

Sleep Complaints and Depression in an Aging Cohort: A Prospective Perspective

Robert E. Roberts, Ph.D., Sarah J. Shema, M.S.,
George A. Kaplan, Ph.D., and William J. Strawbridge, Ph.D.

Objective: Most research on the association between sleep disturbances and depression has looked at cross-sectional data. The authors used two waves of data from a panel study of community residents aged 50 years or more to investigate this issue prospectively. **Method:** Data on symptoms of major depressive episodes and sleep problems were examined for a subgroup of the 1994 and 1995 surveys of the Alameda County (California) Study (N=2,370). The authors examined the effects of age, gender, education, marital status, social isolation, functional impairment, financial strain, and alcohol use. Depression was measured with 12 items that covered the DSM-IV diagnostic criteria for major depressive episodes, including insomnia and hypersomnia. **Results:** The prevalences were 23.1% for insomnia and 6.7% for hypersomnia in 1994. Sleep was a significant correlate of depression, as were being female, older age, social isolation, low education, financial strain, and functional impairment. When sleep problems and depression were examined prospectively, with controls for the effects of the other variables, sleep problems in 1994 predicted depression in 1995. However, other symptoms of major depressive episodes—anhedonia, feelings of worthlessness, psychomotor agitation/retardation, mood disturbance, thoughts of death—were much stronger predictors of future major depression. **Conclusions:** Sleep disturbance and other symptoms that are diagnostic for major depression are strongly associated with the risk of future depression. Sleep disturbance appears to be a less important predictor of depression. More epidemiologic research is needed on the relative contributions of the range of depressive symptoms to the risk of clinical depression.

(Am J Psychiatry 2000; 157:81–88)

What is the role of sleep disturbance in the onset of depression? From a clinical perspective, there clearly is a strong association between sleep problems and depression, so much so that disturbed sleep (insomnia and/or hypersomnia) has been included as one of the nine diagnostic criteria in DSM-III, DSM-III-R, and DSM-IV for major depressive episodes.

Evidence for the clinical importance of disturbed sleep is provided by numerous studies. For example,

Received June 1, 1998; revisions received Jan. 29 and July 6, 1999; accepted July 17, 1999. From the Health Science Center, School of Public Health, The University of Texas at Houston; the Public Health Institute, Berkeley, Calif.; the Department of Epidemiology, School of Public Health, University of Michigan, Ann Arbor; and the Human Population Laboratory, California Department of Health Services, Berkeley, Calif. Address reprint requests to Dr. Roberts, Health Science Center, The University of Texas at Houston, P.O. Box 20186, Houston, TX 77225; reroberts@utsph.sph.uth.tmc.edu (e-mail).

Supported in part by National Institute on Aging grant AG-11375 to Dr. Kaplan.

Benca and colleagues (1) identified 177 studies with data from 7,151 patients and comparison subjects. On the basis of the results of the meta-analysis of this body of research, Benca and colleagues reported that most psychiatric study groups showed reduced sleep efficiency and total sleep time. Overall, the findings for patients with affective disorders differed most frequently and significantly from those for comparison subjects. However, no single sleep variable appeared to have clear specificity for any particular psychiatric disorder, including depression.

From an epidemiologic perspective, there also is evidence for an association between sleep disturbance and depression. Much of this evidence comes from cross-sectional, or prevalence, studies (2–9).

Whereas prevalence studies provide evidence for the covariation of sleep disturbance and depression, they do not permit us to address the question of whether sleep disturbance is a precursor or a prodrome in the onset of depression. To answer that question, we need

prospective studies that examine the occurrence of future depression in those with and without sleep disturbances at baseline. This is critical, since it is generally assumed that the causal structure that produces morbidity is different before and after depression has occurred. In other words, factors that cause the disorder may be different from those that sustain or prolong it (10, 11). Fortunately, we also have data—albeit, not much—from longitudinal or prospective studies.

Ford and Kamerow (12) found that subjects with complaints of persistent insomnia were three times more likely to develop depression within a 1-year interval than those without persistent insomnia. Dryman and Eaton (13) found the emergence of four depressive symptoms over the course of a year to be associated with the onset of new episodes of depression. One of these symptoms was disturbed sleep. Breslau et al. (14) reported that the relative risk for the onset of major depression was four times greater for subjects with a lifetime history of 2 or more weeks of insomnia than for those without such complaints. Rodin et al. (15) found an association between depressed mood and self-reports of four sleep problems over a 3-year period. Early morning awakening was the sleep symptom that most consistently related to depressed mood over time. In the longest prospective study yet reported, Chang et al. (16) found the relative risk of clinical depression was double for men with reported insomnia at baseline. Livingston et al. (17) reported that the strongest predictor of future depression among those who were not depressed at baseline was sleep disturbance at baseline. Only two of these prospective studies (15, 17) examined sleep and depression by using data from study groups of older subjects. Thus, at this point, we have few data on the role of sleep disturbance as a precursor or prodrome (18) of depression that occurs later in life.

Our purpose in this report is to provide additional data on the role of sleep disturbance in the occurrence of depression among older persons. Specifically, we examine the risk of depression occurring among older individuals who had sleep disturbances but did not meet the symptom criteria for DSM major depression at baseline.

By using data from the 1994 and 1995 Alameda County (California) Study surveys, we estimated the prevalence of symptoms of DSM-IV major depressive episodes in the Alameda County cohort and examined associated risk factors—in particular, the effects of sleep complaints—on subjects age 50 years and older.

METHOD

Study Group

Data on symptoms of major depressive episodes and sleep problems were examined for the 1994 and 1995 surveys of the Alameda County Study cohort. Survivors were interviewed in 1974, 1983 (50% of the study group), and 1994 with response rates of 85%, 87%, and 93%, respectively. Detailed design and sampling proce-

dures for this study have been reported elsewhere (19, 20). Written informed consent was not required when the study was begun in 1965. Approval for all subsequent data collection has been obtained from the California State Committee for the Protection of Human Subjects.

The 1994 follow-up study group included 2,730 subjects aged 46–102 years who responded to the survey. In 1995, all those who completed a questionnaire in 1994 were recontacted. Of these 1994 respondents, 2,661 who were able to participate were located, and 2,570 completed a brief version of the 1994 questionnaire, which focused primarily on health and functional status. The analyses reported here are based on a subgroup (N=2,370) of respondents aged 50 years or older in 1994 for whom there were complete data on the measures of depression and sleep in 1994 and 1995 and on the measures of risk factors. The mean age was 64.9 years (range=50–95 years). There were 1,034 men in the subgroup (43.6%).

Measures

The measure of depression was a set of 12 items that operationalized the diagnostic symptom criteria for a major depressive episode that are outlined in DSM-IV. Designated the DSM-12D (for the 12-item scale for DSM depression), the items or symptom queries were adapted from the Primary Care Evaluation of Mental Disorders mood disorders section (21). The symptom queries were 1) feeling sad, blue, or depressed; 2) loss of interest or pleasure in most things; 3) feeling tired out or low on energy most of the time; 4) loss of appetite or weight loss; 5) overeating or weight gain; 6) trouble falling asleep or staying asleep; 7) sleeping too much; 8) more trouble than usual concentrating on things; 9) feeling down on yourself, no good, or worthless; 10) being so fidgety or restless that you move around a lot more than usual; 11) moving or speaking so slowly that other people notice; and 12) thinking about death more than usual—your own, someone else's, or death in general. The probe statement asks whether the respondent has felt that way nearly every day for the past 2 weeks (yes/no). The measure can be used to estimate the prevalence of major depressive episodes, or it can be used as a scale. The internal consistency of the latter was 0.80 in this study group. For our study, we labeled subjects as having major depression if they were study subjects in 1994 or 1995 and experienced five or more symptoms of depression, as specified by the DSM-IV criteria, at least one of which had to be depressed mood or anhedonia almost daily for the past 2 weeks. Operating characteristics of this measure in the Alameda County Study cohort have been reported previously (22, 23).

Sleep disturbances or complaints were measured with the two items from the DSM-12D on trouble falling asleep or staying asleep (insomnia) and sleeping too much (hypersomnia).

The risk factors (correlates) examined were age, gender, education, marital status, social isolation, financial strain, problems with daily activities, and the use of alcohol. These factors can be categorized as status attributes, psychosocial resources, and stressors (24, 25) and are widely considered to be important determinants of the risk for depression. Age was categorized as 50–59, 60–69, 70–79, and 80 years or older. Educational attainment was dichotomized as 12 years or less and more than 12 years. Marital status also was dichotomized as married or other (divorced, separated, widowed, or never married). Our measure of isolation consisted of six items: 1) how many friends can you confide in? 2) how many relatives do you feel close to? 3) how many friends and relatives do you see at least once a month? 4) how many friends and relatives can you turn to for help? 5) how many friends and relatives can you talk to about personal matters? and 6) how many friends and relatives do you have you can ask for advice or information? A score of less than 3 on each question was considered an indication of isolation. The total number of such responses was categorized as low (no responses indicating isolation), medium (one or two responses indicating isolation), or high (three or more responses indicating isolation) social isolation. Financial strain consisted of five items that recorded how many times there was not enough money to 1) buy clothes, 2) fill a prescription, 3) see a doctor, 4) pay rent or mortgage, and 5) buy food. Not having enough money for any item was classified as finan-

TABLE 1. Prevalence of Sleep Complaints by Age Group in the 1994 and 1995 Surveys From the Alameda County (California) Study

Year and Sleep Complaint	Total N	Age Group (years)								Analysis of Differences Across Age Groups (df=1)	
		50-59 (N=873)		60-69 (N=695)		70-79 (N=581)		≥80 (N=221)		χ^2	p
		N	%	N	%	N	%	N	%		
1994											
Hypersomnia	159	52	6.0	38	5.5	49	8.4	20	9.0	4.98	0.03
Insomnia	548	199	22.8	143	20.6	144	24.8	62	28.1	2.84	0.09
Any sleep complaint	675	238	27.3	175	25.2	184	31.7	78	35.3	7.41	0.007
1995											
Hypersomnia	170	61	7.0	38	5.5	57	9.8	14	6.3	1.13	0.29
Insomnia	604	197	22.6	165	23.7	163	28.1	79	35.7	16.63	0.001
Any sleep complaint	714	237	27.1	188	27.1	202	34.8	87	39.4	17.95	0.001

TABLE 2. Prevalence of Major Depressive Episodes in 1994 and 1995 Among Subjects With Sleep Complaints in 1994 in the Alameda County (California) Study (N=2,370)

Sleep Complaint in 1994	1994				1995			
	Depressed (N=206) ^a		Not Depressed (N=2,164)		Depressed (N=215) ^b		Not Depressed (N=2,155)	
	N	%	N	%	N	%	N	%
No sleep complaints (N=1,695)	44	2.6	1,651	97.4	80	4.7	1,615	95.3
Insomnia only (N=516)	102	19.8	414	80.2	92	17.8	424	82.2
Hypersomnia only (N=127)	37	29.1	90	70.9	25	19.7	102	80.3
Both insomnia and hypersomnia (N=32)	23	71.9	9	28.1	18	56.3	14	43.8

^a Significant difference in prevalence of depression across sleep problems ($\chi^2=386.95$, df=3, p=0.001).

^b Significant difference in prevalence of depression across sleep problems ($\chi^2=190.59$, df=3, p=0.001).

cial strain. We also asked respondents if they had difficulties with daily activities: 1) walking across a small room, 2) bathing, 3) brushing their hair or washing their faces, 4) eating, 5) dressing, 6) moving from a bed to a chair, and 7) using the toilet. Any difficulty on any item was classified as having a problem with daily activities. In every wave of the Alameda County Study, data were collected for estimation of the number of drinks consumed in a month by using questions on the quantity and frequency of alcohol consumed. We defined heavy drinking as more than 60 drinks of alcohol per month.

Statistical Methods

Point prevalences for hypersomnia, insomnia, any sleep problems, and depression status were calculated for the 10-year age categories for 1994 and 1995. Chi-square tests of trend were used to test the differences in the proportions of people with sleep complaints across the age groups. Chi-square tests also were used to test for differences in the proportions of subjects with sleep problems across depression status. Separate logistic regression models were used to estimate the odds ratios for depression in 1995 by different 1994 risk factors, after exclusion of people who were depressed in 1994. Crude and adjusted models were used to assess the association between sleep complaints in 1994 and 1995 and depression measured in 1995. Insomnia, hypersomnia, and any sleep problems were analyzed in separate models. The adjustment variables included in the adjusted model were age, gender, marital status, social isolation, education, financial problems, problems with daily activities, and heavy drinking.

Because sleep complaints are part of the diagnostic criteria for DSM-IV major depression, we created a new case definition for our subjects that excluded sleep from the symptom criteria. We also defined caseness as a total of four of the remaining eight diagnostic criteria, with at least one criterion being depressed mood or anhedonia. Logistic regression was used to assess the association between sleep complaints, measured in 1994 and 1995, and 1995 depression status, defined without sleep problems. Crude and adjusted models were run separately for insomnia, hypersomnia, and any sleep problems. Subjects who were depressed in 1994 were excluded from the analyses.

RESULTS

Table 1 presents data on the prevalence of sleep complaints in the Alameda County Study cohort in 1994 and in 1995. There was a statistically significant difference in the self-reported prevalences of insomnia and hypersomnia across age categories. A chi-square test for trends revealed an association between sleep problems and age for hypersomnia and for any sleep problem in 1994 and for insomnia and for any sleep problem in 1995. For example, the prevalence of any sleep problem in 1994 was 27.3% among subjects aged 50-59 years and 35.3% among those aged 80 years and older. In 1994, the overall prevalence of insomnia was 23.1%, and the overall prevalence of hypersomnia was 6.7%. The prevalence of any sleep complaint was 28.5%.

Table 2 presents data on the association between sleep problems and DSM-12D depression in 1994 and 1995. As shown, the relation was pronounced. In 1994, only 2.6% of those with no sleep complaints were classified as depressed, whereas 71.9% of those with both sleep complaints were depressed. Prospectively, the pattern was very similar. That is, 1994 sleep problems were significantly associated with depression in 1995.

The crude association of putative risk factors (including sleep disturbance) measured in 1994 to depression status in 1995 is presented in table 3. For these analyses, we eliminated from the cohort all subjects who met the DSM-IV diagnostic criteria for major depressive episodes at baseline in 1994. Significant correlates of depression were sleep complaints, female gen-

TABLE 3. Relation of 1994 Risk Factors to 1995 Major Depressive Episodes in the Alameda County (California) Study (N=2,164)^a

Risk Factor in 1994	Relation to Depression in 1995	
	Unadjusted Odds Ratio	95% CI
Insomnia		
No	1.00	
Yes	2.79	1.90-4.10
Hypersomnia		
No	1.00	
Yes	3.37	1.89-6.04
Any sleep complaint		
No	1.00	
Yes	3.32	2.29-4.83
Age (years)		
50-59	1.00	
60-69	1.05	0.65-1.69
70-79	1.31	0.81-2.13
80 or more	1.93	1.06-3.50
Gender		
Male	1.00	
Female	1.69	1.14-2.50
Marital status		
Married	1.00	
Divorced, separated, widowed, or never married	1.14	0.76-1.70
Social isolation		
None	1.00	
Moderate	1.83	1.13-2.95
High	2.78	1.74-4.43
Education (years)		
12 or greater	1.00	
<12	1.62	1.03-2.57
Financial problems		
None	1.00	
Any	2.00	1.30-3.08
Problems with daily activities		
None	1.00	
Any	3.09	1.88-5.06
Heavy drinking		
60 or fewer drinks per month	1.00	
>60 drinks per month	0.57	0.21-1.58

^a Excludes subjects who were depressed in 1994 (N=206).

der, older age, high level of social isolation, low education level, financial problems, and problems with daily activities. Alcohol use was not related to depression. A perusal of the crude odds ratios presented in table 3 indicates that the strongest correlates of depression were problems with daily activities and sleep complaints.

We then examined the association of sleep complaints in 1994 and 1995 to the risk of depression in 1995. As was done previously, subjects with sleep problems in 1994 who did not meet the diagnostic criteria for major depressive episodes were used to examine the risk for depression in 1995. As shown in table 4, the strongest risk factor for depression in 1995 was a sleep complaint in 1995, as expected. However, a sleep complaint in both 1994 and 1995, which suggests chronic sleep difficulties, substantially increased the relative risk of depression in 1995. Sleep complaints only in 1994 increased the relative risk of depression much less, and for insomnia, the increase was not statistically significant. These associations held for

TABLE 4. Relation of Sleep Complaints in 1994 and 1995 to Major Depressive Episodes in 1995 in the Alameda County (California) Study (N=2,164)^a

Sleep Complaint and Year	Relation to Depression in 1995			
	Unadjusted Odds		Adjusted Odds ^b	
	Odds Ratio	95% CI	Odds Ratio	95% CI
Insomnia				
Neither year	1.00		1.00	
1994 only	1.80	0.74-4.38	1.66	0.67-4.09
1995 only	10.89	6.67-17.77	10.29	6.23-16.99
1994 and 1995	9.23	5.63-15.13	8.08	4.88-13.39
Hypersomnia				
Neither year	1.00		1.00	
1994 only	3.61	1.66-7.85	2.46	1.09-5.54
1995 only	9.00	5.30-15.28	9.45	5.42-16.48
1994 and 1995	5.13	2.20-11.98	3.46	1.43-8.38
Any sleep complaint				
Neither year	1.00		1.00	
1994 only	3.23	1.30-8.02	2.85	1.14-7.13
1995 only	19.20	10.54-34.98	18.22	9.93-33.41
1994 and 1995	18.14	0.05-32.75	14.80	8.12-26.96

^a Excludes subjects who were depressed in 1994 (N=206).

^b Adjusted for age, gender, marital status, social isolation, education, financial problems, problems with daily activities, and heavy drinking.

TABLE 5. Relation of Sleep Complaints in 1994 and 1995 to Major Depressive Episodes in 1995, With Sleep Excluded From Diagnostic Criteria, in the Alameda County (California) Study (N=2,164)^a

Sleep Complaint and Year	Relation to Depression in 1995			
	Unadjusted Odds		Adjusted Odds ^b	
	Odds Ratio	95% CI	Odds Ratio	95% CI
Insomnia				
Neither year	1.00		1.00	
1994 only	1.47	0.68-3.15	1.40	0.64-3.03
1995 only	6.58	4.25-10.17	6.18	3.95-9.67
1994 and 1995	5.57	3.58-8.67	4.85	3.09-7.61
Hypersomnia				
Neither year	1.00		1.00	
1994 only	3.76	1.85-7.64	2.69	1.29-5.61
1995 only	7.21	4.28-12.14	7.15	4.17-12.29
1994 and 1995	4.12	1.77-9.55	2.88	1.21-6.89
Any sleep complaint				
Neither	1.00		1.00	
1994 only	2.40	1.19-4.83	2.16	1.06-4.39
1995 only	8.88	5.53-14.26	8.33	5.16-13.47
1994 and 1995	8.39	5.29-13.31	6.84	4.27-10.97

^a Excludes subjects who were depressed in 1994 (N=206).

^b Adjusted for age, gender, marital status, social isolation, education, financial problems, problems with daily activities, and heavy drinking.

univariate associations and in multivariate analyses that controlled for the other risk factors presented in table 3.

As shown in table 5, eliminating the symptoms of disturbed sleep from the diagnostic criteria for major depression did not alter the association observed in table 4, with one exception. The odds ratios declined in value, substantially so in the case of any sleep problem in 1995 only or in 1994 and 1995. But the same pattern was observed in table 4 and table 5—a sleep

TABLE 6. Relation of Individual Depressive Symptoms in 1994 to Major Depressive Episodes in 1995 in the Alameda County (California) Study (N=2,164)^a

Symptom in 1994	Relation to Depression in 1995	
	Odds Ratio	95% CI
Loss of interest or pleasure in most things	7.85	3.87–15.89
Feeling down on yourself, no good, or worthless	5.30	2.63–10.68
Being so fidgety or restless that you moved around a lot more than usual, or moving or speaking so slowly that other people could have noticed	5.20	3.01–8.96
Feeling tired out or low on energy most of the time	3.93	2.62–5.89
Feeling sad, blue, or depressed	3.68	2.29–5.90
Thinking about death more than usual—your own or someone else's, or death in general	3.66	2.35–5.69
Trouble falling asleep or staying asleep, or sleeping too much	2.76	1.88–4.06
Trouble falling asleep or staying asleep	2.49	1.67–3.69
Sleeping too much	2.26	1.22–4.19
More trouble than usual concentrating	2.38	1.36–4.20
Loss of appetite or weight loss, or overeating or gaining weight	1.96	1.29–2.99

^a Excludes subjects who were depressed in 1994 (N=206). All models were adjusted for age, gender, marital status, social isolation, education, financial problems, problems with daily activities, and heavy drinking in 1994.

problem in both 1994 and 1995 was a stronger predictor than a sleep problem only in 1994, and a sleep problem only in 1995 also was a strong predictor of 1995 depression. In table 5, even with sleep removed from the diagnostic criteria for major depressive episodes, current sleep problems were a strong predictor of a current major depressive episode.

At one level, our analyses could be construed as testing whether sleep in 1994 predicts conversion from not meeting the DSM criteria for major depressive episodes in 1994 to doing so in 1995. One way to address this issue would be to construct a measure of subthreshold depression and to examine the risk of subthreshold depression in 1995 among those with and without a sleep disturbance at baseline in 1994. We attempted such an analytic strategy, but after we defined depression as a mood disturbance and/or anhedonia plus three other criteria (excluding sleep), there were insufficient numbers of subthreshold cases to sustain multivariate analyses prospectively. Thus, we were not able to explore this issue and cannot rule out this possibility. Still, we believe our results make it reasonably clear that sleep disturbance has implications for the development of DSM-IV episodes of major depression.

However, we then posed a different question. Given that sleep disturbance is a significant predictor of the risk of future episodes of depression, what is the importance of sleep relative to the other diagnostic criteria? These results are presented in table 6. When we analyzed the data for this question, it became clear that the symptoms of disturbed sleep, while a significant predictor of future episodes of major depression, are not among the most important criteria. When they are arrayed in descending order according to the magnitude of their odds ratios, the symptoms of disturbed sleep rank near the bottom in predicting future depressive episodes. For this older study group, anhedonia, feelings of worthlessness, psychomotor agitation/retardation, mood disturbance, and thoughts of death are more strongly associated with future episodes of depression than are symptoms of sleep disturbance. We also examined the effect on 1995 depression status of

symptoms of disturbed sleep only in 1994, only in 1995, and in both 1994 and 1995. The same general pattern observed in table 6 was observed (data not shown). That is, the symptoms of disturbed sleep ranked well behind mood disturbance, anhedonia, fatigue, worthlessness, psychomotor agitation, and thoughts of death in terms of the relative risk for 1995 depression.

DISCUSSION

To summarize, our analyses of the Alameda County Study cohort data from the 1994 and 1995 surveys indicate that sleep complaints increase the subsequent risk of depression. In 1994, those with any sleep complaint had a 2.85 relative risk of being depressed in 1995. Those with hypersomnia in 1994 had a 2.46 relative risk of depression in 1995. The increase in relative risk for those with insomnia in 1994 was 1.66, but this was not statistically significant (table 4).

The Alameda County Study data also demonstrate the possible role of chronic sleep problems in the relative risk for depression. Among those with insomnia in both 1994 and 1995, the relative risk for depression in 1995 was 8.08. For those with hypersomnia in 1994 and 1995, the relative risk for depression was 3.46. For those with any sleep complaint in both 1994 and 1995, the relative risk for depression in 1995 was 14.80 (table 4). Some of this increased relative risk is, of course, probably the result of the presence of depression in 1995. The data in table 5 indicate that, even with the symptoms of disturbed sleep removed from the diagnostic algorithm for major depressive episodes, sleep in 1995 was still the strongest predictor of depression in 1995, relative to the other putative risk factors, although the magnitude of the odds ratios was substantially reduced from table 4 to table 5.

Our results add to the growing literature on the role of sleep disturbance in the risk of developing depression. Several studies that did not focus on older study groups have found an increased risk of depression at

follow-up among those with sleep problems at baseline (12, 14, 16, 26, 27). In several of these, the odds ratios for depression were three to four times greater for those with sleep problems at baseline. Evidence from the two prospective studies involving older study groups also corroborate our results (15, 17). On the other hand, there is some negative evidence (28).

In addition to these community-based, epidemiologic studies, there is evidence that sleep disturbance also affects the clinical course of depression. Perlis et al. (29), using data from a group of 14 formerly depressed patients aged 27–49 years, found that patients who had subsequent greater levels of sleep disturbance several weeks before an episode of major depression were at an increased risk for such episodes. They suggested that sleep complaints may precede the series of symptoms that constitute the syndrome of major depression.

However, our analyses also provide a cautionary note. When we examined the role of disturbed sleep in the risk for future episodes of depression, compared to the role of the other symptoms of depression, our results suggested that disturbed sleep is less important. Data from this cohort of older subjects indicate that symptoms such as anhedonia, feelings of worthlessness, psychomotor agitation/retardation, mood disturbance, and thoughts of death are much stronger predictors of future major depressive episodes.

Ford and Kamerow (12) did not examine the risk imposed by the symptoms of disturbed sleep relative to the other diagnostic criteria for depression. However, Dryman and Eaton (13) did such an analysis. The subjects in the Epidemiologic Catchment Area (ECA) study group were age 18 years or older, and the results were presented separately for men and women. For the latter group, disturbed sleep ranked third in predicting future major depressive episodes behind trouble concentrating and feelings of worthlessness or guilt. For men, sleep disturbance was the least predictive for the risk of future episodes of major depression. Indeed, sleep was not a statistically significant predictor of subsequent episodes of major depression. The most robust risk factors for subsequent depression among men were the same for women—trouble concentrating and feelings of worthlessness or guilt. Dysphoric mood was not included, since all patients had to meet this criterion. Thus, our results corroborate the results for men reported by Dryman and Eaton (13) but not their results for women. These differences may be due to the differences in study group composition or measures of depression. Dryman and Eaton used the NIMH Diagnostic Interview Schedule and the DSM-III criteria; we used a symptom checklist and the DSM-IV symptom criteria.

Our results also clearly indicate that increasing age is associated with an increased prevalence of sleep problems (table 1). Insomnia, hypersomnia, and any sleep problems increased from age 50–59 years to age 80 years and older. The prevalences were between 20% and 40% for insomnia and any sleep problem. Preva-

lences were much lower for hypersomnia. The association was not uniformly monotonic. In fact, there appears to be a clear threshold effect, with those age 70 and older reporting higher prevalences of sleep problems in both 1994 and 1995 than those younger than age 70 years. How do our rates compare to those from other studies? Morgan (30) reviewed the results of six studies that presented data on older adult populations (most were age 65 years or older). He concluded that between 20% and 40% of elderly people living at home experience disturbed or poor-quality sleep, ranging from moderate to severe. Since that review, other articles on the prevalence of sleep disturbance in community groups of older persons have appeared. In a number of these (3, 5, 8, 17, 31), the prevalences fell between 20% and 45%. Our prevalences of any sleep problem (28.5%) and insomnia (23.1%) are at the lower end of this range, but they are within the range nonetheless. Most previous studies did not focus on hypersomnia.

Some studies have shown lower prevalences of disturbed sleep—some substantially lower (4, 6, 7, 12, 32). Such differences are essentially indicative of the impact of case definition on subsequent prevalence rates.

Like all field studies, the Alameda County Study imposes certain limitations on the analysis and interpretation of the data. First and foremost, our measure of disturbed sleep was not comprehensive. While we were able to examine both hypersomnia and insomnia, we were not able to examine different dimensions of the latter. For example, we did not have separate data on difficulty initiating and difficulty maintaining sleep and on early morning awakening. The latter has been implicated in the risk of depression in adult study groups (14, 15).

As noted earlier, our sleep items assessed whether subjects had experienced disturbed sleep (insomnia or hypersomnia) almost every day in the past 2 weeks. The items were a subset of the DSM-IV diagnostic criteria for a major depressive episode. Thus, our results were limited in that we were not able to partition our study group into those with acute sleep problems and those with chronic sleep problems. In their epidemiologic study from the United Kingdom, Ohayon et al. (32) found that the median duration of the symptoms of insomnia was 24 months. We could not examine whether the risk factor profiles differed for those with sleep disturbances of shorter and longer duration, although it might be expected that the role of comorbid somatic and psychiatric problems would be more pronounced for chronic sleep problems (33). We also should note that since our measure of disturbed sleep was part of our measure of depression (as per DSM-IV), we analyzed our data on the association of sleep with and without the sleep symptoms in our definition of depression. The fact that sleep still predicted depression provides a more convincing case for this association. Even so, future research should focus on acute and chronic sleep disturbances and their impact on the subsequent risk for depression.

Comorbid psychiatric disorders—in particular, anxiety and drug and alcohol abuse disorders—might confound the observed association between the symptoms of disturbed sleep and depression. For example, Ford and Kamerow (12) found that subjects in the ECA study with disturbed sleep at baseline were at an increased risk of subsequent episodes of major depression, anxiety disorders, alcohol abuse, and any psychiatric disorder. The Alameda County Study was an omnibus health survey and, as such, did not include diagnostic data on anxiety or substance abuse disorders. However, we did include a measure of the quantity and frequency of alcohol consumption. This measure contributed little to the observed association between sleep and depression. Clearly, comorbidity is an area for future exploration.

Another obvious limitation is that we did not have objective data on disturbed sleep. That is, we did not have physiological measures of sleep generated by procedures such as EEGs. Whereas such measures are desirable, to date they have not been regularly incorporated into community-based, epidemiologic studies. Thus, whereas such data would be useful to have, self-reports and interview-based measures remain the measures most widely used in community surveys. Our study was no exception.

To summarize, we believe that the available evidence is reasonably clear on three points. First, sleep disturbance exhibits strong patterns of co-occurrence with other defining symptoms of major depression. Second, sleep disturbance, particularly of a chronic nature, is associated with the risk of subsequent depression. In fact, several studies (18, 29) suggest that sleep disturbance may occur before and presage development of the full clinical syndrome of depression. Third, whereas the symptoms of disturbed sleep may constitute precursor or prodromal symptoms in the development of clinical depression (29), the etiologic role of sleep vis-à-vis the other symptoms of depression remains poorly understood. Our data suggest that disturbed sleep may not be as important as the other diagnostic criteria in predicting who might be at risk of future episodes of depression.

We suggest that more effort needs to be directed at understanding the timing and sequence of precursor or prodromal symptoms in the development of clinical syndromes. From an etiologic perspective, one unresolved question is the natural history of symptoms that constitute the diagnostic criteria for depression. That is, what is the risk for future episodes of depression that is attributable to the various diagnostic criteria—in this case, the symptoms of disturbed sleep? If strong precursors (i.e., those with a high attributable risk) can be identified, then we have potential targets for preventive interventions (18). When we realize that the prodromal period may be quite long (perhaps 8–10 years in the case of major depression [18]), preventive intervention strategies directed at strong precursors may have time to lower the risk of developing the full clinical syndrome. In this case, what may be more use-

ful from a prevention perspective is knowledge about the risk factors that affect precursor symptoms such as disturbed sleep rather than clinical syndromes per se.

REFERENCES

1. Benca RM, Obermeyer WH, Thisted RA, Gillin JC: Sleep and psychiatric disorders: a meta-analysis. *Arch Gen Psychiatry* 1992; 49:651–668
2. Husby R, Lingjaerde O: Prevalence of reported sleeplessness in northern Norway in relation to sex, age and season. *Acta Psychiatr Scand* 1990; 81:542–547
3. Habte-Gabr E, Wallace RB, Colsher PL, Hulbert JR, White LR, Smith IM: Sleep patterns in rural elders: demographic, health, and psychobehavioral correlates. *J Clin Epidemiol* 1991; 44:5–13
4. Bliwise DL, King AC, Harris RB, Haskell WL: Prevalence of self-reported poor sleep in a healthy population aged 50–65. *Soc Sci Med* 1992; 34:49–55
5. Gislason T, Reynisdottir H, Kristbjarnarson H, Benediksdottir B: Sleep habits and sleep disturbances among the elderly—an epidemiological survey. *J Intern Med* 1993; 234:31–39
6. Blazer DG, Hays JC, Foley DJ: Sleep complaints in older adults: a racial comparison. *J Gerontol* 1995; 50A:M280–M284
7. Henderson S, Jorm AF, Scott LR, Mackinnon AJ, Christensen H, Korten AE: Insomnia in the elderly: its prevalence and correlates in the general population. *Med J Aust* 1995; 162:22–24
8. Foley DJ, Monjan AA, Brown SL, Simonsick EM, Wallace RB, Blazer DG: Sleep complaints among elderly persons: an epidemiologic study of three communities. *Sleep* 1995; 18:425–432
9. Janson C, Gislason T, DeBacker W, Plaschke P, Bjornsson E, Hetta J, Kristbjarnarson H, Vermeire P, Boman G: Prevalence of sleep disturbances among young adults in three European countries. *Sleep* 1995; 18:589–597
10. Roberts RE: Special population issues in screening for depression, in *Depression in Primary Care: Screening and Detection*. Edited by Attkisson CC, Zich JM. New York, Routledge, 1990, pp 183–216
11. Eaton WW: Studying the natural history of psychopathology, in *Textbook in Psychiatric Epidemiology*. Edited by Tsuang MT, Tohen M, Zahner GEP. New York, Wiley-Liss, 1995, pp 157–177
12. Ford DE, Kamerow DB: Epidemiologic study of sleep disturbances and psychiatric disorders: an opportunity for prevention? *JAMA* 1989; 262:1479–1484
13. Dryman A, Eaton WW: Affective symptoms associated with the onset of major depression in the community: findings from the US National Institute of Mental Health Epidemiologic Catchment Area program. *Acta Psychiatr Scand* 1991; 84:1–5
14. Breslau N, Roth T, Rosenthal L, Andreski P: Sleep disturbance and psychiatric disorders: a longitudinal epidemiological study of young adults. *Biol Psychiatry* 1996; 39:411–418
15. Rodin J, McAvay G, Timko C: A longitudinal study of depressed mood and sleep disturbances in elderly adults. *J Gerontol* 1988; 43:45–53
16. Chang PP, Ford DE, Mead LA, Cooper-Patrick L, Klag MJ: Insomnia in young men and subsequent depression. *Am J Epidemiol* 1997; 146:105–114
17. Livingston G, Blizard B, Mann A: Does sleep disturbance predict depression in elderly people? a study in inner London. *Br J Gen Pract* 1993; 43:445–448
18. Eaton WW, Badawi M, Melton B: Prodromes and precursors: epidemiologic data for primary prevention of disorders with slow onset. *Am J Psychiatry* 1995; 152:967–972
19. Berkman LF, Breslow L: *Health and Ways of Living: The Alameda County Study*. New York, Oxford University Press, 1983
20. Hochstim JR: Health and ways of living—the Alameda County, California, population laboratory, in *The Community*

SLEEP AND DEPRESSION

- as an Epidemiologic Laboratory. Edited by Kessler II, Levin ML. Baltimore, Johns Hopkins University Press, 1970, pp 149-176
21. Spitzer RL, Williams JBW, Kroenke K, Linzer M: Utility of a new procedure for diagnosing mental disorders in primary care: the PRIME-MD 1000 Study. *JAMA* 1994; 272:1749-1756
 22. Roberts RE, Kaplan G, Shema S, Strawbridge W: Prevalence and correlates of depression in an aging cohort. *J Gerontol* 1997; 52B:5252-5258
 23. Roberts RE, Kaplan GA, Shema SJ, Strawbridge WJ: Does growing old increase the risk for depression? *Am J Psychiatry* 1997; 154:1384-1390
 24. Roberts RE: Epidemiological issues in measuring preventive effects, in *Depression Prevention: Research Directions*. Edited by Munoz RF. Washington, DC, Hemisphere, 1987, pp 45-75
 25. Kaplan GA, Roberts RE, Camacho TC, Coyne JC: Psychosocial predictors of depression: prospective evidence from the human population laboratory studies. *Am J Epidemiol* 1987; 125:206-220
 26. Knitzer J, Steinberg Z, Fleisch B: Schools, children's mental health, and the advocacy challenge. *J Clin Child Psychol* 1991; 20:102-111
 27. Matsuura M, Okubo Y, Kojima T, Takahashi R, Wang YF, Shen YC, Lee CK: A cross-national prevalence study of children with emotional and behavioural problems—a WHO collaborative study in the Western Pacific Region. *J Child Psychol Psychiatry* 1993; 34:307-315
 28. Vollrath M, Wicki W, Angst J: The Zurich Study, VIII: insomnia: association with depression, anxiety, somatic syndromes, and course of insomnia. *Eur Arch Psychiatry Neurol Sci* 1989; 239:113-124
 29. Perlis ML, Giles DE, Buysse DJ, Tu X, Kupfer DJ: Self-reported sleep disturbance as a prodromal symptom in recurrent depression. *J Affect Disord* 1997; 42:209-212
 30. Morgan K: Sleep, insomnia and mental health. *Rev Clin Gerontol* 1992; 2:246-253
 31. Ganguli M, Reynolds CF, Gilby JE: Prevalence and persistence of sleep complaints in a rural older community sample: the Movies Project. *J Am Geriatr Soc* 1996; 44:778-784
 32. Ohayon MM, Caulet M, Priest RG, Guilleminault C: DSM-IV and ICD-90 insomnia symptoms and sleep dissatisfaction. *Br J Psychiatry* 1997; 171:382-388
 33. Kripke DF, Ancoli-Israel S, Mason W, Messin S: Sleep related mortality and morbidity in the aged, in *Sleep Disorders: Basic and Clinical Research*. Edited by Chase M, Weitzman E. New York, SP Medical and Scientific Books, 1983, pp 415-429