

Medical Illness and the Risk of Suicide in the Elderly

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Background: Suicide is a leading cause of death, and rates are especially high among the elderly. Medical illnesses may predispose to suicide, but few controlled studies have examined the association between specific diseases and suicide. We explored the relationship between treatment for several illnesses and the risk of suicide in elderly patients using a population-based approach.

Methods: All Ontario residents 66 years or older who committed suicide between January 1, 1992, and December 31, 2000, were identified from provincial coroners' records. Their prescription records during the preceding 6 months were compared with those of living matched controls (1:4) to determine the presence or absence of 17 illnesses potentially associated with suicide.

Results: During the 9-year study period, we identified 1354 elderly patients who died of suicide. The most common mechanisms involved firearms (28%), hanging (24%), and self-poisoning (21%). Specific illnesses associated with suicide included congestive heart failure (odds ratio [OR],

1.73; 95% confidence interval [CI], 1.33-2.24), chronic obstructive lung disease (OR, 1.62; 95% CI, 1.37-1.92), seizure disorder (OR, 2.95; 95% CI, 1.89-4.61), urinary incontinence (OR, 2.02; 95% CI, 1.29-3.17), anxiety disorders (OR, 4.65; 95% CI, 4.07-5.32), depression (OR, 6.44; 95% CI, 5.45-7.61), psychotic disorders (OR, 5.09; 95% CI, 3.94-6.59), bipolar disorder (OR, 9.20, 95% CI, 4.38-19.33), moderate pain (OR, 1.91; 95% CI, 1.66-2.20), and severe pain (OR, 7.52; 95% CI, 4.93-11.46). Treatment for multiple illnesses was strongly related to a higher risk of suicide. Almost half the patients who committed suicide had visited a physician in the preceding week.

Conclusions: Many common illnesses are independently associated with an increased risk of suicide in the elderly. The risk is greatly increased among patients with multiple illnesses. These data may help clinicians to identify elderly patients at risk of suicide and open avenues for prevention.

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SUICIDE IS A MAJOR HEALTH problem, ranking as the 11th leading cause of death in the United States and accounting for about 30 000 deaths each year.^{1,2} Factors associated with an increased suicide risk include modifiable conditions such as mood disorders,³ alcoholism,^{4,6} and substance abuse,⁷ as well as fixed characteristics such as male sex⁸ and advancing age.⁹ The elderly generally attempt suicide with much higher lethality than younger persons and in many countries kill themselves at a rate higher than any other segment of the population.¹⁰⁻¹² However, suicide in the elderly generally receives less attention in the medical literature and news media than suicide in young adults.¹³

Suicide among older persons differs in many ways from suicide in younger individuals.^{14,15} Because older individuals generally attempt suicide with more le-

thal methods, the ratio of completed to attempted suicides increases substantially with age.^{14,16} Elderly persons who commit suicide are less likely to have discussed their plans beforehand,¹⁷ and non-violent deaths from suicide in the elderly may be mistakenly attributed to illness. In addition, distinctive stresses accompany late life, including retirement, loss of a loved one, social isolation, and an increasing burden of disability, each of which has been suggested as a risk factor for suicide in the elderly.^{4,6,14,17-24}

*For editorial comment
see page 1171*

Many studies have proposed a link between illness and suicide.^{25,26} Most of these associations, however, are inferred from uncontrolled case series, and few rigorous studies have been published.²⁷⁻³⁰ One report of 42 cases found that patients with greater

burdens of psychiatric illness, physical illness, and functional limitation were more likely to commit suicide.³¹ Another report of 85 cases suggests that visual impairment, neurologic disease, and mental illness all increase the risk of suicide, but the effects of individual diseases were not examined.³² In the present study, we used population-based, patient-level health care data to provide a more powerful assessment of the relationship between specific illnesses and suicide in the elderly.

METHODS

SETTING AND SUBJECTS

This was a population-based case-control study set in Ontario, Canada. Ontario is Canada's largest province and had a population of 11 100 876 at the midpoint of the study period, including 1 264 686 who were 66 years or older. All elderly patients in Ontario have universal access to health insurance for prescription drug coverage, physicians' services, and hospital care. The study was approved by the Chief Coroner for Ontario and by the research ethics board of Sunnybrook and Women's College Health Sciences Centre.

IDENTIFICATION OF CASES

We identified consecutive cases of suicide in Ontario residents 66 years or older occurring over a 9-year period (January 1, 1992, to December 31, 2000) from the records of the Office of the Chief Coroner for Ontario. All suspected cases of suicide must be reported to this office by law, and those with clear and cogent evidence of intent in the opinion of the coroner (such as a suicide note or previous threats or episodes of self-harm or other evidence) are deemed suicides (personal communication, Barry McLellan, MD, July 7, 2003). Baseline data for each person was cross-referenced to the Registered Persons Database, which provided demographic information for all Ontario residents. The date of suicide for each case served as the index date for all analyses.

SELECTION OF CONTROLS

For each suicide patient, 4 control patients were selected from the population of Ontario using the Registered Persons Database. Controls were matched with the corresponding case patient for age (± 30 days), sex, and residential income quintile using 1996 population census data. To ensure that controls were residing in Ontario and alive on the date of the suicide, we required potential controls to have visited an optometrist or dentist at least once within a year of the index date. When more than 4 potential controls were available, we randomly selected 4 for analysis. In the 1 instance in which fewer than 4 controls were available, we analyzed only 3 controls and did not alter the matching process. Case patients were eligible to serve as controls in the period preceding their death.³³⁻³⁵

ASCERTAINMENT OF ILLNESSES

We analyzed the prescription medication records of case and control patients in the 6-month period prior to the index date using data from the Ontario Drug Benefit program. This database contains detailed prescription records for all elderly residents of Ontario. We focused on 17 illnesses plausibly associated with an increased risk for suicide based on previously suggested associations or a clinical course characterized by discomfort, suffering, or a poor prognosis. Drugs or drug combinations served as markers of the presence of each illness

(**Table 1**). Because ascertaining illness from administrative data is not a straightforward process,³⁶⁻³⁹ marker medications for each illness were selected by the consensus of 3 clinicians (D.N.J., N.H., and D.A.R.) with the goal of maximizing specificity. Patients were deemed to have an illness when at least 1 prescription for these medications was dispensed in the 6 months prior to the index date. We did not use physician diagnosis claims to identify illness because the latter are often unreliable, particularly in the presence of multiple concomitant diseases,⁴⁰⁻⁴² and we avoided reliance on hospital discharge diagnoses because some chronic illnesses merit hospitalization only infrequently.

To test the specificity of our findings, we also examined 3 illnesses in which we did not expect an association with suicide because of the minor or intermittent nature of symptoms (glaucoma, gout, and hypothyroidism). We also included 1 illness (dyslipidemia) for which we postulated that the treatment might be associated with a paradoxically reduced risk for suicide based on a prior study suggesting a significantly lower risk of traumatic death among patients receiving lipid-lowering agents.⁴³ Illnesses that could not be reliably discerned from others based on outpatient medication records (such as hypertension and cerebrovascular disease) were excluded from the analysis.

STATISTICAL ANALYSIS

Databases were linked in an anonymous fashion using an encrypted version of each patient's 10-digit health card number. The primary analysis used conditional logistic regression to estimate the odds ratio (OR) and 95% confidence interval (CI) for suicide associated with specific illnesses. Those illnesses bearing a relationship to suicide in the univariate analysis were included in a multivariate model to adjust for the influence of other illnesses. The relationship between the number of illnesses and suicide risk was estimated using contingency tables and was further explored using logistic regression models to explore nonlinearity with the use of cubic and quadratic terms. All tests of significance were 2 tailed and used a *P* value of less than .05 as the threshold for statistical significance.

SENSITIVITY ANALYSES

We repeated our analyses using several modifications to test the robustness of our findings. In the first instance, the selection process was repeated without the requirement that controls have a recent visit to a dentist or optometrist. In another, cases were excluded from serving as potential controls prior to their suicide. In a third analysis we stratified the cohort by sex, age, and income quintile. Finally, we performed a post hoc analysis of the relationship between specific illnesses and the chosen method of suicide.

RESULTS

PATIENT CHARACTERISTICS

During the 9-year study interval (January 1, 1992, to December 31, 2000) a total of 1354 suicides in adults 66 years or older were identified in Ontario, equivalent to a rate of approximately 12 suicides per 100 000 individuals annually. For 25 cases (2%), linkage to health care records was not possible because of an invalid health card number, erroneous identifying data, or a principal residence outside Ontario. Therefore, 1329 suicide cases were available for analysis. The matching process yielded 5315 controls with similar demographic features (**Table 2**).

Table 1. Prescription Markers of Illness

Illness	Marker Medication(s)
Cardiovascular	
Ischemic heart disease	Nitrates (any route)
Congestive heart failure	Furosemide plus an angiotension-converting enzyme inhibitor
Respiratory	
Chronic lung disease	Theophylline or inhaled β -agonists, anticholinergics, or glucocorticoids
Gastrointestinal	
Hyperacidity syndromes	Proton-pump inhibitors or H ₂ -receptor antagonists
Neurologic	
Seizure disorder	Phenytoin
Parkinson disease	Levodopa, bromocriptine, selegiline, ropinarole, or pramipexole
Metabolic	
Diabetes	Any oral hypoglycemic agent or insulin
Musculoskeletal	
Rheumatoid arthritis	Any nonsteroidal anti-inflammatory plus a disease-modifying agent*
Genitourinary	
Incontinence	Oxybutinin or bethanechol
Psychiatric	
Affective disorder	Cyclic antidepressants, SSRIs and MAOIs (excluding bupropion)
Bipolar disorder	Lithium carbonate
Psychotic disorder	Any neuroleptic
Anxiety disorder	Benzodiazepines
Malignancy	
Breast cancer	Tamoxifen
Prostate cancer	Antiandrogens, gonadotropin-releasing hormone agonists
Pain-related conditions	
Moderate pain	Codeine or hydrocodone-containing analgesics
Severe pain	Morphine, hydromorphone, or transdermal fentanyl
Comparison illnesses	
Hypothyroidism	Levothyroxine
Glaucoma	Topical glaucoma preparations (eg, pilocarpine, timolol, and others)
Gout	Allopurinol or colchicine
Dyslipidemia	HMG-CoA reductase inhibitors, bile acid-binding resins, or fibric acid derivatives

Abbreviations: HMG-CoA, hydroxymethyl glutaryl coenzyme A; MAOIs, monoamine oxidase inhibitors; SSRIs, selective serotonin reuptake inhibitors.

*Disease-modifying agents include methotrexate, gold preparations, antimalarials, azathioprine, sulfasalazine, or penicillamine.

MECHANISM OF SUICIDE

The mechanism of suicide for the 1329 cases was diverse (**Table 3**). Death by firearm was the single most frequent method, comprising over a quarter of all cases. Women accounted for only 5 of the 370 firearm-related deaths; in contrast, women most often committed suicide by self-poisoning. Hanging was the second most frequent cause of death among both men and women, accounting for about 1 in 4 suicides. Mechanisms of suicide were generally consistent during the 9-year study period. Overall, 1192 patients (90%) died outside of the hospital or in the emergency department.

ILLNESSES AND SUICIDE RISK

Eleven of the 15 prespecified illnesses were associated with a significantly increased risk of suicide (**Table 4**). Consistent with previous research, bipolar disorder, major depression, and severe pain were associated with the largest increases in suicide risk. In contrast, we found no increased risk among patients with gout, hypothyroidism, or glaucoma. As expected, treatment for dyslipidemia was associated with a reduction in the risk for suicide. After adjustment for the presence of other illnesses, 9 conditions were found to be independent predictors of an in-

creased risk for suicide. Bipolar disorder, depression, and severe pain retained the strongest associations with suicide. Sensitivity analyses using alternate control selection procedures yielded uniformly consistent results.

BURDEN OF ILLNESS AND SUICIDE RISK

We further analyzed patients according to their total number of illnesses using the illnesses retained in the multivariate model (**Figure**). We observed a strong association between the cumulative number of illnesses and the estimated relative risk of suicide. Compared with patients with no identified illness, for example, patients with 3 illnesses had about a 3-fold increase in the estimated relative risk of suicide (OR, 3.5; 95% CI, 2.9-4.2), and patients with 5 illnesses had about a 5-fold increase in risk (OR, 5.7; 95% CI, 4.4-7.4). The association between the number of illnesses and suicide risk remained consistent using polynomial regression models, which revealed no significant curvilinear relationship.

USE OF HEALTH CARE SERVICES

We examined health care visits by patients prior to the index date. Compared with controls, elderly persons who

Table 2. Patient Characteristics*

Characteristic	Cases (n = 1329)	Controls (n = 5315)
Demographics		
Male	1012 (76)	4047 (76)
Female	317 (24)	1268 (24)
Median age, y	74.4	74.4
Median household income†	48 749	48 590
Study illnesses		
Ischemic heart disease	141 (10.7)	605 (11.4)
Congestive heart failure	88 (6.6)	214 (4.0)
Chronic lung disease	220 (16.6)	583 (11.0)
Hyperacidity syndromes	292 (22.0)	972 (18.3)
Seizure disorder	34 (2.6)	47 (0.9)
Parkinson disease	25 (1.9)	63 (1.2)
Diabetes mellitus	117 (8.8)	507 (9.5)
Rheumatoid arthritis	4 (0.3)	16 (0.3)
Urinary incontinence	29 (2.2)	58 (1.1)
Psychoses and agitation	142 (10.7)	128 (2.4)
Depression	422 (31.8)	374 (7.0)
Anxiety and sleep disorders	660 (49.7)	948 (17.8)
Bipolar disorder	23 (1.7)	10 (0.2)
Breast cancer	4 (0.3)	11 (0.2)
Prostate cancer	20 (1.5)	68 (1.3)
Moderate pain	348 (26.2)	831 (15.6)
Severe pain	62 (4.7)	33 (0.6)
Control illnesses		
Dyslipidemia	64 (4.8)	485 (9.1)
Hypothyroidism (treated)	91 (6.8)	339 (6.4)
Glaucoma	77 (5.8)	262 (4.9)
Gout	52 (3.9)	263 (4.9)

*Data expressed as number (percentage) of people except where noted.
†Median household income expressed in 1996 Canadian dollars.

Table 3. Mechanism of Suicide*

Mechanism	Men (n = 1012)	Women (n = 317)	Total (n = 1329)
Firearm	365 (36)	5 (2)	370 (28)
Hanging	260 (26)	58 (18)	318 (24)
Self-poisoning	154 (15)	131 (41)	285 (21)
Fall from height	80 (8)	34 (11)	114 (9)
Suffocation	44 (4)	39 (12)	83 (6)
Drowning	38 (4)	29 (9)	67 (5)
Stabbing	37 (4)	7 (2)	44 (3)
Vehicle trauma†	15 (1)	5 (1)	20 (2)
Miscellaneous‡	19 (2)	9 (3)	28 (2)

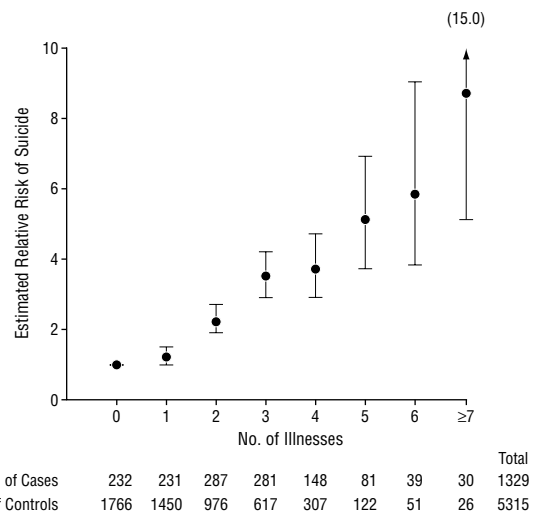
*Data expressed as count (percentage) of subjects.
†Includes collisions with automobiles, trains, and subways.
‡Includes suicides by self-immolation (n = 11), exposure to cold (n = 6), electrocution (n = 5), explosion (n = 3), starvation (n = 1), strangulation (n = 1), and unspecified blunt trauma (n = 1).

committed suicide were almost twice as likely to have visited a physician in the week before death (45% vs 24%; $P < .001$). Most suicide patients visited a physician in the month before death (73% vs 49% of controls during the same month; $P < .001$). Of the suicide patients who saw a physician in the preceding month, 720 (75%) registered 3 or more visits. Physician claims for visits just prior to suicide were not generally accompanied by ominous diagnoses. The 5 most common diagnoses listed in the week before suicide were anxiety, unspecified gastroin-

Table 4. Association Between Illnesses and Suicide*

Chronic Illness	Univariate	Multivariate†
Study illnesses		
Ischemic heart disease	0.92 (0.76-1.12)	NI
Congestive heart failure	1.73 (1.33-2.24)	1.36 (1.00-1.85)
Chronic lung disease	1.62 (1.37-1.92)	1.30 (1.06-1.58)
Hyperacidity syndromes	1.26 (1.09-1.47)	0.81 (0.68-0.97)
Seizure disorder	2.95 (1.89-4.61)	2.41 (1.42-4.07)
Parkinson disease	1.60 (1.00-2.55)	1.11 (0.65-1.90)
Diabetes mellitus	1.01 (0.73-1.41)	NI
Rheumatoid arthritis	1.00 (0.33-2.99)	NI
Urinary incontinence	2.02 (1.29-3.17)	1.11 (0.65-1.89)
Psychoses and agitation	5.09 (3.94-6.59)	2.60 (1.93-3.50)
Depression	6.44 (5.45-7.61)	3.94 (3.27-4.75)
Anxiety and sleep disorders	4.65 (4.07-5.32)	3.22 (3.27-4.75)
Bipolar disorder	9.20 (4.38-19.33)	3.58 (1.57-8.18)
Breast cancer	1.46 (0.46-4.57)	NI
Prostate cancer	1.18 (0.71-1.95)	NI
Moderate pain	1.91 (1.66-2.20)	1.24 (1.04-1.47)
Severe pain	7.52 (4.93-11.46)	4.07 (2.51-6.59)
Control illnesses		
Dyslipidemia	0.49 (0.37-0.65)	0.44 (0.32-0.60)
Hypothyroidism (treated)	1.08 (0.85-1.38)	NI
Glaucoma	1.19 (0.91-1.54)	NI
Gout	0.78 (0.57-1.06)	NI

Abbreviation: NI, not included in multivariate model.
*Numbers of cases and controls with various illnesses are shown in Table 2. Data are odds ratio (95% confidence interval).
†Multivariate analysis adjusts for presence of other predictive illnesses from univariate analysis.



This figure demonstrates the relationship between a patient's total number of illnesses and the estimated relative risk of suicide compared with patients with no illness. Included are those illnesses associated with suicide in the univariate analysis (Table 4). Points represent point estimates and vertical bars represent the associated 95% confidence intervals. Patients with the greatest number of illnesses (≥ 7) have about a 9-fold higher risk of suicide than those without illness ($P < .001$ for the trend).

testinal symptoms, depression, unspecified cardiac symptoms, and hypertension. Visits to a psychiatrist were also more common in the preceding week among those who committed suicide than among controls (6% vs 0.2%; $P < .001$). Ten patients committed suicide on the same day they saw a psychiatrist.

ILLNESS AND MECHANISM OF SUICIDE

Among suicide cases, we found clustering of some illnesses with some mechanisms of suicide. Relative to the general cohort, patients with severe pain were more likely to kill themselves with a firearm (45% vs 28%; $P = .002$) or by poisoning (32% vs 21%; $P = .03$). Similarly, patients with congestive heart failure were twice as likely to shoot themselves (44% vs 28%; $P < .001$) and half as likely to hang themselves (10% vs 24%; $P = .002$). Patients with Parkinson disease were more likely to commit suicide by suffocation (20% vs 6%; $P = .004$). Patients with psychotic disorders were less likely to use a firearm (14% vs 28%; $P < .001$). Patients with bipolar disorder had no apparent predisposition regarding mode of suicide. However, none of these contrasts were based on prespecified hypotheses.

EXPLORATORY ANALYSES

Most illnesses were consistently associated with suicide among patients of differing demographic characteristics. The association with psychoses was somewhat stronger for women (unadjusted OR, 8.2; 95% CI, 5.1-13.0) than men (OR 4.0; 95% CI, 3.0-5.5). Conversely, the association between severe pain and suicide was somewhat stronger for men (OR, 9.9; 95% CI, 6.0-16.4) than for women (OR, 3.3; 95% CI, 1.4-7.7). The association between bipolar disorder and suicide was stronger for those younger than the median age (OR, 13.6; 95% CI, 5.0-36.8) than those older than the median age (OR, 4.8; 95% CI, 1.5-15.7). The association between most illnesses and suicide was marginally stronger among patients in the highest income quintile than among those in the lowest income quintile.

COMMENT

Using population-based data we found a significant association between suicide in the elderly and several common medical and psychiatric illnesses. In addition, we observed that the coexistence of multiple illnesses confers a marked increase in the risk of suicide. Most of the people who committed suicide had visited a physician in the month before their death, and each of these visits might have presented an opportunity to intervene.

Several common medical illnesses, including congestive heart failure, chronic lung disease, and seizures, were independently associated with an increased risk for suicide, while others, such as diabetes, ischemic heart disease, and Parkinson disease, were not. Our methods did not permit us to explore the underlying reasons for these associations. Several psychiatric illnesses were strongly associated with suicide, in agreement with many past reports.^{3,4,17,44-49} Importantly, our study identifies only those patients with treated, recognized depression. Unrecognized depression is common in the elderly,^{14,16} and our analysis likely underestimates the true magnitude of the association between depression and suicide.

The risk for suicide among patients with severe pain merits particular attention. Patients with severe pain and inadequate analgesia may view suicide as a means of escape from suffering. Because high-potency opiates are of-

ten reserved for the treatment of cancer pain, suicide may result from an associated poor prognosis, concerns of debility or loss of dignity, or the fear of posing a burden to loved ones. While these arguments are largely speculative, physicians who care for patients with painful conditions should be alert to the possibility of underlying depression and the potential for suicide.

The present study has important limitations. The identification of suicide cases is prone to multiple biases. Even though the suicide rate in our cohort is comparable to data from Canada (12.6 per 100 000 elderly)⁵⁰ and the United States (15.9 cases per 100 000 elderly),⁵¹ deaths from suicide may be misclassified, and no study can truly purport to capture all cases.⁵²⁻⁵⁴ Indeed, a nonviolent suicide in an older patient is both easier to conceal and easier to misattribute to medical illness; therefore, our study may underestimate the magnitude of the various risk factors. Presumably, such misclassification tends to bias any association between illness and suicide toward the null.

Other limitations of our research relate to the use of prescription records as markers of illness. While this is often done,^{43,55} some drug classes (eg, neuroleptics and antidepressants) may be used for multiple illnesses. We attempted to select drugs or drug combinations that were reasonably specific for the disorders of interest. However, we were unable to test for many illnesses thought to have a positive association with suicide, including most malignancies, and we were not able to detect several possible contributing factors that might increase the risk for suicide, such as bereavement, isolation, and alcohol abuse. Alcoholism is common among patients who commit suicide,⁵⁶ is often unrecognized by physicians,^{57,58} and cannot be reliably identified using administrative data. Some of our secondary analyses were exploratory and may have been influenced by multiple hypothesis testing. However, a major strength of our study was the ability to explore many associations in a large, population-based sample at the individual patient level. Finally, our findings do not exclude the possibility that some medications directly contributed to an increased risk of suicide.

None of these limitations invalidate our observation that many illnesses place the elderly at risk for suicide. However, suicide is not simply a response to illness, and this study defines only 1 aspect of a complex and incompletely understood problem. Our findings have important implications for prevention because most elderly patients who commit suicide visit a physician shortly beforehand, and many of them have clinically recognizable features of depression at the time.^{3,11,49} Physicians, nurses, and other health care professionals should be alert to the possible threat of suicide in elderly patients with chronic illness, particularly in patients with multiple illnesses, symptoms of depression, or other risk factors for suicide.

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