

Correlates of Beck Depression Inventory Scores in an Ambulatory Elderly Population: Symptoms, Diseases, Laboratory Values, and Medications

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Background. Depression is one of the most important psychiatric disorders of older people. Between 1% and 5% of elderly persons who live in the community have major depression. Depressed elderly people are thought to be more likely to complain of symptoms such as headache, constipation, and pain than of disordered mood. The purpose of this study was to determine whether certain symptoms, diseases, or drugs used by older people correlate with scores on the Beck Depression Inventory.

Methods. Beck Depression Inventory scores were obtained in an ambulatory elderly population to identify correlates with self-reported signs, symptoms, diseases, drugs, and laboratory values. A total of 1048 participants were studied, including 712 women and 336 men.

Results. In this study, 13.7% of the men and 20.7% of the women had scores suggesting possible depression. A linear regression model revealed eight factors of significance in predicting scores on the Beck Depression Inventory. The most important predictors were the total number of symptoms reported by the patient ($P < .0001$), and subjective complaints of memory loss ($P < .0003$) and of pain in the abdomen ($P < .0004$).

Conclusions. Clinically, the results of this study suggest that depression is underdiagnosed in older patients and that multiple somatic symptoms are the best indicator of depression in this population.

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Depression is one of the most important psychiatric disorders of older people, although it has been reported to be less prevalent in this age group than in younger groups.^{1,2} Between 1% and 5% of elderly persons who live in the community have major depression; the prevalence of depression is much greater among elderly persons in institutions.^{1,3} In long-term and acute care facilities, from 10% to 20% of elderly people have major depression.⁴

Early information concerning the prevalence of clinical depression in older individuals was limited to results of research from patient-based studies.^{5,6} These early studies found that the highest rates of major depression occurred in persons of middle age, with lower rates

found in the elderly. In a community-based sample, Warheit et al⁷ found that 18.5% of subjects 19 years of age or younger had clinically significant symptomatology, compared with 28.3% of the community aged 70 years or older.

In the United States, recent community surveys have attempted to correct deficiencies of earlier studies by employing the depression criteria set forth by the American Psychiatric Association in *Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised* (DSM-III-R).⁸ The studies in the Epidemiologic Catchment Area Program in collaboration with the staff of the National Institute of Mental Health moved beyond samples of convenience and persons presenting for treatment, and described the extent and nature of psychiatric disorders in well-defined communities.^{2,9-10} The 6-month prevalence of major depressive episodes in men over 65 years of age ranged from a low of 0.1% in St Louis to a high of 0.5% in New Haven; for women the range was from 1.0% in St Louis to 1.6% in New

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Haven.¹⁰ In a community-based study in the Piedmont area of North Carolina, Blazer et al² found the prevalence of major depressive episodes over a 6-month period among persons 65 years of age and older to be 0.69%.

Studies of community populations have demonstrated that the symptomatic presentation of depression in later life is similar to that in younger ages. Those symptoms include depressed mood, anhedonia and apathy, weight loss, insomnia, psychomotor agitation and retardation, fatigue, feelings of worthlessness or inappropriate guilt, difficulty concentrating or memory loss, and thoughts of death or suicide.¹ Other clinicians have maintained that elderly persons are more likely to mask their depression than individuals at earlier stages in their lives. They believe that the elderly are more likely to complain of symptoms such as headache, constipation, or pain than of disordered mood.^{2,11-14} Drugs such as propranolol, corticosteroids, and reserpine, which are commonly used by older people, have been associated with depression.¹⁵⁻¹⁷

If certain symptoms or symptom complexes are more prevalent in depressed elderly people, then clinicians can use this information to identify patients at high risk. We have used information collected from participants in the Florida Geriatric Research Program to test the hypothesis that certain symptoms, diseases, and drugs used by older people correlate with scores on the Beck Depression Inventory.

Methods

Information used for this study was collected from participants in the Florida Geriatric Research Program (FGRP) (formerly the Dunedin Program), which was begun in 1975 to screen elderly subjects on an annual basis for undetected medical disorders. Methods used in data collection, storage, and analysis have been described in detail elsewhere.^{18,19}

When the FGRP began in 1975, the city of Dunedin had a population of 23,288 residents; 6826 were older than 65 years of age. Over 4300 subjects enrolled in the program (64% of those eligible) but only about 3000 could be screened the first year because of space and personnel limitations. Enrolled subjects returned on a yearly basis, and new subjects were entered as dropouts occurred. Dunedin represents a stable population of study participants. Over a 7-year period, 2500 (83%) of the original study group who were enrolled in the first year were still participating. Follow-up studies of dropouts showed that about one half had died, one fourth had moved from the area, and the remainder had missed

appointments because of illness, transportation problems, or other reasons.

Participants in the program were scheduled for annual screening by telephone or personal visit about 12 months before their appointments because of great demand and interest in the clinic. As a part of the evaluation, subjects completed a detailed health questionnaire containing approximately 180 questions and a form for listing both prescribed and nonprescribed medications used on a regular basis. A hemogram, red cell indices, and a SMAC-23 biochemical profile were obtained in addition to a brief clinical assessment that included an electrocardiogram. Since July 1987, all subjects seen have also completed the Beck Depression Inventory (BDI) and the Mini-Mental State Examination.^{20,21}

The BDI is a 21-item multiple-choice inventory of depressive symptoms that has frequently been used as a measure of depression in elderly persons. Reliability and validity studies have suggested that the psychometric properties of the BDI for elderly population samples are reasonably good.^{22,23} It has been used to accurately screen depressed medically ill geriatric outpatients. Norris and co-workers¹⁴ compared BDI scores with the current DSM-III-R diagnosis of depression. When using a cutoff score of 10, the BDI correctly identified 84% of the cases, with a sensitivity of 0.89 and a specificity of 0.82. When employing a cutoff score of 17, the BDI correctly identified 84% of subjects, with a sensitivity of 0.50 and a specificity of 0.92. Gallagher²⁴ has reviewed the development and utility of the BDI in older adults.

Statistical Analysis

Information on approximately 30 to 40 diseases and 30 to 40 symptoms was obtained from the questionnaire to study their relationship with BDI scores. Additionally, laboratory values and the 26 most frequently used medications were used in a model to identify their relationship with BDI scores. A stepwise linear regression procedure was performed individually on symptoms, diseases, drugs, and laboratory values. Factors found to be significantly correlated with BDI scores in the stepwise procedures done on the individual factor groups were then subjected to a second stepwise regression procedure to identify those factors most highly correlated with BDI scores in the presence of factors from other groups. Factors identified as significant from the second stepwise procedure were then used to develop a linear regression model to examine the association of significant factors with BDI scores. Unless otherwise stated, all models are adjusted for the covariates age and sex. All statistical procedures were performed using the Statistical Analysis System (SAS).²⁵

Table 1. Frequency of Beck Depression Inventory Scores by Sex

| BDI Score | Number of Women | Number of Men | Total |
|-----------|-----------------|---------------|-------|
| 0 | 50 | 28 | 78 |
| 1 | 53 | 27 | 80 |
| 2 | 45 | 31 | 76 |
| 3 | 65 | 36 | 101 |
| 4 | 72 | 42 | 114 |
| 5 | 57 | 33 | 90 |
| 6 | 63 | 35 | 98 |
| 7 | 51 | 21 | 72 |
| 8 | 45 | 15 | 60 |
| 9 | 32 | 16 | 48 |
| 10 | 32 | 6 | 38 |
| 11 | 25 | 12 | 37 |
| 12 | 22 | 7 | 29 |
| 13 | 14 | 5 | 19 |
| 14 | 21 | 6 | 27 |
| 15 | 11 | 6 | 17 |
| 16 | 6 | 2 | 8 |
| 17 | 10 | 1 | 11 |
| 18 | 6 | 1 | 7 |
| 19 | 5 | 1 | 6 |
| 20 | 5 | 1 | 6 |
| 21 | 3 | 3 | 6 |
| 22 | 4 | 0 | 4 |
| 23 | 2 | 0 | 2 |
| 24 | 5 | 0 | 5 |
| >24 | 8 | 1 | 9 |
| Total | 712 | 336 | 1048 |

Results

Beck Depression Inventory scores were obtained on 712 (67.9%) women and 336 (32.1%) men during the period from July 1987 through August 1988. The average age of the women was 80.0 years, and the average age of the men was 80.9 years.

The mean BDI score for women was 6.9 (SE 0.21); for men, it was 5.6 (SE 0.24) ($P < .0001$). Forty-six (13.7%) men and 147 (20.6%) women scored above 10 on the BDI. The distribution of depression scores for this population is shown in Table 1.

Stepwise Multiple Regression Analysis

Signs and symptoms associated with the BDI. All reported symptoms in Table 2 were studied to determine whether specific complaints were associated with BDI scores. Significant factors that were positively correlated with BDI scores, as identified by the stepwise regression per-

Table 2. Signs and Symptoms Correlated with Beck Depression Inventory Scores as Identified by Stepwise Analysis Regression

| Signs and Symptoms | P Value |
|-----------------------------------|---------|
| Feel awkward | .0001 |
| Frequent abdominal pain | .0001 |
| Shortness of breath | .0001 |
| Change in voice | .0001 |
| Loss of vision | .0001 |
| Memory loss | .0002 |
| Swallowing problems | .0032 |
| Sensation of fainting or floating | .0077 |
| Constipation | .0257 |
| Incontinent of urine | .0392 |

Signs and symptoms not correlated: frequent headaches, dizziness, syncope, tinnitus, numbness in arms or legs, aches, pains in joints, diarrhea, exertional angina, swollen feet or ankles, recurrent cough, hematochezia, chest discomfort with tension and anxiety, paroxysmal nocturnal dyspnea, feet/legs cold, pain in hands, feet, or legs on exposure to cold, temporary loss of use of limbs, aphasia, hemoptysis, palpitation, nocturia, claudication, dysuria.

formed on symptoms only, are listed in Table 2. Ten symptoms involving several different organ systems were identified from this procedure. These symptoms were positively associated with BDI scores. Participants who complained of these symptoms had higher scores on the BDI.

Diseases. Diseases reported by FGRP participants were examined to determine whether they correlated with scores on the BDI. The stepwise regression performed on diseases revealed that only eight were associated with increased BDI scores (Table 3). Self-reported anemia, arthritis, and angina were the most highly significant factors that correlated positively with BDI scores.

Drugs. The 26 most frequently used drugs were examined to determine whether the use of specific therapeutic agents correlated with increased BDI scores (Table 4). Six drugs were found to be significantly associated with increased BDI scores when a stepwise regression procedure was performed on only the 26 most

Table 3. Conditions and Diseases Correlated with Beck Depression Inventory Scores as Identified by Stepwise Regression Analysis

| Diseases | P Value |
|-----------------------|---------|
| Anemia | .0001 |
| Arthritis | .0001 |
| Angina | .0001 |
| Bronchitis | .0013 |
| Ulcers | .0014 |
| Shingles | .0024 |
| Cancer | .0172 |
| Myocardial infarction | .0497 |

Conditions and diseases not correlated: hypertension, cirrhosis, heart failure, bone fracture, diabetes mellitus, glaucoma, hypo- or hyperthyroidism, hiatal hernia, parkinsonism, kidney infection, hemorrhoids, stroke, gallbladder, temporal arteritis, kidney stones, leukemia, gout, Paget's disease, diverticulitis, bursitis, hepatitis, jaundice, cataracts.

Table 4. Drugs Correlated with Beck Depression Inventory Scores as Identified by Stepwise Regression Analysis

| Drugs | P Value |
|---------------------------------|---------|
| Furosemide | .0001 |
| Acetaminophen | .0001 |
| Nitroglycerin | .0029 |
| Aspirin | .0063 |
| Cimetidine | .0070 |
| Hydrochlorothiazide/triamterene | .0187 |

Drugs not correlated: multiple vitamins, vitamin E, vitamin C, multiple vitamins with minerals, digoxin, calcium, potassium chloride, psyllium, hydrochlorothiazide, propranolol, dipyridamole, aspirin-aluminum glycinate-magnesium carbonate, vitamin B complex, ibuprofen, isosorbide dinitrate, multiple vitamin with iron, diazepam, calcium/vitamin D, aluminum hydroxide.

frequently reported drugs. Furosemide, acetaminophen, nitroglycerin, and aspirin were the most highly significant factors positively associated with scores on the BDI.

Other clinical factors. A stepwise regression analysis of 23 laboratory factors listed in Table 5 identified four laboratory values that correlated with BDI scores. These included higher serum creatinine, lower red blood cell count, higher aspartate aminotransferase, and lower serum chloride. There was no significant correlation between BDI scores and systolic or diastolic blood pressure, or between BDI scores and body weight.

Linear Regression Model

A linear regression model was developed by including only significant signs, symptoms, diseases, laboratory values, and drugs from the individual stepwise procedures in a second stepwise procedure. In this model, the total number of reported symptoms, diseases, and drugs were also included as factors that might predict BDI scores.

Eight factors were identified by the stepwise procedure as being significantly associated with BDI scores (Table 6). These eight factors included the total number of signs or symptoms reported, pain in the abdomen, memory loss, lower red blood cell count, loss of vision, the number of drugs used, a feeling of awkwardness, and

Table 5. Laboratory and Clinical Values Correlated with Beck Depression Inventory Scores as Identified by Stepwise Regression Analysis

| Laboratory Value | P Value |
|-----------------------------------|---------|
| Serum creatinine | .0013 |
| Aspartate aminotransferase (SGOT) | .0016 |
| Red blood cell count | .0224* |
| Serum chloride | .0231* |

*Negatively correlated. Laboratory values not correlated: systolic blood pressure, diastolic blood pressure, serum potassium, chloride, carbon dioxide, blood urea nitrogen, uric acid, calcium, phosphorus, total protein, albumin, bilirubin, alkaline phosphatase, lactate dehydrogenase, alanine aminotransferase (SGPT), cholesterol, triglycerides, iron, hematoctrit, hemoglobin, white blood cell count, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, mean corpuscular volume.

Table 6. Factors Correlating with Beck Depression Inventory Scores in the Linear Regression Model

| Factor | P Value | Partial R ² |
|--|---------|------------------------|
| Total number of signs or symptoms reported | .0001 | .2551 |
| Memory loss | .0003 | .0073 |
| Pain in the abdomen | .0004 | .0089 |
| Loss of vision | .0010 | .0083 |
| Lowered red blood cell count | .0015 | .0066 |
| Feeling of awkwardness | .0051 | .0051 |
| Shortness of breath | .0060 | .0049 |
| Total number of drugs used | .0097 | .0043 |

complaints of shortness of breath. In this model the number of symptoms reported was the most important predictive factor of BDI scores.

Discussion

In a recent review, Blazer¹ reported that between 1% and 2% of elderly persons who live in the community have major depression, and an additional 2% have dysthymia or neurotic depression. BDI scores obtained from the present investigation were higher than expected. In this study, 13.7% of men and 20.6% of women had BDI scores above 10. This is a surprising finding since participants in this program are generally upper-middle-class retirees who are likely to be more health conscious than the general population. Large population studies of elderly people should be conducted to assess the level of depression in different geographical areas and in different socioeconomic groups.

The main objective of this study was to determine whether specific signs, symptoms, diseases, or drugs were correlated with scores on the BDI. If certain symptoms or symptom clusters were pathognomonic of depression, then clinicians providing care to the elderly could use knowledge of these symptoms to quickly identify patients who were suffering from depression. In this study the total number of symptoms appeared to be the best predictor of the BDI score and was a much better predictor of BDI scores than was any individual symptom. The total number of symptoms serves as a marker for patients who complain about many things, and is consistent with the clinical wisdom of depression. This study suggests that a major clue to physicians as to which patients might be depressed is the number of their somatic complaints.

Numerous symptoms were found to be associated with higher scores on the BDI. Participants who complained of feeling awkward or having sensations of fainting or floating were more likely to have scores in the depressed range on the BDI. These two symptoms appear closely related and may have several causes. Feeling awkward may result from neurologic causes or it may

indicate weakness from skeletal muscle atrophy. A complaint of feeling faint or having floating sensations is a more common symptom volunteered by patients. This symptom is frequently observed in anxiety disorders, and it may often be a manifestation of orthostatic hypotension.^{26,27}

Memory loss is a frequent complaint among elderly people. This complaint may accurately reflect the patient's awareness of real decline, or it may reflect stereotyped expectations of intellectual decline in the elderly.^{11,28} Depression has previously been correlated with subjective memory complaints in the elderly.²⁸ In the present study, a report of memory loss was a strong predictive factor of a higher score on the BDI. Plotkin and Jarvik²⁹ have shown that improvement in depressive symptoms was significantly related to a decrease in subjective memory complaints in elderly depressed outpatients.

None of the eight diseases correlating with BDI scores on the individual stepwise analysis for diseases was found to be of prognostic significance in the final linear model. Five of the eight diseases (arthritis, angina, shingles, ulcer, cancer) are frequently associated with significant pain. It is noted that the use of aspirin and acetaminophen was also correlated with BDI scores in the individual drug analysis, and this might suggest a relationship between pain and depression.

Diseases such as parkinsonism, stroke, and hypothyroidism have frequently been identified as causative factors of depression in the elderly.¹¹ These diseases were not important predictors of BDI scores in this study, possibly because of their low prevalence in the population or perhaps because of undiagnosed disease.

Numerous drugs such as propranolol, thiazide diuretics, and reserpine have been reported to induce depression, although there have been no carefully designed prospective studies to document this link. In the present study, six drugs were found to be associated with increased BDI scores. Interestingly, one of the most widely recognized drugs, propranolol, was not associated with increased BDI scores. Reserpine was not used with sufficient frequency to test for associated depression. Drugs associated with increased BDI scores in this investigation are generally used to treat coronary artery disease, arthritis, congestive heart failure, and gastrointestinal disease. These diseases have been shown to have a significant impact on physical and mental health and role and social functioning.³⁰ Neither individual drugs nor diseases were included, however, in the final predictive model. Results from this study suggest that symptoms, or the patient's perception of symptoms, are more important factors than the seriousness of the disease itself. Diseases that limit physical activity or cause significant pain may be more

highly associated with depression. The question that remains to be answered is whether multiple symptoms and diseases cause depression or depression causes multiple symptoms and diseases.

Low red blood cell (RBC) count was an important predictive factor of BDI scores in this elderly population. The RBC count is highly correlated with both hemoglobin ($r = .83$) and hematocrit ($r = .86$), so it is not surprising that neither of those factors was chosen by the stepwise procedure. The reason for the importance of low RBC count is not clear. One explanation for the correlation of RBC count with depression could be poor nutrition in depressed subjects. There was no correlation with body weight and BDI scores, however. Serum albumin concentration, another indicator of nutritional status, did not correlate with BDI scores.

Anemia of chronic disease is a more likely explanation for the low RBC finding in this study. Arthritis, angina, ulcers, and cancer were all highly correlated with BDI scores in this study, and these diseases have all been found to produce chronic anemia.³¹⁻³³ It is possible that depression could be a primary cause of the decreased RBC count through an unknown effect on the reticuloendothelial system. This possibility should be investigated further.

Limitations of Study

The accuracy of the BDI as a screening test for depression in elderly patients may have limited the results of this study. When using a cutoff score of 10 on the BDI, previous research has shown the test to have a specificity of 0.82. With this estimate of specificity, a number of false-positive results are possible when the BDI is used as a screening instrument. Given that the results of this study suggested a higher prevalence of depression in the elderly than expected, additional research should be conducted on elderly samples using structured interviews to diagnose psychiatric disorders.

The FGRP population may not be representative of all older persons in the United States. Participants are generally white upper-middle-class retirees who continue to be screened year after year. For these reasons, they probably differ from the national elderly population in a number of ways that could affect the ability to generalize our results.

Another possible limitation in this study is the validity of self-reported diseases by participants in the program. This question was addressed in a previous study in which the agreement of self-reported disease by 107 randomly selected FGRP participants was compared with information from their medical charts.³⁴ Investigators found a high level of agreement between self-re-

ported disease and subsequent documentation of the disease in the medical records.

Given the above limitations, this report has identified a high percentage of elderly people living in the community who scored in the depressed range on the BDI. We have found that elderly persons who complain of multiple signs and symptoms and who report the use of multiple medications have a high probability of clinical depression. When present in the elderly, certain symptoms such as pain in the abdomen, memory loss, loss of vision, and feeling awkward should raise the clinician's suspicion of depression.

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