of studies with a lower rate of depression in the lowest SES group; but the Kendall's tau coefficient was nonsignificant ( $\tau = 0.15$ ,  $p = 0.12$ ).

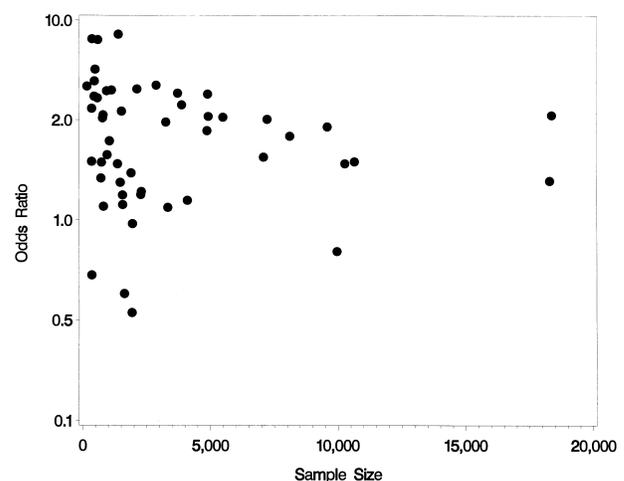
## DISCUSSION

To the best of our knowledge, this is the first meta-analysis of socioeconomic inequality in depression. More than 30 years after the Dohrenwends' landmark review (7), SES remains a moderate to strong prevalence correlate for depression. Low SES slightly increases the risk of episode onset and moderately increases the risk for persistence of depression. Such an association is not limited to the bottom SES group but persists throughout the entire social stratum.

The nature of this association is not clear-cut. Regarding the direction of this association for depression, the results more consistently support the contention that causation (low SES increases risk of depression) has the edge over selection (depression hinders social mobility), although both processes are at play (90, 104, 105). Part of the difficulty in disentangling such processes is that causation and selection

need to be settled on intergenerational comparisons. A recent intergenerational study that included parental psychopathology and SES supported the causation assumption and rejected selection both within and between generations (106). Recent reviews suggest that causation and selection are not mutually exclusive explanations and that they may be combined over the life cycle (23, 104).

The processes linking SES and depression divide broadly into two groups: stress and strain (107). The stress theory postulates that personal resources, such as coping style, self-esteem, mastery, and locus of control, buffer the impact of stress on depression and that higher-SES individuals are better endowed with such resources (95, 100). The stronger



**FIGURE 5.** Funnel plot of 51 prevalence studies of the relation between socioeconomic factors and depression that were published after 1979.

**TABLE 5. Differences in the log odds ratio of depression associated with study characteristics in 51 prevalence studies\***

| Covariate  | Change in log odds ratio per unit change in regressor in univariate regression |             |           | Change in log odds ratio per unit change in regressor in multivariate regression ( $R^2 = 0.34$ ) |            |           |
|--|--|-------------|-----------|---|------------|-----------|
|  | $\beta$  | SE† $\beta$ | $p$ value | $\beta$   | SE $\beta$ | $p$ value |
| Intercept‡   |  |             |           | 0.168   | 0.383      | 0.17      |
| SES† measured by income versus other§                          | 0.362  | 0.071       | <0.01     | 0.64  | 0.132      | <0.01     |
| Diagnostic instrument versus symptom inventory§                | -0.121   | 0.051       | <0.01     | 0.511   | 0.098      | <0.01     |
| Women (%)  | 0.408  | 0.274       | 0.03      | 0.457   | 0.315      | 0.04      |
| Short period of reference (<6 months vs. longer)§              | 0.324  | 0.052       | <0.01     | 0.305   | 0.068      | <0.01     |
| European studies versus others§                                | -0.166   | 0.049       | <0.01     | -0.300  | 0.081      | >0.01     |
| Studies from North America versus others§                      | 0.218  | 0.053       | <0.01     | 0.057   | 0.104      | 0.15      |
| Controlling for age and sex versus noncontrol§                 | 0.042  | 0.025       | 0.02      | 0.047   | 0.039      | 0.06      |
| Date (years)   | -0.011   | 0.003       | <0.01     | -0.016  | 0.006      | <0.01     |
| Major depression only versus common mental disorders§          | -0.096   | 0.053       | 0.02      | 0.015   | 0.068      | 0.21      |
| Sample scope (national versus local)§                          | -0.097   | 0.031       | <0.01     | -0.013  | 0.038      | 0.18      |
| SES measured by education versus other§                        | -0.255   | 0.05        | <0.01     | 0.009   | 0.08       | 0.23      |
| Mean age (years)   | 0.015  | 0.004       | <0.01     | 0.001   | 0.005      | 0.21      |
| SES measured by occupation versus other§                       | 0.06   | 0.062       | 0.08      |   |            |           |
| Prevalence of depression (%)¶                                  | 0.001  | 0.004       | 0.17      |   |            |           |
| Relative rank of top group minus relative rank of bottom group | 0.087  | 0.116       | 0.11      |   |            |           |

\* The natural logarithm of the odds ratio was the dependent variable.

† SE, standard error; SES, socioeconomic status.

‡ The mean value of the univariate intercepts was 0.518.

§ Dummy variable coded 1 if true and 0 otherwise.

¶ Imputation of the mean value for correlation studies.

relation between persistent depression (compared with incidence) and SES found in our meta-analysis is consistent with this stress theory. The strain theory addresses the impact of community features such as values, social welfare, social cohesion, infrastructure, and public health policy (107–109). This framework builds upon widespread between-country differences in socioeconomic health inequalities observed for subjective health (110) or cause-specific mortality (111). However, the evidence for such contextual effects on mental disorders is conflicting (19, 20). A recent study showed that individual income and regional unequal distribution of income interacted in affecting the level of mental disorder (21). Our work also suggests that socioeconomic inequalities in depression are stronger in some regions but did not permit identification of any specific strain factors.

Our results may be affected by three limitations related to confounding bias, lack of specificity, and publication bias. Gender and age are well-known confounding factors in the

SES-depression relation: Because women have a higher prevalence of depression and lower SES, ignoring gender will exacerbate the socioeconomic gradient. Conversely, overlooking age tends to suppress this gradient, because age has a U-shaped relation with depression and a reverse U-shaped association with income (112). Meta-regression suggests that controlling for age and gender might lead to an increase in socioeconomic inequalities in depression, possibly because the lowering age effect is higher than the exacerbating sex effect.

Physical disease might provide another potentially confounding factor that is seldom considered in psychiatric epidemiology (9). Although the third DSM-IV axis is devoted to somatic diseases, very few of the studies reviewed provided results controlling for physical health. There is empirical evidence, on the one hand, of a relation between psychiatric disorder and physical diseases such as cancer and cardiovascular disorders (113) and, on the other

hand, of a relation between SES and physical diseases. However, the high prevalence of depression and the dose-response relation make it unlikely that physical disease greatly conflates the SES-depression relation. Moreover, a previous study by Lynch et al. (70) suggests that the overall impact of physical disease on the SES-depression relation is slight.

This study may have lacked specificity regarding depression, since we decided to include 30 studies of overall psychiatric disorder. We made this decision in order to gain statistical power and to obtain a wide range of studies. We sought to assess the cost of such a decision by undertaking a sensitivity analysis. Keeping only the 19 studies that focused on major depression had only a slight influence on the overall point estimates (results not shown), although some precision was lost. As the meta-regression also showed, there was only a small, nonsignificant difference between those two kinds of studies. Thus, we felt more confident that lack of specificity was not a serious problem in this study.

These results are vulnerable to two sources of publication bias: positive results and availability. Some important psychiatric epidemiologic studies have not addressed the question of the socioeconomic distribution of depression—for example, the study of the Mental Health Supplement to the Ontario Health Survey in Canada (114) and the Early Developmental Stages of Psychopathology Study in Munich, Germany (68). A subsequent cross-national review indicated that education was related to mental health status in Ontario but not in Munich (1). A second form of bias occurs when studies yielding inverse results lack the information needed for being considered in the meta-analysis. However, all in all, the funnel plot and the rank correlation coefficient do not suggest a positive-results publication bias. Nevertheless, an availability bias cannot be excluded, particularly with regard to developing countries. Such studies are less likely to be published in peer-reviewed English-language journals. Taking a recent cross-national review of seven countries as a reference (1), none of the three original studies from developing countries had been published in peer-reviewed journals. We succeeded in including studies published in languages other than English, but an obvious paucity of works from Asia and Africa remained.

Nonetheless, we found compelling evidence of inequalities in depression favoring the higher SES groups. There is increasing recognition within the public health field that specific strategies are needed to tackle health inequalities (115, 116). Our results suggest that one strategy would be to focus on decreasing the chronicity of depression among people in the lower socioeconomic strata.

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