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Associations between mental disorders and the common cold in adults: a population-based cross-sectional study

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ABSTRACT

Objective: To investigate the association between specific mental disorders and the common cold.

Methods: Negative binomial regression analyses were applied to examine cross-sectional associations of a broad range of mental disorders according to the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)* employing the standardized diagnostic Munich Composite International Interview, with the self-reported number of occurrences of the common cold during the past 12 months in a representative population sample of 4022 German adults aged 18–65 years.

Results: After adjustment for covariates including age, gender, and marital and socioeconomic status, having any 12-month *DSM-IV* mental disorder (incidence rate ratio [IRR] = 1.44, 95% confidence interval [CI] = 1.29–1.60), any substance abuse or dependence (IRR = 1.32, 95% CI = 1.14–1.52), possible psychotic disorder (IRR = 1.43, 95% CI = 1.09–1.87), any mood disorder (IRR = 1.35, 95% CI = 1.16–1.56), any anxiety disorder (IRR = 1.40, 95% CI = 1.23–1.59), or any somatoform disorder (IRR = 1.38, 95% CI = 1.18–1.62) was shown to be positively associated with the number of occurrences of a cold during the past 12 months.

Conclusion: The presence of a *DSM-IV* mental disorder was associated with a 44% higher risk of having experienced a cold in the past 12 months. Further studies are needed to explore potential common risk factors for incidence of mental disorders and the common cold, since the pathway connecting them has not been fully determined.

Keywords: common cold, cross-sectional, mental disorder, population-based sample

Introduction

Several studies have revealed that poor mental health conditions including perceived stress [1-3] and negative mood [2, 4, 5] are risk factors for developing a common cold. However, prior data relate to symptom scales rather than diagnoses of mental disorders. As yet, it is unclear whether the presence of a mental disorder has an impact on susceptibility to the common cold.

The link of mental disorders with the common cold is an important public health matter. Both mental disorders and the common cold are prevalent in general populations and are associated with a high economic burden in terms of work absenteeism and health care costs [6-8]. Recent estimates indicate that every year over 38.2% of the total European population of 30 countries, or 164.8 million people, suffers from at least one mental disorder [6]. In addition, the common cold is one of the most frequent infectious illnesses [9]. It has been reported that adults experience on average two to five colds per person each year [10]. Symptoms of the common cold, including nasal stuffiness and discharge, sore throat, chills, cough, headache, and malaise, are so common that tests are of no use in diagnosing the common cold [9]. More than 200 types of viruses have been detected as being responsible for colds, yet up to 30% of all colds still remain without a proven viral cause [9].

Available knowledge of the impact of mental health on the vulnerability to upper respiratory infections largely relies on experimental studies, in which subjects fulfilling certain health conditions were exposed to viruses [3]. According to the findings from the World Mental Health Surveys [11], growing numbers of people frequently experience co-occurrence of physical and mental disorders. Examining the relationship of mental disorders and occurrences of the common cold in a general population is therefore an urgent issue.

The present study investigates whether, and to what extent, a broad range of *DSM-IV (Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition)* [12] mental disorders (i.e., substance, mood, anxiety, and somatoform disorders), diagnosed with the standardized diagnostic Munich Composite International Diagnostic Interview (M-CIDI) [13], are associated with subjects' self-reported number of occurrences of the common cold during the past 12 months in a representative population sample aged 18–65 years.

Methods

Design

We used data from the German National Health Interview and Examination Survey (GHS) [14]. The GHS was conducted to supply representative nationwide epidemiologic data on major mental and physical disorders, impairments, and healthcare utilization. The GHS was based on a stratified, cross-sectional sample randomly drawn from the population registries of individuals living in Germany in 1997. Data were collected between November 1997 and April 1999 [14]. The GHS was commissioned by the German Ministry of Research, Education, and Science and the Robert Koch Institute and approved by the relevant institutional review board and ethics committee. All subjects provided written informed consent. A detailed description of the GHS methodology and sampling is available elsewhere [14]. Data of the present study are based on the sample of the GHS Mental Health Supplement (GHS-MHS) that was conducted in individuals aged 18 to 65 years ($n = 4181$; conditional response rate 87.6% from $N = 4775$ eligible subjects) [14, 15]. There were no differences between the respondents and nonrespondents in terms of gender, age, and self-reported health status [14].

Measures

Mental disorders

The computer-assisted version of the Munich Composite International Diagnostic Interview (DIA-X/M-CIDI) [13], administered by clinically trained psychologists and physicians, was employed in assessments of mental disorder diagnoses in the GHS-MHS. The fully structured DIA-X/M-CIDI is a modified version of the World Health Organization CIDI (version 1.2), supplemented by questions to cover *DSM-IV* and International Classification of Diseases, version 10 (ICD-10) criteria. Mental disorder diagnoses reported in the study were obtained using the DIA-X/M-CIDI diagnostic algorithms for 12-month *DSM-IV* criteria [13]. Details of psychometric properties and feasibility of the DIA-X/M-CIDI are available elsewhere [16, 17]. In summary, the test–retest reliability of the full DIA-X/M-CIDI was good, with kappa values ranging between 0.56 and 0.81 [16]. The validity of the full DIA-X/M-CIDI diagnoses compared to diagnoses from independent treating physicians in a sample of 68 randomly chosen patients ranges from moderate to excellent [16]. The sensitivity of the DIA-X/M-CIDI mental disorder diagnoses ranges from 87.5% to 100%, while their specificity ranges from 71.2% to 100% [17].

The present study included the following 12-month *DSM-IV* mental disorder diagnostic categories: substance use disorders (alcohol abuse or dependence, nicotine dependence, illicit substance abuse or dependence), possible psychotic disorder, mood disorders (major depression, dysthymia, bipolar disorders), anxiety disorders (panic disorder, agoraphobia, social phobia, specific phobia [animal, natural environment, blood-injection-injury, situational type], generalized anxiety disorder, obsessive-compulsive disorder), and somatoform syndromes and disorders (somatic symptom index 4/6, pain disorder).

Number of occurrences of a cold

All subjects were asked to report the number of occurrences of a cold during the previous 12 months with the question, “In the previous 12 months, did you have once or several times an influenza or a common cold, so that you could not go to work or carry out your daily activities?” (no, once, several times). If subjects reported having had an influenza or a common cold several times during the past 12 months, they were subsequently asked to report how often an influenza or a common cold had occurred in that period.

Sociodemographic information

We considered gender, age, and marital and socioeconomic status as covariates because these have been linked with both mental disorders and common cold occurrences in previous studies [1, 15, 18]. Age was treated as a continuous measure. Marital status was dichotomized (in relationship, not in relationship). Socioeconomic status was dichotomized according to the Winkler Index [19] that uses information about educational level, monthly net household income, and occupational position as indicators (middle/high, low).

Statistical analyses

The dependent variable was the number of occurrences of a cold during the previous 12 months. A count variable has certain properties: (a) it takes on whole numbers only, (b) it can never be negative, and (c) it tends to be positively skewed [20]. Since a count variable often does not meet the assumptions of normality and homoscedasticity which is required for ordinary least squares regression [21] a Poisson model is often preferred. The Poisson model, however, assumes that the

variance of the counts is equal to the mean [20]. In the case of over-dispersion, i.e., when the variance of the dependent variable is larger than the mean, the negative binomial model, which is an extension to the Poisson model as it captures the extent of overdispersion, is generally better suited [21]. As the number of occurrences of a cold showed considerable overdispersion, we used negative binomial regression model to analyse the associations between the *DSM-IV* mental disorders (predictors) and the self-reported number of occurrences of a cold (outcome) during the previous 12 months. Model coefficients are reported in terms of incidence rate ratios (IRRs) with 95% confidence intervals (CIs), because parameter estimates based on the analysis of counts are generally expressed in terms of IRRs [21]. IRR here denotes by which factor the estimated number of occurrences of a cold is increased if having a specific DSM-IV mental disorder [21]. In addition, we checked for multicollinearity among all variables considered in the study. An increased degree of multicollinearity (i.e., an inflation factor greater than 10) may cause a risk for the unstable estimation of the regression coefficients [22]. Variances of inflation factor values of the present data were unproblematic, ranging from 1.01 to 1.26.

Covariates in the analysis included gender, age, and marital and socioeconomic status. The appropriate statistical weight was applied in all analyses to ensure that the data were representative of the population [14]. A p value $< .05$ was considered statistically significant. Analyses were performed using STATA 10.0 [23].

Study subjects

A total of 4181 GHS-MHS subjects were eligible for this study objective. Of these, 126 subjects were excluded from the study due to missing data; in 90 subjects

the number of occurrences of a cold was not reported and 36 subjects did not report their marital and/or socioeconomic status. Among the 4055 subjects with complete data that were relevant to the study, we detected multivariate outliers. We defined an outlier as an observation whose dependent-variable value was unusual given its values on the predictor variables, which may have been caused by a sample peculiarity or a data entry error [24]. Since the outliers may have had an overall impact on the estimations, we examined Studentized residuals and their distributions with plots. We detected 33 subjects with absolute Studentized residuals greater than 3 as outliers and excluded them from the analyses. The present analyses were done on a total of 4022 subjects aged 18 to 65 years (96.9% of the GHS-MHS subjects).

Results

Among the 4022 subjects included in the study, 2021 were male (50.3%). The mean age of the study subjects was 41.8 years (SD = 13.1). The majority were in a relationship ($n = 2583$; 64.2%), and 3265 subjects (81.2%) of the study sample had middle or high socioeconomic status. A proportion of 1.3% ($n = 52$) of the study sample received treatment in a psychiatric hospital at any point in their lives. Table 1 provides the sociodemographic characteristics of the sample. The study subjects reported a total of 1563 occurrences of a cold (mean = 0.55; SD = 0.83; range 0–5 episodes) during the past 12 months.

- Table 1 about here -

Overall, subjects with any one of the explored *DSM-IV* mental disorders had a higher IRR of colds than the reference subjects (i.e., subjects without any of the explored *DSM-IV* mental disorder) during the past 12 months (see Table 2). After adjustments for sociodemographic covariates, a 44% higher risk of having

experienced a cold was found in subjects with any *DSM-IV* mental disorder compared to subjects with no *DSM-IV* mental disorders (IRR = 1.44, 95% CI = 1.29–1.60). Likewise, a risk of having experienced a cold was 43% higher in subjects with a possible psychotic disorder compared to subjects without a possible psychotic disorder (IRR = 1.43, 95% CI = 1.09–1.87), 40% higher in subjects with any anxiety disorder compared to subjects without any anxiety disorder (IRR = 1.40, 95% CI = 1.23–1.59), 38% higher in subjects with any somatoform disorder compared to subjects without any somatoform disorder (IRR = 1.38, 95% CI = 1.18–1.62), 35% higher in subjects with any mood disorder compared to subjects without any mood disorder (IRR = 1.35, 95% CI = 1.16–1.56), and 32% higher in subjects with any substance abuse or dependence disorder compared to subjects without any substance abuse or dependence disorder (IRR = 1.32, 95% CI = 1.14–1.52) in the adjusted models.

With regard to relationships between each 12-month *DSM-IV* mental disorder and colds, presence of nicotine dependence (IRR = 1.28, 95% CI = 1.10–1.50), illicit substance abuse or dependence (IRR = 2.39, 95% CI = 1.73–3.30), major depression (IRR = 1.39, 95% CI = 1.17–1.64), dysthymia (IRR = 1.34, 95% CI = 1.07–1.68), panic (IRR = 1.57, 95% CI = 1.19–2.08), agoraphobia (IRR = 1.47, 95% CI = 1.06–2.04), specific phobia (IRR = 1.52, 95% CI = 1.29–1.78), somatic symptom index 4/6 (IRR = 1.39, 95% CI = 1.09–1.76), and pain (IRR = 1.26, 95% CI = 1.05–1.51) remained related to the number of occurrences of a cold, even after adjusting for sociodemographic covariates. There were no relationships between alcohol abuse or dependence or bipolar, social phobia, generalized anxiety, or obsessive-compulsive disorder and the number of occurrences of a cold.

- Table 2 about here -

Discussion

This study investigated the relationship between a broad range of *DSM-IV* mental disorders and the self-reported number of occurrences of the common cold during the past 12 months. Unlike previous research estimating associations of colds and mental health by using self-reports of mental health conditions related to symptom scales [1-5], this study used *DSM-IV* mental disorder diagnoses that were assessed with a well-established standardized diagnostic interview, administered by trained clinical interviewers. It is also noteworthy that our findings are based on data from a representative population sample, whereas earlier findings about the effect of mental health on the vulnerability to colds mostly relied on results from experimental studies that used subjects fulfilling certain health criteria. Consequently, this study was not limited by sampling selection bias and extends available knowledge on the association between mental health conditions and the common cold.

The present study supports findings from literature reporting the impact of mental health conditions on the occurrence of the common cold [1-5]. We found that subjects with a *DSM-IV* mental disorder had a 44% higher risk of having experienced a cold compared to those with no *DSM-IV* mental disorders during the past 12 months after adjustment for sociodemographic variables. Additionally, elevated risk for the occurrences of a cold was found in the presence of possible psychotic (43%), any anxiety (40%), any somatoform (38%), any mood (35%), and any substance use disorder (32%) in the adjusted models. Mental disorders with the highest-ranking risk of the occurrence of a cold were illicit substance disorder (139%), panic disorder (57%), and specific phobia (52%). Until now, presence of depression has received more attention than other mental disorders when examining the relationship between

mental health and infectious outcome [25, 26]. Therefore, future studies are needed to explore the role of a broad range of mental disorders in vulnerability to colds.

The question arises as to whether our findings indicate that (a) individuals with mental disorder are more susceptible to colds, (b) they have greater sensitivity to perceive symptoms of colds, (c) they have a tendency to over-report the occurrence of a common cold, (d) a common cold increases the risk for developing certain mental disorders, or (e) a common cold and certain mental disorders may share yet unknown common risk factors. There are several possible explanations for these five models.

First, psychological stress has been suggested to contribute to mental disorders [27]. Mental disorders may increase psychological stress and negative emotions in individuals as a result of considerable impairment to fulfilling daily functioning [28]. Therefore, presence of mental disorders may lead to a maladaptive immune system in individuals [29]. Additionally, emotional states have been found to affect individuals' engagement in health-promoting behaviors [30, 31]. Consequently, it is possible that individuals with a mental disorder are more likely to practice behaviors that are related to susceptibility to the common cold (i.e., less physical activity, poor sleeping habits, smoking). Second, it has been reported that negative emotions affect the cognitive perception of physical symptoms in individuals [32, 33]. It is possible that individuals with a mental disorder may interpret vague physical impressions more frequently as symptoms of colds compared to individuals without a mental disorder. Third, Cohen and colleagues [34] have noted that negative emotional style was associated with an over-reporting of unverified symptoms of colds, whereas positive emotional style was associated with an under-reporting of verified symptoms of colds. Although a high validity of the self-assessments of the

cold by subjects themselves compared with the assessments by physicians has been reported [35], possible inaccuracy in self-report assessment of colds without clinical and biological observation should be noted to interpret our findings. Fourth, Dantzer and colleagues [36] have suggested that pro-inflammatory cytokines, which can be induced by infectious agents, initiate “sickness behavior.” Sickness behavior, including weakness, malaise, fatigue, restlessness, sleep changes, fever, and reduced appetite, starts as a disease-coping strategy that promotes an effective immune response in the host to clear infectious agents [36]. However, prolonged or exacerbated sickness behavior may foster the development of symptoms of depression in vulnerable individuals [36]. Since our understanding of the possible contribution of infectious processes to the occurrence of mental disorders is still in its infancy [36], further research is needed to scrutinize this relationship. Fifth, although high prevalence of anxiety and depression in individuals with chronic breathing disorders has been reported [37-39], the pathophysiological mechanisms underlying these relationships remain unclear [40]. As several researchers have suggested [41-44], there is a need to routinely employ screening tools for anxiety and depression in nonpsychiatric medical settings. Anxiety and depression are associated with an increased risk of relapse rates in patients with chronic breathing disorders after treatment [38, 45]. Additionally, there is a report documenting that pulmonary rehabilitation has provided improvement in both physical performance and levels of anxiety and depression in patients with chronic obstructive pulmonary disease [46]. Closer interdisciplinary cooperation between physical and mental health care settings may help to determine possible common risk factors for mental disorders and colds.

There are limitations to this study that should be mentioned. (1) The observational nature of this study does not allow for examination of the mechanisms

by which mental disorders and colds are linked. (2) The cross-sectional nature of this study precludes determination of causality. A prospective study is needed to determine whether onset of mental disorders precedes the occurrences of a cold or whether incidence of a cold is a risk factor for the development of mental disorders, or whether mental disorders and colds have a transactional relationship. (3) Although we controlled for potential effects of sociodemographic variables, other unknown confounders that may influence the observed associations may remain unaccounted for. (4) We evaluated the association between one predictor and one outcome. However these two factors are ultimately linked, the development of a mental disorder as well as the development of colds surely is influenced by multiple risk factors and cannot be completely explained by a simple one-factor model. Therefore, the associations we found in our study may not be translated into one-factor disease models. Rather, they argue for the importance of these specific factors within complex models.

Within the context of these limitations, the current study extends prior findings by providing evidence that mental disorders are associated with the occurrence of colds. Our findings are compatible with recent findings from the World Mental Health Surveys [11] that revealed a growing number of individuals worldwide reporting frequent co-occurrence of mental and physical disorders. Further studies are needed to explore potential common risk factors for incidence of mental disorders and the common cold, since the pathway connecting mental health and susceptibility to the common cold has not been fully determined.

Conflict of interest

The authors declare no conflicts of interest.

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Table 1Sociodemographic characteristics of the study sample ($N = 4022$)

	<i>n</i>	%
Gender		
Male	2021	50.3
Female	2001	49.7
Age		Mean (41.8), SD (13.1)
Marital status		
In relationship	2583	64.2
Not in relationship	1439	35.8
Socioeconomic status		
Middle/high	3265	81.2
Low	757	18.8

SD standard deviation

Table 2

Crude and adjusted incidence rate ratios (IRRs) of cold episodes for *DSM-IV* mental disorders compared to the reference group that had no indexed mental disorder during the past 12 months ($N = 4022$)

<i>DSM-IV</i> mental disorder (<i>n</i>)	IRR <i>c</i>	95% CI	IRR <i>a</i>	95% CI
Any <i>DSM-IV</i> mental disorder (1555)	1.52*	(1.37–1.70)	1.44*	(1.29–1.60)
Any substance abuse or dependence (547)	1.44*	(1.24–1.66)	1.32*	(1.14–1.52)
Alcohol abuse or dependence (169)	1.17	(0.92–1.50)	1.13	(0.88–1.45)
Nicotine dependence (425)	1.41*	(1.20–1.66)	1.28*	(1.10–1.50)
Illicit substance abuse or dependence (29)	3.16*	(2.27–4.40)	2.39*	(1.73–3.30)
Possible psychotic (114)	1.53*	(1.15–2.03)	1.43*	(1.09–1.87)
Any mood (536)	1.42*	(1.22–1.65)	1.35*	(1.16–1.56)
Major depression (370)	1.47*	(1.24–1.74)	1.39*	(1.17–1.64)
Dysthymia (212)	1.32*	(1.06–1.64)	1.34*	(1.07–1.68)
Bipolar (39)	1.47	(0.85–2.53)	1.21	(0.72–2.01)
Any anxiety (695)	1.48*	(1.30–1.69)	1.40*	(1.23–1.59)
Panic (113)	1.67*	(1.24–2.24)	1.57*	(1.19–2.08)
Agoraphobia (97)	1.44*	(1.05–1.98)	1.47*	(1.06–2.04)
Social phobia (89)	1.48*	(1.08–2.01)	1.32	(0.97–1.79)
Specific phobia (369)	1.63*	(1.39–1.92)	1.52*	(1.29–1.78)
Generalized anxiety (67)	1.27	(0.82–1.95)	1.28	(0.86–1.91)
Obsessive-compulsive (33)	1.43	(0.87–2.35)	1.32	(0.80–2.15)
Any somatoform (467)	1.42*	(1.21–1.67)	1.38*	(1.18–1.62)
Somatic symptom index 4/6 (182)	1.32*	(1.03–1.69)	1.39*	(1.09–1.76)
Pain (339)	1.31*	(1.08–1.58)	1.26*	(1.05–1.51)

CI confidence interval; *DSM-IV* *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*; *IRR a* adjusted incidence rate ratios for age, gender, and marital, and socioeconomic status; *IRR c* crude incidence rate ratios

* $p < .05$