Research report

The relationship between physical conditions and suicidal behavior among those with mood disorders

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ABSTRACT

Background: There has recently been increased interest in the relationship between physical illness, mental illness, and suicide. The present study utilizes a large community-based sample to investigate the association between certain physical conditions and suicidal behavior among those with a history of a mood disorder.

Methods: Data came from the nationally representative German Health Survey (N = 4181, age 18–65). Physical conditions were assessed by a general practice physician. DSM-IV mental disorders were assessed using a modified version of the Composite International Diagnostic Interview. Among those with a lifetime mood disorders, suicidal ideation, plans, and attempts were assessed by self-report. Multiple logistic regression analyses were used to examine the association between physical conditions and suicidal behavior among those with a history of mood disorder.

Results: Anxiety and substance use disorders were significantly positively associated with suicidal behavior [OR 1.61, 95% CI 1.13–2.31 and 2.01, 95% 1.34–3.00, respectively]. After adjusting for anxiety and substance use disorders as well as sociodemographic variables, respiratory illness, hypertension, and number of physical disorders were significantly associated with suicidal behavior [AORs 1.72, 1.68, and 1.16, respectively].

Limitations: The findings of this study are limited to adults with a history of a mood disorder. Personality disorders were not assessed.

Conclusion: The present study suggests that among people with mood disorder, respiratory illnesses, hypertension, and number of physical conditions are associated with suicidal behavior independent of the effects of comorbid mental illness. Clinicians should recognize the contributing risk of physical health problems to suicidal behavior.

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1. Introduction

In the year 2000 approximately one million people died by suicide and it is now estimated that by 2020 suicide will become the tenth most common cause of death in the world (European Commission, 2004; Murray and Lopez, 1997). Therefore, suicide prevention is a major public health issue.

Suicidal ideation is strongly associated with an increased risk of attempt (Kessler et al., 1999; Kuo et al., 2001) and in turn, non-fatal suicide attempts are the strongest known clinical predictor for eventual completion (Harris and Barraclough, 1997). Other risk factors for suicidal ideation and suicide attempts include sociodemographic, psychiatric, psychosocial, and physical health factors (Nock et al., 2008a,b; Taylor et al., 2007; Joiner et al., 2005). It has been shown that mood, anxiety, and substance use disorders are well-established risk factors for suicidal behavior (Kessler et al., 1999; Sareen et al., 2005; Borges et al., 2000).
Having a general medical condition is associated with an increased risk of completed suicide (Harris and Barraclough, 1994). Previous studies have shown that individuals with certain physical illnesses including HIV/AIDS and lung disease (Goodwin et al., 2003a), cancer (Druss and Pincus, 2000) and dermatologic diseases (Gupta and Gupta, 1998) not only have significantly higher rates of co-morbid psychiatric illness, but that physical conditions themselves may act as risk factors for suicidal behavior independent from co-morbid mental illness (Taylor et al., 2007; Druss and Pincus, 2000; Goodwin et al., 2003a; Scott et al., 2010). However, other physical conditions such as diabetes, hypertension, and arthritis have inconsistent findings in relation to their risk for suicidal behavior (Goodwin et al., 2003a; Druss and Pincus, 2000; Taylor et al., 2007). This inconsistency may be due, in part, to methodological limitations. A substantial limitation inherent in most existing studies is that the assessment of physical illness is based on self-report (Goodwin et al., 2003a; Druss and Pincus, 2000; Taylor et al., 2007; Scott et al., 2010). This may result in both the over- and under-reporting of diagnosable physical conditions (Bergmann et al., 2004; Smith et al., 2008), and in turn fundamentally bias the observed relationship between suicidal behavior and co-morbid illnesses. Other studies have limited their patient population to those presenting to a primary care physician (Goodwin et al., 2003b), or those under the age of 55 (Goodwin et al., 2003a; Druss and Pincus, 2000). Studies limited to treatment-seeking samples are associated with selection bias.

In the present study we utilize the German Health Survey (GHS) to examine the association between physical conditions and suicidal behavior among a community-based sample of those with a history of mood disorders. The GHS is the first survey to assess Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) mental disorder diagnoses using the computer-assisted Munich Composite International Diagnostic Interview (Wittchen and Pfister, 1997) and to use physician-based diagnosis of physical health conditions by interview, physical exam, and laboratory assessment.

2. Methods

2.1. Sample

The German Health Survey (GHS) data were collected between 1997 and 1999 using a stratified, multistage, cross-sectional design to ensure the sample was representative of the noninstitutionalized German population. Respondents were between the ages of 18 and 79 and provided written consent. The institutional review board of the Robert Koch Institute (Berlin, Germany) approved the survey. There were two main components of the GHS: the core survey (N = 7124; 61.5% response rate) and the mental health supplement (N = 4181; 87.6% response rate; Jacobi et al., 2002). Respondents did not differ from non-responders by age, sex, or self-reported health status. The survey was conducted in German and was translated to English for the purpose of this study by the PI for the GHS (F.J., one of the authors of this study). More detailed descriptions of the survey are available elsewhere (Jacobi et al., 2002, 2004).

2.2. Suicidal behavior assessment

Questions about suicide were asked to all respondents that screened positive for the affective disorder module. Suicidal behavior was not assessed in the general sample. The following lifetime variables were used 1) thinking about committing suicide, 2) planning suicide, and 3) suicide attempt. For the current analyses we created a single composite variable (“lifetime suicidal behavior”) that included individuals who had responded positively to any of the three variables.

2.3. Physical conditions

The current analyses used physical condition diagnoses based on a standardized computer-assisted medical interview administered by a general practice physician, including the review of laboratory results. Physicians took into account information from their interview as well as from self-report questionnaire and confirmatory laboratory results with more than 50 measures (Jacobi et al., 2002). The physical disorders assessed in this study included respiratory disorders, gastrointestinal disorders, diabetes, renal disorders, cardiac disorders, thyroid conditions, liver disorders, allergies, cancer, arthritis, migraine, thrombosis, and hypertension. A continuous variable for number of medical conditions was created from the previous disorders.

2.4. Mental disorders

The DIA-X/M-CIDI (Wittchen and Pfister, 1997), a modified version of the CIDI, was used to assess lifetime, past-year, and past-month diagnoses based on DSM-IV criteria. This fully structured interview assessed substance disorders (abuse or dependence of any substance), mood disorders (major depression, dysthymia, bipolar disorders), and anxiety disorders (panic disorder, social phobia, specific phobia, generalized anxiety disorder, obsessive compulsive disorder). Reliability estimates for the diagnoses range from good to excellent (Wittchen, 1994). To increase power we used lifetime diagnoses for the current analyses and looked only at the categories any anxiety disorder and any substance abuse or dependence (including nicotine).

2.5. Sociodemographic variables

Sex, education, age, and marital status were examined descriptively and included in subsequent regressions as covariates. Education was dichotomized into grade 10 or more than 50 measures (Jacobi et al., 2002). Respondents did not differ from non-responders by age, sex, or self-reported health status. The survey was conducted in German and was translated to English for the purpose of this study by the PI for the GHS (F.J., one of the authors of this study). More detailed descriptions of the survey are available elsewhere (Jacobi et al., 2002, 2004).

2.6. Statistical analysis

For all regression analyses we employed the appropriate statistical weight to ensure the representativeness of the data to the German population. We employed the Taylor Series Linearization method to calculate error estimation in the SUDAAN software system (Shah et al., 1995). Age, gender,
3. Results

3.1. Sociodemographic variables

Among people with a lifetime mood disorder, approximately 76% had no history of suicidal behavior. The remaining 24% had reported at least one of the suicidal behaviors in their lifetime. There were no significant differences between the individuals with no history of suicidal behavior and those with suicidality for any sociodemographic variables. All sample sizes, percentages, and odds ratios are presented in Table 1.

3.2. Mental disorders

Table 2 demonstrates that anxiety and substance use disorders were quite common with 47% of the individuals with suicidal behavior meeting criteria for an anxiety disorder and 41% meeting criteria for any substance use or dependence. Almost 70% of our sample had at least one comorbid mental disorder. After adjusting for sociodemographic variables, individuals with suicidal behavior had increased odds of having a lifetime anxiety disorder as well as having a substance use disorder than individuals without suicidal behavior.

### Table 1
Prevalence of suicidal behavior across sociodemographic characteristics of individuals with a lifetime history of a mood disorder.

<table>
<thead>
<tr>
<th>Sex</th>
<th>No suicidal behavior, n (%)</th>
<th>Suicidal behavior, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>203 (81.2%)</td>
<td>47 (18.8%)</td>
</tr>
<tr>
<td>Female</td>
<td>446 (74.3%)</td>
<td>154 (25.7%)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gr.10/High school</td>
<td>378 (77.3%)</td>
<td>111 (22.7%)</td>
</tr>
<tr>
<td>&gt; High school</td>
<td>264 (75.2%)</td>
<td>87 (24.8%)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–25</td>
<td>66 (71.7%)</td>
<td>26 (28.3%)</td>
</tr>
<tr>
<td>26–35</td>
<td>152 (77.9%)</td>
<td>43 (22.1%)</td>
</tr>
<tr>
<td>36–45</td>
<td>156 (77.2%)</td>
<td>46 (22.8%)</td>
</tr>
<tr>
<td>46–55</td>
<td>152 (76.8%)</td>
<td>46 (23.2%)</td>
</tr>
<tr>
<td>56–65</td>
<td>122 (75.3%)</td>
<td>40 (24.7%)</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>365 (79.2%)</td>
<td>96 (20.8%)</td>
</tr>
<tr>
<td>Single</td>
<td>135 (74.6%)</td>
<td>46 (25.4%)</td>
</tr>
<tr>
<td>Previously married</td>
<td>142 (72.1%)</td>
<td>55 (27.9%)</td>
</tr>
</tbody>
</table>

### Table 2
Relationship between suicidal behavior and the prevalence of mental disorders among those with a lifetime mood disorder.

<table>
<thead>
<tr>
<th></th>
<th>No suicidal behavior, n (%)</th>
<th>Suicidal behavior, n (%)</th>
<th>AOR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any anxiety disorder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>231 (59.5%)</td>
<td>103 (30.5%)</td>
<td>1.14 (1.02–1.28)</td>
</tr>
<tr>
<td>Any substance use disorder</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>184 (28.4%)</td>
<td>82 (40.8%)</td>
<td>2.01 (1.34–3.00)</td>
</tr>
</tbody>
</table>

Any anxiety disorder includes panic disorder, obsessive–compulsive disorder, social phobia, generalized anxiety disorder, agoraphobia, and simple phobia. Any substance abuse/dependence includes alcohol abuse/dependence, nicotine abuse/dependence, and illicit drug abuse/dependence.

AOR—Adjusted for sociodemographic variables from Table 1.

** p < 0.01.

3.3. Physical conditions

Physical conditions were also common with 46% of the suicidal behavior group having an allergy, 39% having a gastrointestinal disorder, and 38% having arthritis. The least common disorders were diabetes (3%), cancer (5%), and liver disease (6%). Logistic regression analyses were first run adjusted for sociodemographic variables (AOR1) and then anxiety disorders and substance use disorders were added to the models (AOR2). All sample sizes, percentages, and the adjusted odds ratios are presented in Table 3. In both models, individuals with a respiratory disorder and those with hypertension had increased odds of reporting suicidal behavior (AOR2 1.72, 95% CI 1.07–2.76 and 1.61, 95% CI 1.10–2.58, respectively). In the first model, after adjusting for sociodemographic variables, gastrointestinal disorders were also significantly associated with suicidal behavior (AOR1 1.52, 95% CI 1.0–2.2), but after adjusting for mental disorders the association was no longer significant. Number of physical conditions was also positively associated with suicidal behaviors (AOR2 1.16, 95% CI 1.04–1.30).

4. Discussion

To the best of our knowledge, this study was the first to utilize a large community-based sample along with standardized physician diagnosed health conditions to evaluate the association between physical illness and suicidal behavior among people with lifetime mood disorders. The study also controlled for anxiety and substance use disorders, reducing the potential for them to act as confounding factors. Previous studies have shown that among those with a history of a mood disorder, having a comorbid anxiety or substance-use disorder is significantly associated with suicide attempts (Sareen et al., 2005; Bolton et al., 2008). Our findings were not specific to suicide attempts, however we did find that among those with a lifetime history of a mood disorder, having either a co-morbid anxiety or substance-use disorder was significantly associated with suicidal behavior. The current study contributes a number of important novel findings among people with a lifetime history of a mood disorder. First, having a respiratory illness was significantly associated with an increased likelihood of suicidal behavior. Second, having high blood pressure was also independently associated with suicidal behavior. Third, there was a
significant association between the number of physical conditions and suicidal behavior. These associations remained significant even after adjusting for the presence of an anxiety or substance-use disorder.

The association between suicidal behavior and respiratory diseases is consistent with previous findings. Significant relationships have been reported between respiratory illnesses and mood and anxiety disorders (Goodwin et al., 2003c; 2010; Cazzola et al., 2010), as well as for respiratory illnesses and suicidal behavior (Druss and Pincus, 2000; Goodwin et al., 2003a,b). For example, Goodwin et al. (2003b) found that among primary care patients, pulmonary disease was associated with an increased likelihood of suicidal ideation, even after adjusting for sociodemographic factors, depression, and other common psychiatric disorders. The mechanism of this association is not fully understood, however a few plausible explanations have been offered. Kaplan et al. (2007) suggested that functional limitation seems to be a stronger risk factor for suicide than illness itself. Respiratory diseases may greatly limit ones physical ability and include distressing symptoms such as dyspnea, frequent coughing, and lethargy (Bartolome et al., 2005). It is also important to consider that those with comorbid mental illness are less able to adapt to the chronic medical symptoms, more likely to be nonadherent to treatment recommendations, experience an amplification of these symptoms, and show additive functional impairment (Katon and Ciechanowski, 2002). Treatment of respiratory illness may act as a moderator, with many of these patients being prescribed steroid-based medications that can increase nervousness, agitation, insomnia, emotional lability, depression, and confusion (Goodwin et al., 2003b; Pokladnikova et al., 2008). Another important consideration is that subthreshold or subclinical anxiety disorders may be present in a proportion of those with pulmonary disease, contributing to the increase in suicidal behavior and not accounted for by a clinically diagnosed anxiety disorder. There are likely several key factors influencing this relationship, and further research is necessary to elucidate these mechanisms.

The finding of a significant association between high blood pressure and suicidal behavior is inconsistent with the current literature. Goodwin et al. (2003a) reported increased odds of suicide attempt among those with hypertension, however, after adjusting for mental disorders and regular physical activity, this relationship was no longer statistically significant. Druss and Pincus (2000) also studied the relationship between physical illness and suicide and found those with hypertension did not have significantly increased odds of either suicide ideation or attempts. A recent study by Scott et al. (2010) showed the presence of hypertension to be significantly associated with first onset of suicidal behavior. An explanation for this variation likely lies in the methodology of each study. The current study included physician diagnosed physical health conditions as opposed to self-report. Methodological differences between self-administered questionnaires and personal interviews have been shown to affect the sensitivity of prevalence studies (Bergmann et al., 2004). Hypertension is often called a “silent disease” and previous studies have reported approximately 70% of the US adult population is aware of their hypertension (Hajjar and Kotchen, 2003; Cutler et al., 2008). By using physician-based diagnoses we may identify previously undiagnosed individuals and therefore be including a more truly representative hypertensive sample population.

One hypothesis for the relationship between hypertension and suicidal behavior is that the medications used to treat hypertension, such as B-blockers and angiotensin-receptor antagonists, have a significant association with suicide. Studies have shown mixed data, however this hypothesis does have some support in the literature (Sørensen et al., 2001; Callréus et al., 2007). Again, more research is necessary in order to gain a better understanding of the interplay among these factors and potential effectiveness of any intervention.

The finding of a significant association between number of physical conditions and suicidal behavior is consistent with previous literature (Druss and Pincus, 2000; Goodwin et al., 2003a; Taylor et al., 2007; Scott et al., 2010). This finding has largely been attributed to an increase in functional disability, impairment, distress, and suffering.

It is also important to note that some studies have found significant associations between certain physical disorders and suicide that were not seen in our study. These include

### Table 3

<table>
<thead>
<tr>
<th>Condition</th>
<th>No suicidal behavior, n (%)</th>
<th>Suicidal behavior, n (%)</th>
<th>AOR1 (95% CI)</th>
<th>AOR2 (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory disorder</td>
<td>81 (12.5%)</td>
<td>43 (21.4%)</td>
<td>1.94 (1.20–3.12) **</td>
<td>1.72 (1.07–2.76) **</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>206 (31.7%)</td>
<td>79 (39.3%)</td>
<td>1.49 (1.02–2.17) *</td>
<td>1.40 (0.96–2.04)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>27 (4.2%)</td>
<td>6 (3.0%)</td>
<td>0.85 (0.42–1.02)</td>
<td>0.69 (0.26–1.82)</td>
</tr>
<tr>
<td>Renal disorder</td>
<td>130 (20.0%)</td>
<td>52 (25.9%)</td>
<td>1.23 (0.81–1.86)</td>
<td>1.17 (0.77–1.79)</td>
</tr>
<tr>
<td>Cardiac</td>
<td>30 (4.6%)</td>
<td>12 (6.0%)</td>
<td>2.05 (0.87–4.83)</td>
<td>1.78 (0.74–4.25)</td>
</tr>
<tr>
<td>Thyroid</td>
<td>144 (22.2%)</td>
<td>56 (27.9%)</td>
<td>1.31 (0.87–1.97)</td>
<td>1.26 (0.83–1.89)</td>
</tr>
<tr>
<td>Liver</td>
<td>33 (5.1%)</td>
<td>11 (5.5%)</td>
<td>0.98 (0.44–2.18)</td>
<td>0.96 (0.42–2.18)</td>
</tr>
<tr>
<td>Allergy</td>
<td>272 (41.9%)</td>
<td>93 (46.3%)</td>
<td>1.37 (0.94–2.00)</td>
<td>1.35 (0.92–1.97)</td>
</tr>
<tr>
<td>Arthritis</td>
<td>235 (36.2%)</td>
<td>77 (38.3%)</td>
<td>1.14 (0.78–1.61)</td>
<td>1.09 (0.74–1.61)</td>
</tr>
<tr>
<td>Cancer</td>
<td>23 (3.5%)</td>
<td>9 (4.5%)</td>
<td>0.90 (0.37–2.16)</td>
<td>0.81 (0.34–1.94)</td>
</tr>
<tr>
<td>Migraine</td>
<td>167 (25.7%)</td>
<td>60 (29.8%)</td>
<td>1.09 (0.73–1.61)</td>
<td>1.07 (0.72–1.59)</td>
</tr>
<tr>
<td>Thrombosis</td>
<td>30 (4.6%)</td>
<td>11 (5.5%)</td>
<td>1.01 (0.44–2.30)</td>
<td>0.95 (0.40–2.18)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>116 (17.9%)</td>
<td>46 (22.9%)</td>
<td>1.75 (1.09–2.84) *</td>
<td>1.61 (1.01–2.58) **</td>
</tr>
<tr>
<td>Number of physical conditions</td>
<td>–</td>
<td>–</td>
<td>1.20 (1.08–1.34) **</td>
<td>1.16 (1.04–1.30) **</td>
</tr>
</tbody>
</table>

AOR1—Adjusted for sociodemographic variables from Table 1.
AOR2—Adjusted for sociodemographic variables and the presence of a comorbid anxiety disorders or substance abuse/dependence.

* p < 0.05.
** p < 0.01.
migraine (Ratcliffe et al., 2009), arthritis (Timonen et al., 2003), and cancer (Druss and Pincus, 2000). The current study assesses physical illness and associated suicidal behavior among those with a history of a mood disorder aged 18–65, does not select for any certain type or group of physical disorders, and adjusts for a wide range of mental disorders. Due to these inherent differences in methodology it is not possible to directly compare results from these previous studies to the results we have found.

There are several limitations of this study. Due to the cross-sectional nature of the data it is not possible to determine causality, nor is it possible to predict risk. We were not able to study the relationship between suicidal behavior and the severity, extent of disability, or chronicity of disease due to the low prevalence of some disorders in this study (notably cancer and diabetes) and limited information for many disorders. Personality disorders were not assessed. Although diagnoses were physician assessed, the possibility for recall bias in the self-reporting of suicidal behavior exists. Under reporting of depressive symptoms or “recall failure” of lifetime major depression prevalence has been described (Patten, 2003). Also, those without a history of a mood disorder were not directed to the questions about suicidal behavior, and the study did not include those under the age of 18, or over the age of 65. These factors limit the generalizability of these findings to youth, the elderly, and those with suicidal behavior without a history of a mood disorder. Finally, there was no data available on completed suicide. These limitations should be addressed in future studies so that a more complete understanding of these relationships can be achieved.

Despite these limitations, the present study is unique in that it uses a large population based sample with physician-diagnosed physical conditions, as well as the assessment of mental disorders using a well-validated diagnostic instrument. Although no causal relationships can be determined, these findings add to the current body of literature concerning the association of physical illness and suicidal behavior. Specifically, among individuals with a history of a mood disorder, respiratory and hypertensive diseases are significantly associated with increased odds of suicidal ideation, planning, and attempts. Although the mechanisms of these associations are not fully understood, future studies may identify important biological, environmental, and psychosocial risk factors that can be used to better appreciate the relationship between certain physical conditions and suicidal behavior. It is anticipated that an increased understanding of these relationships could have significant effects on both the study and the clinical treatment of these conditions.

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Conflict of interest
All the authors declare that they have no conflicts of interest.

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