**Relationship between physical conditions and attempted or completed suicide in more than 9,300 individuals from the United Kingdom: a case-control study**

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*Running title:* Physical conditions and suicide

**Abstract**

*Aims:* The present study of 9,352 adults from the United Kingdom aimed to analyze associations between physical conditions and attempted or completed suicide.

*Methods:* This case-control study included patients aged 16-90 years with a first attempted or completed suicide who were followed in general practices in the United Kingdom between January 2008 and December 2017 (index date). Individuals who had not attempted or completed suicide were matched (1:1) to those who had attempted or completed suicide by sex, age, index year, index month, and practice. Variables included sex, age, index year, index month, and all physical and psychiatric conditions diagnosed in more than 1% of patients who had attempted or completed suicide in the year prior to the index date. A multivariable logistic regression analysis was performed to assess possible associations.

*Results:* The case-control study included 4,676 patients who had and 4,676 patients who had not attempted or completed suicide. After (1:1) matching, 52.1% of the patients were women and the mean (standard deviation) age was 33.6 (15.1) years. After adjusting for psychiatric conditions, we found that three past-year physical conditions were significantly associated with attempted or completed suicide. These conditions were unspecified injuries to the head (odds ratio [OR]=4.26, 95% confidence interval [CI]=2.27-8.00), sleep disorders (OR=1.60, 95% CI=1.09-2.32), and epilepsy (OR=1.57, 95% CI=1.04-2.39).

*Conclusions:* Head injuries, sleep disorders, and epilepsy were associated with attempted or completed suicide. Further research is needed to gain a better understanding of the mechanisms underlying these relationships.

**Keywords:** physical conditions; attempted suicide; completed suicide; United Kingdom; case-control study.

**Introduction**

Each year, suicide accounts for approximately 800,000 deaths around the world [1]. Suicide is responsible for 1.4% of premature deaths worldwide and is the second leading cause of death in adolescents and young adults. Attempted suicide is even more frequent, and previous research has indicated that the one-year prevalence of attempted suicide is between 0.3% and 0.4% [2]. Furthermore, attempted suicide is one of the strongest risk factors for completed suicide, and one meta-analysis has showed that attempted suicide or deliberate self-harm is associated with a 16-fold increase in suicide risk [3]. Based on these figures, better understanding risk factors for suicidal behavior and completed suicides in the general population is a public health priority.

Well-known risk factors for suicidal behavior include sociodemographic characteristics (e.g., sex, age and employment), unhealthy behaviors (e.g., alcohol consumption and drug use), and common psychiatric disorders (e.g., depression, anxiety, and schizophrenia) [4]. However, various physical conditions have also been found to be associated with suicidality. For example, a study including 209,915 individuals from Denmark showed that myocardial infarction was positively associated with the risk of suicide in people with or without psychiatric comorbidity [5]. Another retrospective cohort study found a positive relationship between traumatic brain injury (TBI) and suicide, as well as that this association remained significant even after accounting for a psychiatric diagnosis prior to the traumatic brain injury [6]. Moreover, previous cross-sectional research has found an association between multimorbidity (i.e. the presence of two or more chronic health conditions) and suicidal behavior [7]. Although an important body of literature has investigated the association between individual physical conditions and suicide, few studies have analyzed the effects of multiple physical disorders on suicidality at the same time [8–13]. These studies are subject to several limitations that need to be acknowledged. First, some of them were conducted in specific populations (e.g., patients with mood disorders [9], veterans [12], and middle-aged and older adults [13]), and thus the generalizability of their results may be limited. Second, since physical conditions were assessed based on self-reports in the majority of these studies [8,11–13], the findings may have been subject to recall or social desirability biases. Third, most of these studies have failed to include completed suicide [8,9,11–13], so more research is needed on the association between physical conditions and completed suicide.

Therefore, the goal of this study of 9,352 adults from the United Kingdom was to analyze potential associations between physical conditions and attempted or completed suicide. Given that there were more than 6,500 deaths by suicide in the United Kingdom in 2018 [14], identifying physical conditions strongly associated with attempted or completed suicide in this country is urgently needed to help establish prevention strategies.

**Methods**

*Database*

This study was based on data from the Disease Analyzer database (IQVIA), which compiles drug prescriptions, diagnoses, and basic medical and demographic data obtained directly and in anonymous format from computer systems used in the practices of general practitioners and specialists [15]. Diagnoses (International Classification of Diseases, 10th revision [ICD-10]), prescriptions (European Pharmaceutical Market Research Association [EphMRA] Anatomical Therapeutic Chemical [ATC] Classification system), and the quality of reported data are monitored by IQVIA based on a number of criteria (e.g., completeness of documentation, linkage between diagnoses and prescriptions).

In the United Kingdom, the sampling methods used to select physicians’ practices were appropriate for obtaining a representative database of people followed in general practices [15]. The sampling method for the Disease Analyzer database is based on statistics from all physicians in the United Kingdom. These statistics are used to determine the panel composition according to the following strata: region, community size category, and physician age.

*Study population*

This case-control study included patients aged 16-90 years with a first attempted or completed suicide who were followed in general practices in the United Kingdom between January 2008 and December 2017 (index date). Attempted and completed suicides were documented by general practitioners in a note. Attempted suicide could not be distinguished from completed suicide. Individuals who had not attempted or completed suicide were matched (1:1) to those who had attempted or completed suicide by sex, age, index year, index month, and practice (exact matching). For patients who had not attempted or completed suicide, a randomly selected visit date between January 2008 and December 2017 was selected (index date; Figure 1).

*Study variables*

Variables included sex, age, index year, index month, and all physical and psychiatric conditions diagnosed in more than 1% of patients who had attempted or completed suicide in the year prior to the index date. Diagnoses of physical and psychiatric conditions relied on the ICD-10 classification. Psychiatric conditions included depression (ICD-10: F32, F33), anxiety disorders (F41), mental and behavioral disorders due to use of alcohol (F10), mental and behavioral disorders due to multiple drug use and use of other psychoactive substances (F19), reaction to severe stress and adjustment disorders (F43), specific personality disorders (F60), bipolar affective disorder (F31), schizophrenia (F20), and sexual dysfunction not caused by an organic disorder or disease (F52).

*Statistical analyses*

The prevalence of physical and psychiatric conditions diagnosed in the year prior to the index date was compared between individuals who had and those who had not attempted or completed suicide using the Chi-squared test. Associations between physical conditions and attempted or completed suicide were analyzed before and after adjusting for psychiatric conditions. Physical conditions were included in the regression model using forward stepwise selection. We adjusted for psychiatric disorders in order to distinguish the physical conditions directly associated with attempted or completed suicide from those for which the association likely involved at least one psychiatric condition. Since patients who had not attempted or completed suicide were matched (1:1) to patients who had attempted or completed suicide by sex, age, index year, index month, and practice, the regression models were not adjusted for these variables. P-values lower than 0.05 were considered statistically significant. All analyses were performed using SAS 9.4.

**Results**

This case-control study included 4,676 patients who had and 4,676 patients who had not attempted or completed suicide. From 4,676 cases, 79% have completed suicide. After 1:1 matching, 52.1% of the patients were women, and the mean (standard deviation) age was 33.6 (15.1) years (Table 1). Thirteen physical conditions were significantly more frequent in participants who had than in those who had not attempted or completed suicide, while all psychiatric conditions except sexual dysfunction not caused by organic disorder or disease were more common in the suicide/suicide attempt than in the non-suicide/non-suicide attempt group (Table 2). Before adjusting for psychiatric conditions, there were seven physical conditions positively associated with attempted or completed suicide (i.e. unspecified injuries to the head, sleep disorders, chronic obstructive pulmonary disease, epilepsy, other functional intestinal disorders, other gastroenteritis and colitis of infectious and unspecified origin, and dorsalgia). After adjusting for psychiatric conditions, only three physical conditions remained significant, namely unspecified injuries to the head (odds ratio [OR]=4.26, 95% confidence interval [CI]=2.27-8.00), sleep disorders (OR=1.60, 95% CI=1.09-2.32), and epilepsy (OR=1.57, 95% CI=1.04-2.39).

**Discussion**

*Main findings*

This case-control study of more than 9,300 patients showed that numerous physical conditions were more frequent in those who had than in those who had not attempted or completed suicide. Furthermore, we found in the regression model adjusted for psychiatric conditions that unspecified injuries to the head, sleep disorders, and epilepsy were significantly associated with attempted or completed suicide, suggesting that these physical conditions may have independent effects on suicidality.

*Interpretation of the findings*

One major finding of this study is that brain injury was positively associated with attempted or completed suicide, a finding that is in line with previous studies [6,16,17]. Several hypotheses may explain the association between brain injury and attempted or completed suicide. First, TBI has negative effects on cognition, and cognitive impairments are known to increase the risk of suicide. For example, a nationwide cohort study of participants from Sweden found that those with TBI were more likely to be diagnosed with dementia than those without TBI, and the association was stronger for severe and multiple TBI [18]. Meanwhile, a longitudinal study using data from Denmark showed that hospital-diagnosed dementia was a risk factor for suicide, and the relationship remained significant even after adjusting for mood disorders [19]. Second, TBI is a major life event that can trigger unhealthy behaviors, and these unhealthy behaviors may be positively associated with suicide risk. A nationally representative cross-sectional survey of participants aged ≥12 years from Canada found that use of illicit drugs significantly increased in the year following TBI [20], and these drugs (e.g., cannabis and cocaine) increased the odds of suicidal ideation and suicide attempt [21]. Third, unemployment is frequent after TBI, and unemployment may also favor suicidal behavior. It was observed in a prospective, multicenter study conducted in France that only 38% of patients were employed four years after TBI [22], and a systematic review and meta-analysis identified long-term unemployment as a predictor of suicide in the general population [23]. Fourth, TBI is related to impulsivity and aggression [24], both of which are linked to suicide [25].

Another interesting result of this case-control study is the positive relationship between sleep disorders and attempted or completed suicide. An important body of literature has recently shown that sleep disorders increase the risk of suicidality [26–28]. For example, a 2012 meta-analysis of 39 studies found a significant and positive association between sleep disturbance and suicidal ideation, suicide attempt, and suicide [26]. A key putative mediator between sleep problems and suicide is mental health, which we treated as a covariate in the current study. Sleep problems may lead to mental health problems, which in turn increase the risk for suicidal thoughts and behaviors. One longitudinal study showed that sleep problems at age 8 predicted depression at age 10 [29]. Another study showed that sleep problems in childhood predicted anxiety disorders in adulthood, but not depression [30]. A sizeable body of literature has linked these mental health outcomes to suicidal thoughts and behaviors [3]. However, sleep disturbances may also be a symptom of mental health problems or a side effect of medication use [31]. Another mediator likely involved in the association between sleep disorders and suicidality is physical inactivity. A Finnish prospective cohort study showed that individuals reporting insomnia symptoms were at an increased risk for physical inactivity compared to those without insomnia [32]. Interestingly, a meta-analysis of 18 studies showed that inactive people were more likely to report suicidal ideation than their active counterparts, and not meeting physical activity guidelines was a risk factor for suicidal ideation [33]. Furthermore, sleep disorders may also favor the occurrence of binge drinking [32], and heavy drinking is a risk factor for suicidality in adults [34]. A fourth mediator that may play an important role in the sleep disorder-suicide relationship is impaired quality of life. Specifically, sleep problems can negatively affect a wide range of health-related quality of life measures (e.g., physical functioning, general health, and social functioning) [35]. In turn, decreased health-related quality of life may increase the risk for suicidal ideation and suicide attempt [36].

A positive and significant association was also observed between epilepsy and attempted or completed suicide in the present study, confirming previous findings obtained in different settings. For instance, one multi-country study investigating the relationship between 13 physical conditions and suicidal behavior in 37,915 participants identified epilepsy as the strongest risk factor for suicidality [8]. One key mediator in the association between epilepsy and attempted or completed suicide is fracture. A case-control study using the data of approximately 35,000 participants found that the use of antiepileptic drugs increased the risk of hip fracture potentially via decreased bone mineral density and increased fall risk [37]. In addition, a study including more than 165,600 patients from Taiwan showed that, after adjusting for age, sex, and each patient’s comorbidity history, fracture was an independent risk factor for suicidal behavior [38]. Lack of social support may also mediate the effects of epilepsy on attempted and completed suicide. A case-control study conducted in China revealed that levels of family cohesion, marriage quality, and social support were lower in patients with epilepsy than in controls [39], while a large body of literature has identified a lack of social support as a risk factor for suicide [40–42].

Interestingly, we identified four physical conditions (i.e. chronic obstructive pulmonary disease, other functional intestinal disorders, other gastroenteritis and colitis of infectious and unspecified origin, and dorsalgia) that were significantly associated with attempted or completed suicide prior to but not after adjustment for psychiatric conditions. This last finding suggests that these associations are likely mediated by psychiatric disorders. For example, a study based on a sample of adults from Canada showed that chronic obstructive pulmonary disease was a risk factor for past-year generalized anxiety disorder even after adjusting for a wide range of factors (e.g., social support, health behaviors, and early childhood adversities) [43]. Another longitudinal study of 1,269 adult twins from Spain demonstrated a significant and positive relationship between lower back pain and the risk of depression and anxiety symptoms [44].

Finally, in the present study, cancer was not significantly associated with attempted or completed suicide. On contrast, it was found in a previous matched-control study conducted in Canada that there was a positive association between cancer and risk of death from suicide [45]. It was further showed in England that patients with cancer were a particularly high risk for suicide in the six months following cancer diagnosis [46]. Therefore, the lack of significant association between cancer and attempted or completed suicide in this study must be interpreted with caution. One hypothesis to explain this finding is that cancer survivors at a particular risk for suicide were followed by psychiatrists and oncologists and not by general practitioners, and thus were not included in this study.

*Clinical implications and directions for future research*

Based on the study findings, the presence of physical conditions should not be overlooked when identifying patients at a particular risk for suicide. In addition, these results clearly show that the management of physical conditions is important not only to prevent the complications of these disorders but also to prevent suicidal behavior and suicides. Finally, the proper management of physical conditions in people at a high risk for suicidality requires a good dialogue between general practitioners, specialists (e.g., neurologists), and mental health professionals (e.g., psychiatrists). In terms of future research, more studies are needed to investigate the mediators involved in the associations between physical conditions and suicide.

*Strengths and limitations*

The two major strengths of this case-control study are the use of data obtained in general practices and the inclusion of the majority of physical conditions documented in the database. Nonetheless, the findings of this study should be interpreted in the light of several limitations. First, the diagnosis of physical conditions relied on ICD-10 codes only, while more information on the severity and the duration of these disorders may have allowed more detailed statistical analyses. Second, attempted or completed suicide was documented by physicians using a personal note, and some patients with a suicidal history may have been misclassified as controls who had not attempted or completed suicide. Third, several factors such as employment, income, and social support were lacking, although these variables may play a mediating or confounding role in the relationship between physical conditions and suicidality. Fourth, this study included patients who were followed in general practices, and therefore, the results may not be generalizable to those followed in psychiatric practices or the general population. Finally, data were analyzed in the UK, and these findings may not be extrapolated to populations in other countries.

*Conclusions*

Injuries to the head, sleep disorders, and epilepsy were significantly associated with attempted or completed suicide. Further research is needed to gain a better understanding of the mechanisms underlying these relationships.

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**Figure 1.** Selection of study patients

**Une image contenant capture d’écran

Description générée automatiquement**

**Table 1.** Baseline characteristics of study patients prior to and after 1:1 matching by sex, age, index year, index month, and physician

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variables | Prior to 1:1 matching | | After 1:1 matching | |
| Individuals who had attempted or completed suicide | Individuals who had not attempted or completed suicide | Individuals who had attempted or completed suicide | Individuals who had not attempted or completed suicide |
| N | 4,816 | 2,233,481 | 4,676 | 4,676 |
| Female gender | 52.2 | 52.5 | 52.1 | 52.1 |
| Male gender | 47.8 | 47.5 | 47.9 | 47.9 |
| Mean age in years (standard deviation) | 33.6 (15.3) | 44.5 (19.5) | 33.6 (15.1) | 33.6 (15.1) |
| *Age groups (years)* | | | | |
| Age 16-20 | 24.2 | 9.8 | 23.6 | 23.6 |
| Age 21-25 | 15.7 | 10.2 | 15.9 | 15.9 |
| Age 26-30 | 11.3 | 10.0 | 11.5 | 11.5 |
| Age 31-35 | 9.2 | 9.0 | 9.3 | 9.3 |
| Age 36-40 | 9.7 | 8.7 | 9.9 | 9.9 |
| Age 41-45 | 9.3 | 8.8 | 9.4 | 9.4 |
| Age 46-50 | 7.2 | 7.9 | 7.3 | 7.3 |
| Age 51-60 | 7.6 | 12.7 | 7.5 | 7.5 |
| Age >60 | 5.9 | 23.0 | 5.7 | 5.7 |

Data are listed in % unless otherwise stated.

**Table 2.** Prevalence of psychiatric and physical conditions in patients who had or had not attempted or completed suicide

|  |  |  |  |
| --- | --- | --- | --- |
| Diagnosis (ICD-10 code) | Proportion in individuals who had attempted or completed suicide (%) | Proportion in individuals who had not attempted or completed suicide (%) | p-value |
| *Psychiatric conditions* | | | |
| Depression (F32, F33) | 26.7 | 5.8 | <0.001 |
| Anxiety disorders (F41) | 11.4 | 3.7 | <0.001 |
| Mental and behavioral disorders due to use of alcohol (F10) | 6.7 | 0.6 | <0.001 |
| Mental and behavioral disorders due to multiple drug use and use of other psychoactive substances (F19) | 2.5 | 0.7 | <0.001 |
| Reaction to severe stress and adjustment disorders (F43) | 2.5 | 0.4 | <0.001 |
| Specific personality disorders (F60) | 2.2 | 0.1 | <0.001 |
| Bipolar affective disorder (F31) | 1.1 | 0.1 | <0.001 |
| Schizophrenia (F20) | 1.0 | 0.1 | <0.001 |
| Sexual dysfunction not caused by organic disorder or disease (F52) | 1.0 | 0.7 | 0.116 |
| *Physical conditions* | | | |
| *Diseases of the nervous system* | | | |
| Sleep disorders (G47) | 2.7 | 1.0 | <0.001 |
| Epilepsy (G40) | 1.6 | 0.9 | 0.001 |
| Migraine (G43) | 1.6 | 1.4 | 0.398 |
| *Endocrine, nutritional, and metabolic diseases* | | | |
| Diabetes mellitus (E10-E14) | 2.9 | 2.7 | 0.662 |
| Disorders of the thyroid gland (E00-E07) | 1.8 | 1.5 | 0.289 |
| Obesity (E66) | 1.1 | 1.0 | 0.479 |
| Dyslipidemia (E78) | 1.0 | 1.1 | 0.919 |
| *Diseases of the respiratory system* | | | |
| Asthma (J45) | 7.1 | 6.1 | 0034 |
| Acute upper respiratory infections of multiple and unspecified sites (J06) | 4.2 | 3.5 | 0.086 |
| Unspecified acute lower respiratory infection (J22) | 3.5 | 2.6 | 0.016 |
| Acute pharyngitis (J02) | 3.0 | 2.8 | 0.457 |
| Acute tonsillitis (J03) | 2.4 | 2.2 | 0.489 |
| Vasomotor and allergic rhinitis (J30) | 2.1 | 2.0 | 0.662 |
| Acute sinusitis (J01) | 1.2 | 1.4 | 0.418 |
| Chronic obstructive pulmonary disease (COPD) (J44) | 1.1 | 0.6 | 0.002 |
| *Diseases of the digestive system* | | | |
| Other gastroenteritis and colitis of infectious and unspecified origin (A09) | 3.1 | 1.9 | <0.001 |
| Other functional intestinal disorders (K59) | 2.2 | 1.2 | 0.005 |
| Functional dyspepsia (K30) | 2.0 | 1.4 | 0.017 |
| Irritable bowel syndrome (K58) | 1.7 | 1.1 | 0.013 |
| Gastro-esophageal reflux disease (K21) | 1.3 | 0.9 | 0.029 |
| Hemorrhoids and perianal venous thrombosis (K64) | 1.0 | 0.7 | 0.094 |
| *Diseases of the skin and subcutaneous tissue* | | | |
| Acne (L70) | 1.8 | 2.1 | 0.263 |
| Atopic dermatitis (L20) | 1.6 | 1.9 | 0.385 |
| Other dermatitis (L30) | 1.3 | 1.2 | 0.645 |
| Psoriasis (L40) | 1.1 | 0.9 | 0.176 |
| *Diseases of the musculoskeletal system and connective tissue* | | | |
| Dorsalgia (M54) | 8.7 | 6.5 | <0.001 |
| Shoulder lesions (M75) | 1.3 | 1.1 | 0.390 |
| Arthrosis of the first carpometacarpal joint (M19) | 1.2 | 0.7 | 0.043 |
| *Other diseases* | | | |
| Hypertension (I10) | 4.3 | 4.9 | 0.236 |
| Candidiasis (B37) | 1.9 | 1.6 | 0.264 |
| Ischemic heart diseases (I20-I25) | 1.6 | 1.3 | 0.294 |
| Unspecified injuries to the head (S09) | 1.3 | 0.3 | <0.001 |
| Dermatophytosis (B35) | 1.2 | 1.5 | 0.206 |
| Cancer (C00-C99) | 1.2 | 1.2 | 0.317 |

**Table 3.** Association between physical conditions and attempted or completed suicide before and after adjusting for psychiatric conditions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Diagnosis (ICD-10 code) | Before adjusting for psychiatric conditions | | After adjusting for psychiatric conditions | |
| Odds ratio (95% confidence interval) | p-value | Odds ratio (95% confidence interval) | p-value |
| Unspecified injuries to the head (S09) | 4.84 (2.65-8.83) | <0.001 | 4.26 (2.27-8.00) | <0.001 |
| Sleep disorders (G47) | 2.65 (1.89-3.72) | <0.001 | 1.60 (1.09-2.32) | 0.015 |
| Chronic obstructive pulmonary disease (COPD) (J44) | 1.97 (1.22-3.16) | 0.005 | 1.56 (0.93-2.63) | 0.094 |
| Epilepsy (G40) | 1.69 (1.15-2.50) | 0.008 | 1.57 (1.04-2.39) | 0.033 |
| Other functional intestinal disorders (K59) | 1.62 (1.16-2.25) | 0.004 | 1.13 (0.79-1.63) | 0.510 |
| Other gastroenteritis and colitis of infectious and unspecified origin (A09) | 1.60 (1.22-2.10) | <0.001 | 1.16 (0.86-1.57) | 0.331 |
| Dorsalgia (M54) | 1.34 (1.14-1.56) | <0.001 | 1.08 (0.91-1.29) | 0.364 |

Physical conditions were included as independent variables and were selected based on forward stepwise selection. All psychiatric conditions displayed in Table 2 were included in the model adjusted for psychiatric comorbidity.