

# Risk Factors for Depression Among Elderly Community Subjects: A Systematic Review and Meta-Analysis

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**Objective:** The goal of this study was to determine risk factors for depression among elderly community subjects.

**Method:** MEDLINE and PsycINFO were searched for potentially relevant articles published from January 1966 to June 2001 and from January 1967 to June 2001, respectively. The bibliographies of relevant articles were searched for additional references. Twenty studies met the following six inclusion criteria: original research reported in an English or French publication, study group of community residents, age of subjects 50 years or more, prospective study design, examination of at least one risk factor, and use of an acceptable definition of depression. The validity of studies was assessed according to the four primary criteria for risk factor studies described by the Evidence-Based Medicine Working Group. Information about group size at baseline and follow-up, age, proportion of men, depression criteria, exclusion criteria at

baseline, length of follow-up, number of incident cases of depression, and risk factors was abstracted from each report.

**Results:** Follow-up of the inception cohort was incomplete in most studies. In the qualitative meta-analysis, risk factors identified by both univariate and multivariate techniques in at least two studies each were disability, new medical illness, poor health status, prior depression, poor self-perceived health, and bereavement. In the quantitative meta-analysis, bereavement, sleep disturbance, disability, prior depression, and female gender were significant risk factors.

**Conclusions:** Despite the methodologic limitations of the studies and this meta-analysis, bereavement, sleep disturbance, disability, prior depression, and female gender appear to be important risk factors for depression among elderly community subjects.

(*Am J Psychiatry* 2003; 160:1147–1156)

Major depression occurs in 1% to 3% of the general elderly population (1, 2), and an additional 8% to 16% have clinically significant depressive symptoms (1, 3). The prognosis of these depressive states is poor. A meta-analysis of outcomes at 24 months estimated that only 33% of subjects were well, 33% were depressed, and 21% had died (4). Moreover, studies of depressed adults (5, 6) indicate that those with depressive symptoms, with or without depressive disorder, have poorer functioning, comparable to or worse than that of people with chronic medical conditions such as heart and lung disease, arthritis, hypertension, and diabetes (7). In addition to poor functioning, depression increases the perception of poor health (7), the utilization of medical services (8), and health care costs (9).

The preceding findings suggest that depression in elderly community subjects is a serious problem. Nonetheless, probably fewer than 20% of cases are detected or treated (2, 4). Even among those detected and treated, the effectiveness of interventions appears to be modest (10). Escalating health care costs and shrinking health care resources challenge health care professionals to find more

effective and less expensive approaches to depression in the elderly.

The success of a program for preventing delirium among elderly medical inpatients (11) offers hope that a similar intervention model may be useful in preventing depression among elderly community subjects. This program involved identification of elderly medical inpatients with at least one of six targeted risk factors for delirium and implementation of standardized intervention protocols for each of the risk factors present. The program attenuated the risk factors and reduced the incidence of delirium by 40%. To develop a similar intervention model for preventing depression among elderly community subjects, risk factors for depression in this population must be defined. Thus, the purpose of this investigation was to determine risk factors for depression among elderly community subjects by systematically reviewing original research on this topic. The review process, modified from the one described by Oxman et al. (12), involved systematic selection of articles, assessment of validity, abstraction of data, and qualitative and quantitative synthesis of results.

TABLE 1. Prospective Studies of Risk Factors for Depression Among the Elderly

Study	Number of Subjects		Age (years)		% Male	Criteria for Depression <sup>a</sup>	Exclusion Criteria at Baseline <sup>a</sup>	Length of Follow-Up (months)	Cases of Incident Depression	
	Baseline	Follow-Up	Range	Mean					N	%
Phifer and Murrell, 1986 (15)	2,937	1,233	≥55	68	41	CES-D Scale score >20	CES-D Scale score >16; psychiatric treatment in past 6 months	6	66	5.4
McHorney and Mor, 1988 (16)	1,754	1,447	—	58	28	RDC	—	3–4	285	19.7
Kennedy et al., 1990 (17)	1,243	1,243	≥65	74	46	CES-D Scale score >16 plus 5 points above baseline	CES-D Scale score >16	24	163	13.1
Harlow et al., 1991 (18)	600	445	65–75	—	0	CES-D Scale	—	12	—	—
Russell and Cutrona, 1991 (19)	301	284	≥65	—	40	Zung Depression Scale	Poor health, psychiatric treatment in past 6 months, dementia, institutionalization	12	—	—
Green et al., 1992 (20)	1,070	—	≥65	—	—	GMS-AGECAT criteria (level 3.5)	GMS-AGECAT depression (level 3+)	36	44	4.1
Livingston et al., 1993 (21)	705	524	≥65	75	37	Short CARE (clinical depression criteria)	—	24	22	4.2
Mendes de Leon et al., 1994 (22)	1,046	731	≥65	73	65	CES-D Scale score >20	—	36	77	10.5
Beekman et al., 1995 (23)	340	238	55–89	—	50	CES-D Scale score >16	Depression, MMSE score <16	12	38	16.0
Zeiss et al., 1996 (24)	—	680	≥50	—	41	CES-D Scale score >12 plus SADS criteria	Depression	24	95	14.0
Kivela et al., 1996 (25)	944	679	≥60	69	41	DSM-III criteria	Depression	60	60	8.8
Prince et al., 1998 (26)	538	383	≥65	76	39	Short CARE (pervasive depression criteria)	Depression	12	46	12.0
Turvey et al., 1999 (27)	—	5,449	70–103	77	38	Modified CES-D Scale score >6 CIDI criteria	—	24	327	6.0
Livingston et al., 2000 (28)	141	79	65–95	—	23	Short CARE (depression homogeneous scale positive)	Limitations in activities of daily living, depression, dementia	24 36	193 19	3.5 24.1
Schoevers et al., 2000 (29)	3,747	1,940	65–84	—	38	GMS-AGECAT criteria (level 3.5)	Depression, dementia	36	309	15.9
Geerlings et al., 2000 (30)	325	234	55–85	69	48	CES-D Scale score >16 plus 5 points above baseline	Depression	36	33	14.1
Forsell, 2000 (31)	1,777	903	≥75	85	23	DSM-IV criteria	Depression, anxiety, psychosis	36	29	3.2
Paterniti et al., 2000 (32)	1,191	1,014	59–71	65	41	CES-D Scale score >16 for men and >22 for women	Depression	24	64	6.3
Roberts et al., 2000 (33)	2,370	2,228	50–95	65	44	DSM-IV criteria	Depression	12	—	—
Kritz-Silverstein et al., 2001 (34)	2,029	944	50–89	71	46	BDI score >13	Severe depression, disability	96	17	1.8

<sup>a</sup> CES-D Scale: Center for Epidemiologic Studies Depression Scale. RDC: Research Diagnostic Criteria. GMS-AGECAT: Geriatric Mental State Schedule Automated Geriatric Examination for Computer Assisted Taxonomy. Short CARE: shortened Comprehensive Assessment and Referral Evaluation. MMSE: Mini-Mental State Examination. SADS: Schedule for Affective Disorders and Schizophrenia. CIDI: Composite International Diagnostic Interview. BDI: Beck Depression Inventory.

## Method

### Selection of Articles

The selection process involved four steps. First, two computer databases, MEDLINE and PsycINFO, were searched for potentially relevant articles published from January 1966 to June 2001 and from January 1967 to June 2001, respectively. For MEDLINE, the key words "depression," "risk factor," and "aged" and the text word "community" were used; for PsycINFO, the same words were used as text words. Second, relevant articles (judged on the basis of the title and abstract) were retrieved for more detailed evaluation. Third, the bibliographies of relevant articles were searched for additional references. Finally, all retrieved articles were screened to determine which met the following six inclusion criteria: 1) original research published in English or French, 2) study group of community residents, 3) subjects age 50 years or older, 4) prospective design that excluded subjects who were depressed at baseline (or controlled for baseline depression in the analysis), 5) study of at least one risk factor for depression, and 6) acceptable definition of depression (either recognized diagnostic criteria or cutoff on a depression rating scale).

### Assessment of Validity

To determine validity, the methods of each study were assessed according to the four primary criteria for risk factor studies described by the Evidence-Based Medicine Working Group (13): 1) clearly identified comparison groups that were similar with respect to important determinants of outcome, other than the one of interest (or analysis that controlled for differences in important determinants), 2) measurement of exposures and outcomes in the same way, 3) a sufficiently long follow-up (i.e., 1 year), and 4) a sufficiently complete follow-up (i.e., including 80% of inception cohort). Each study was scored with respect to meeting (+) or not meeting (–) each of these criteria.

### Abstraction of Data

Information about the size of the study group at baseline and follow-up, subjects' age, proportion of men, criteria for depression, exclusion criteria at baseline, length of follow-up, number of incident cases of depression, and risk factors was abstracted from each report.

### Data Synthesis

**Qualitative.** All abstracted information was tabulated. A qualitative meta-analysis was conducted by summarizing, comparing, and contrasting the abstracted data.

**Quantitative.** A quantitative meta-analysis was conducted for risk factors with usable data from two or more studies. To obtain a pooled estimate of the odds of depression associated with each risk factor, we conducted a meta-analysis using a Bayesian hierarchical (random effects) model (14). In the Bayesian framework, information available before the analysis is combined with the observed data to obtain a posterior distribution for the parameters of interest (14). We assumed no prior information was available. The variance between odds ratios from different studies is a measure of the heterogeneity of the studies. A Bayesian 95% posterior credible interval may be interpreted in a straightforward manner as an interval that contains the parameter of interest with 95% probability given the observed data. We also estimated the probability that the pooled odds ratio was greater than 1.

**TABLE 2. Validity of Prospective Studies of Risk Factors for Depression Among the Elderly According to Four Criteria<sup>a</sup>**

Study	Similar Comparison Groups	Same Measure of Depression	Sufficient Follow-Up	
			Long Enough Interval (12 months)	Complete Data (80% of subjects)
Phifer and Murrell, 1986 (15)	+	+	–	–
McHorney and Mor, 1988 (16)	+	+	–	+
Kennedy et al., 1990 (17)	+	+	+	+
Harlow et al., 1991 (18)	+	+	+	–
Russell and Cutrona, 1991 (19)	+	+	+	+
Green et al., 1992 (20)	+	+	+	—
Livingston et al., 1993 (21)	+	+	+	–
Mendes de Leon et al., 1994 (22)	+	+	+	+
Beekman et al., 1995 (23)	+	+	+	–
Zeiss et al., 1996 (24)	+	+	+	—
Kivela et al., 1996 (25)	+	+	+	–
Prince et al., 1998 (26)	+	+	+	–
Turvey et al., 1999 (27)	+	+	+	—
Livingston et al., 2000 (28)	+	+	+	–
Schoevers et al., 2000 (29)	+	+	+	–
Geerlings et al., 2000 (30)	+	+	+	+
Forsell, 2000 (31)	+	+	+	–
Paterniti et al., 2000 (32)	+	+	+	+
Roberts et al., 2000 (33)	+	+	+	+
Kritz-Silverstein et al., 2001 (34)	+	+	+	–

<sup>a</sup> The four primary criteria for risk factor studies described by the Evidence-Based Medicine Working Group (13). A plus sign indicates the study met the criteria; a minus sign indicates the study did not meet the criteria; a dash indicates fulfillment of the criteria could not be determined.

## Results

### Selection of Articles

The search strategy yielded 130 potentially relevant studies; 45 were retrieved for more detailed evaluation. Twenty studies (15–34) met the inclusion criteria (Table 1). The other 25 studies were excluded for the following reasons: four did not meet the age criterion, 16 were not prospective, two did not study at least one risk factor, and three did not meet two or more of the inclusion criteria.

### Assessment of Validity

Six studies met all of the criteria. Most studies had incomplete follow-up of the inception cohort (Table 2).

TABLE 3. Findings on Risk Factors for Depression Among the Elderly From Univariate Analysis of Prospective Studies<sup>a</sup>

Study	Disability	Older	Female	Poor Social Support	New Medical Illness	Poor Health Status	Sleep Disturbance	Prior Depression	Less Education	Unmarried	Bereavement	Cognitive Impairment
Phifer and Murrell, 1986 (15)		0	0						0	0		
McHorney and Mor, 1988 (16)	+							+				
Kennedy et al., 1990 (17)	+	+	+	0	+	+	+			-		0
Harlow et al., 1991 (18)	+	+		+	+		+		+			
Russell and Cutrona, 1991 (19)				+								
Green et al., 1992 (20)		0	0	0			0	0		0	0	0
Livingston et al., 1993 (21)							+					
Mendes de Leon et al., 1994 (22)											+	
Beekman et al., 1995 (23)	+	0	0		+				0	0		
Zeiss et al., 1996 (24)	+					0						
Kivela et al., 1996 (25)	0	0	0		0			0				
Prince et al., 1998 (26)	+					+	+					+
Turvey et al., 1999 (27)		0	0					0				
Livingston et al., 2000 (28)		-	0	0	0		0		0		0	
Schoevers et al., 2000 (29)	+	+	0	0	+	+		+	0	0	+	0
Geerlings et al., 2000 (30)	+					+						
Forsell, 2000 (31)	+	0	0	0		0		+	+	0		+
Paterniti et al., 2000 (32)												
Roberts et al., 2000 (33)	+	+	+	+			+		+	0		
Kritz-Silverstein et al., 2001 (34)												
Number of studies	11	11	10	8	6	6	7	6	7	7	4	5
Number of positive studies	10	4	2	3	4	4	5	3	3	0	2	2

<sup>a</sup> A plus sign indicates a risk factor; a minus sign indicates a protective factor; zero indicates the factor had no effect of either type; blank cells indicate the factor was not studied. Each of the risk factors shown was examined in two or more studies. Risk factors examined in one study each were poor locus of control, more daily hassles, poor life satisfaction, loneliness, pain, family illness, more neuroticism, more extroversion, limitations in instrumental activities of daily living, new limitations in instrumental activities of daily living, religion unimportant, absence of a pet, lower social class, low exercise level, immigrant status, childlessness, and financial problems.

New Disability	Poor Self-Perceived Health	Nonwhite Race or Ethnicity	Institutionalized	Living Alone	Vision or Hearing Impairment	Loss Events	Lower Income	Smoking	More Anxiety	Use of Hypnotics, Tranquilizers	Alcohol Abuse	Family Depression
		0										
+	+	+		0	+	0	+					
	+									+		
						+						
		0		0				+	0	0	0	0
			+									
+	+		0					0			0	
				0		0						
+									+			0
			0		+							
											0	
3	3	3	3	3	2	3	2	2	2	2	2	2
3	3	1	1	0	2	1	1	1	1	1	0	0

TABLE 4. Findings on Risk Factors for Depression Among the Elderly From Multivariate Analysis of Prospective Studies<sup>a</sup>

Study	Disability	Bereavement	Poor Health Status	Female	Poor Social Support	Older	Unmarried	New Medical Illness	Prior Depression	Less Education
Phifer and Murrell, 1986 (15)	+	0		0	+	0	0	+		0
McHorney and Mor, 1988 (16)	+			0	0	+				+
Kennedy et al., 1990 (17)	+			+			-	+		
Harlow et al., 1991 (18)	+	+	+		0					
Russell and Cutrona, 1991 (19)										
Green et al., 1992 (20)		+		+	0	0	0		0	
Livingston et al., 1993 (21)										
Mendes de Leon et al., 1994 (22)		+								
Beekman et al., 1995 (23)										
Zeiss et al., 1996 (24)										
Kivela et al., 1996 (25)										
Prince et al., 1998 (26)	+		+							
Turvey et al., 1999 (27)		+								
Livingston et al., 2000 (28)										
Schoevers et al., 2000 (29)		+	+					+	+	
Geerlings et al., 2000 (30)	+		0							
Forsell, 2000 (31)	0		0	0	0	0	0		+	0
Paterniti et al., 2000 (32)										
Roberts et al., 2000 (33)										
Kritz-Silverstein et al., 2001 (34)										
Number of studies	7	6	5	5	5	4	4	3	3	3
Number of positive studies	6	5	3	2	1	1	0	3	2	1

<sup>a</sup> A plus sign indicates a risk factor; a minus sign indicates that the factor had a protective effect; zero indicates it had no effect of either type; blank cells indicate the factor was not studied. Each of the risk factors shown was examined in two or more studies. Risk factors examined in one study each were family tension, poor caretaker, length of deceased loved one's illness, new disability, low income, low life satisfaction, loneliness, smoking, pain, limitations in instrumental activities of daily living, new limitations in instrumental activities of daily living, early parental death, parental depression, poor locus of control, Jewish or Catholic religious attendance, cognitive impairment, alcohol abuse, living alone, absence of pet, lower social class, institutionalization, family depression, low exercise level, anxiety, medication use (hypnotics, tranquilizers), immigrant status, childlessness, and low blood pressure.

### Data Synthesis

**Qualitative.** The 20 included studies (Table 1) involved more than 23,058 subjects at baseline, more than 20,678 subjects at follow-up, and more than 1,694 subjects with incident depression. The numbers of subjects at baseline and follow-up ranged from 141 to 3,747 and from 79 to 5,449 subjects, respectively. The subjects' mean ages were reported in 13 articles (mean=58–85 years). Nineteen articles included gender distribution: 0%–65% of subjects were men (median=41%). The length of reported follow-up ranged from 3 to 96 months (median=24). Nine studies used DSM or structured interview criteria to diagnose depression, nine used a cutoff on a depression rating scale, and two used both. Among the 17 reports that included the frequency of incident depression, the frequencies ranged from 1.8% to 24.1% (median=12.0%) and were generally higher in studies using cutoffs on rating scales than in those using diagnostic criteria.

Forty-two different risk factors were studied by univariate analysis, 25 in two or more studies and 17 in one study each (Table 3). Disability, being older, female gender, new medical illness, poor health status, sleep disturbance, prior depression, less education, cognitive impairment, new disability, poor self-perceived health, poor social support, bereavement, and vision or hearing impairment were identified as risk factors for depression in at least two studies each.

Forty-three risk factors were studied by multivariate analysis, 15 in two or more studies and 28 in one study each (Table 4). Disability, bereavement, new medical illness, poor health status, female gender, prior depression, sleep disturbance, and poor self-perceived health were identified as risk factors for depression in at least two studies each. Risk factors identified by both univariate and multivariate techniques in at least two studies each were disability, female gender, new medical illness, poor health status, prior depression, sleep disturbance, poor self-perceived health, and bereavement.

**Quantitative.** Only 13 risk factors had data that could be used in the quantitative meta-analysis (Table 5 and Figure 1). The combined odds ratios ranged from 1.0 to 3.3. Greater heterogeneity was observed among studies evaluating lower education, disability, poor health status, cognitive impairment, prior depression, and new medical illness as risk factors for depression. On the basis of the combined odds ratios (and their 95% credible intervals) and the posterior distributions of the odds ratios (pooled odds ratio >1), the following were found to be significant risk factors for depression: bereavement, sleep disturbance, disability, prior depression, and female gender. Higher age, lower education level, being unmarried, and poor social support did not appear to be risk factors. Poor health, cognitive impairment, living alone, and new medical illness were uncertain risk factors.

Sleep Disturbance	Poor Self-Perceived Health	Loss Events	Vision or Hearing Impairment	Nonwhite Race or Ethnicity
		+		
		0		
0	+		+	+
	+			
0				0
+				
			0	
+				
4	2	2	2	2
2	2	1	1	1

## Discussion

The combined results of 20 prospective studies of risk factors for depression among elderly community subjects indicate that five factors (bereavement, sleep disturbance, disability, prior depression, and female gender) are significant risk factors for depression. The median interval between the determinations of risk factor status and depression status was 24 months.

Notably, three of these risk factors are potentially modifiable, namely, bereavement, sleep disturbance, and disability. Based on the pooled odds ratios data in this meta-analysis, the attributable risks for these three risk factors were 69.4% (95% credible interval=42.2–79.5), 57.0% (95% credible interval=35.7–73.3), and 56.5% (95% credible interval=20.4–83.5), respectively. Thus, a large proportion of depression among elderly people in the community may be attributed to one of these risk factors. Because these risk factors are frequent in elderly community subjects, their modification could be expected to have an important public health impact.

Elderly populations could be screened to identify individuals at high risk of depression (e.g., bereaved women with prior depression, disability, and sleep disturbance). Subsequently, these individuals could be targeted for interventions to abate the three potentially modifiable risk factors and reduce the risk of depression. Such interventions might include education about the significance of the risk factors, bereavement counseling and support (35),

new skills training, “maintenance of routines” protocols (36), enhancement of social supports (37), individual or group therapy to facilitate adjustment to loss of function (38), and sleep enhancement protocols (39).

These five risk factors may serve two other purposes (40). First, they could identify whole populations at high risk of depression and aid the development of population-based interventions to reduce the frequency of depression. Second, they could focus treatment on the most important putative contributing factors (e.g., bereavement, loss of function, sleep disturbance).

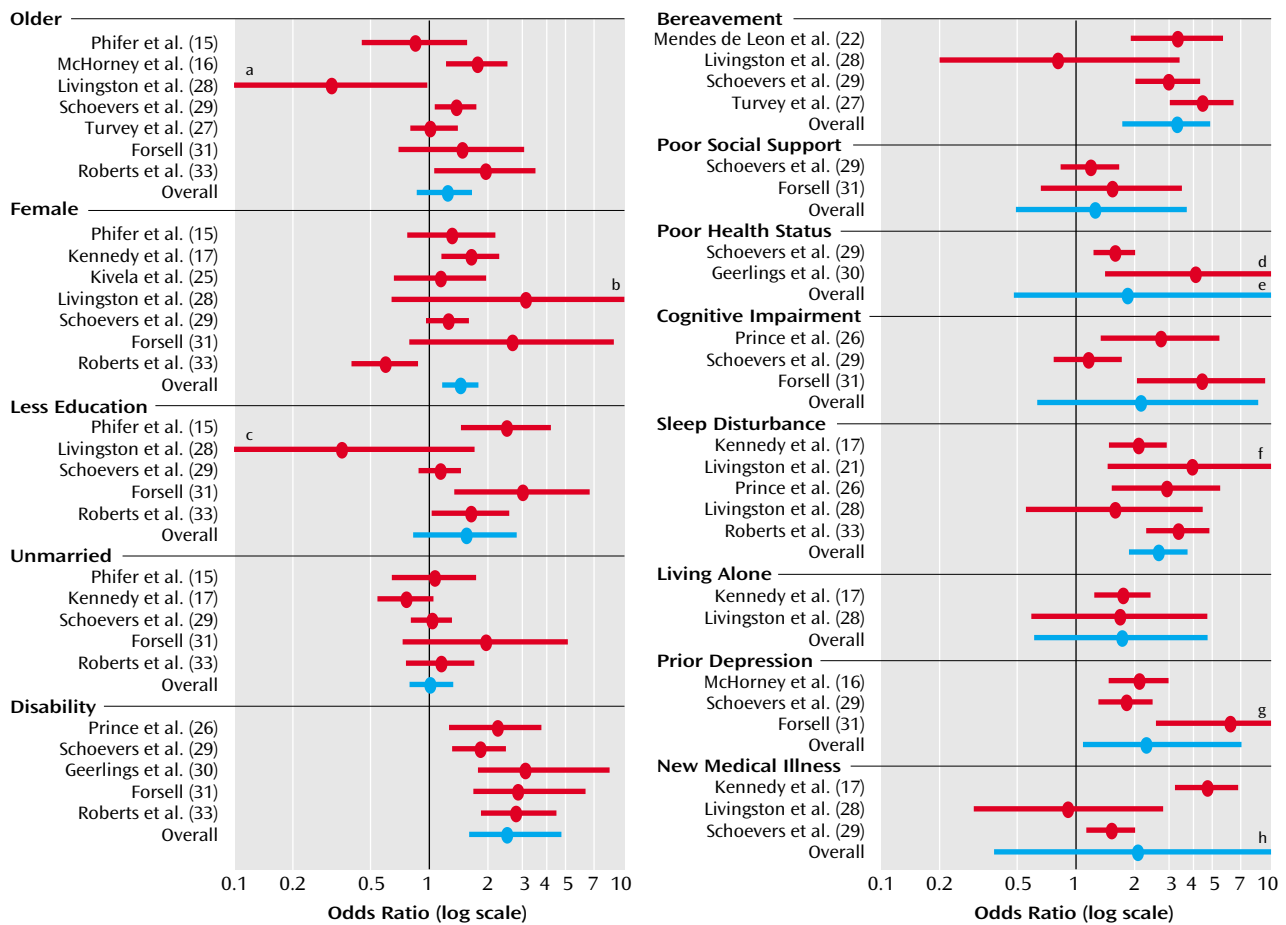
The finding that bereavement is an important risk factor for depression contradicts the results of the Epidemiologic Catchment Area (ECA) study (41), which indicated low rates of bereavement-related depression in the elderly. However, it has been argued that the ECA study probably failed to diagnose the low-level symptomatic forms of depression experienced by many elderly (42).

This review has 10 potential limitations. First, the search of the literature was conducted by one author only. Second, the search was limited to articles published in English or French. Third, we did not assess publication bias, although it is unlikely that this bias influences publication of risk factor studies. Fourth, the data were abstracted by one author only. Fifth, follow-up of the enrolled cohort was incomplete in most studies; however, the results of studies with and without complete follow-up were similar. Sixth, examination of depression status was complicated by differences in the length of follow-up; nonetheless, there were no consistent differences in reported risk factors by length of follow-up. Seventh, the examination of the results of the univariate and multivariate analyses was complicated by differences in the definitions of some risk factors from one study to the next, and the examination of the results of the multivariate analyses was complicated by adjustments for different variables in different studies. Eighth, we have identified with some confidence five factors that increase the risk of depression and four factors (higher age, lower education level, being unmarried, poor social support) that do not appear to increase the risk of depression; however, many potential risk factors have not been studied adequately. Ninth, in this meta-analysis, we could not determine whether the simultaneous presence of multiple risk factors results in a cumulative increase in the risk of depression; however, the results of four studies included in this meta-analysis (15, 18, 19, 29) suggest that different risk factors play both additive and interactive roles. Finally, there was heterogeneity in the results for some risk factors (i.e., lower education level, disability, poor health status, cognitive impairment, prior depression, new medical illness), perhaps related to different definitions of these variables in different studies and small study groups in some studies; consequently, the results of the meta-analysis for these risk factors must be interpreted cautiously.

TABLE 5. Results of Meta-Analysis of Prospective Studies of Risk Factors for Depression Among the Elderly

Risk Factor	Pooled Odds Ratio		Variance Between Studies		Probability of Pooled Odds Ratio >1 (%)
	Posterior Median	95% Credible Interval	Posterior Median	95% Credible Interval	
Older	1.2	0.9–1.7	0.05	<0.01–0.64	91
Female	1.4	1.2–1.8	0.01	<0.01–0.16	100
Less education	1.5	0.8–2.8	0.14	<0.01–2.20	95
Unmarried	1.0	0.8–1.3	0.01	<0.01–0.30	50
Disability	2.5	1.6–4.8	0.11	<0.01–1.49	100
Recent bereavement	3.3	1.7–4.9	0.03	<0.01–1.57	99
Lower social class	1.2	0.5–3.7	0.03	<0.01–5.87	80
Poor health status	1.8	0.5–12.8	0.14	0.01–10.71	91
Cognitive impairment	2.1	0.6–8.6	0.39	<0.01–8.20	93
Sleep disturbance	2.6	1.9–3.7	0.02	<0.01–0.52	100
Living alone	1.7	0.6–4.7	0.03	<0.01–6.16	92
Prior depression	2.3	1.1–7.1	0.11	<0.01–5.13	97
New medical illness	2.1	0.4–10.1	0.71	0.08–11.57	86

FIGURE 1. Individual and Combined Odds Ratios and 95% Credible Intervals in Prospective Studies of Risk Factors for Depression Among the Elderly



- a Credible interval extends to 0.09.
- b Credible interval extends to 14.9.
- c Credible interval extends to 0.07.
- d Credible interval extends to 11.7.
- e Credible interval extends to 12.8.
- f Credible interval extends to 10.5.
- g Credible interval extends to 14.5.
- h Credible interval extends to 10.1.

To conclude, five risk factors for depression among elderly community subjects include bereavement, sleep disturbance, disability, prior depression, and female gender.

Despite the methodologic limitations of the studies and this meta-analysis, these findings may guide efforts to develop programs to prevent depression in this population.



Received April 16, 2002; revisions received Oct. 8 and Nov. 25, 2002; accepted Dec. 2, 2002. From the Department of Psychiatry, St. Mary's Hospital and McGill University; the Department of Clinical Epidemiology and Community Studies, St. Mary's Hospital; and the Department of Epidemiology and Biostatistics, McGill University, Montreal. Address reprint requests to Dr. Cole, Department of Psychiatry, St. Mary's Hospital, 3830 Lacombe Ave., Montreal, Quebec H3T 1M5, Canada.

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