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## Mental Disorders among Adults with Asthma: Results from the World Mental Health Surveys

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## Abstract

**Objectives—** 1) to determine which common mental disorders are associated with asthma in the general population after controlling for age and sex; and 2) to assess whether the associations of mental disorders with asthma are consistent across diverse countries.

**Methods—** Eighteen population surveys of household-residing adults were carried out in 17 countries (N=85,088). Mental disorders were assessed with the CIDI 3.0, a fully structured diagnostic interview. Disorders considered here are 12-month anxiety disorders (generalized anxiety disorder, panic disorder/agoraphobia, post traumatic stress disorder and social phobia), depressive disorders (dysthymia and major depressive disorder), and alcohol use disorders (abuse and dependence). Asthma was ascertained by self-report of lifetime diagnosis among a sub-sample (N=42,697).

**Results—** The pooled estimates of the age-sex adjusted odds of mental disorder among persons with asthma relative to those without asthma were 1.6 (95% CI: 1.4, 1.8) for depressive disorders, 1.5 (95% CI: 1.4, 1.7) for anxiety disorders, 1.7 (95% CI: 1.4, 2.1) for alcohol use disorders.

**Conclusions—** This first cross-national study of the relationship between asthma and mental disorders confirms that a range of common mental disorders occurs with greater frequency among persons with asthma. These results attest to the importance of clinicians in diverse settings being alert to the co-occurrence of these conditions.

## Keywords

adult; asthma; cross-sectional; mental disorders

## INTRODUCTION

Asthma is a major public health problem in industrialised countries and its prevalence has been increasing in both developed and developing countries in recent decades [1,2]. A considerable number of studies have suggested that there is an association between asthma, particularly at the severe end, and some mental disorders. In research among adults, studies conducted among clinical and general practice samples have found higher than expected rates of anxiety disorders (particularly panic disorder) and of major depression among those with asthma [3–10]. However, treatment-seeking biases limit the extrapolation of findings from clinical studies to resolving the question of whether asthma and mental disorders are associated in the general population [11].

Some studies have investigated the asthma-mental disorder relationship in the adult general population [11–16]. Collectively, these studies suggest that asthma is related to both mood and anxiety disorders, though this conclusion could be considered premature due to the limitations of many of these studies. These limitations include not using diagnostic measures of mental disorders [12–14], a limited age-range of participants [16,17], or a limited number of mental disorders investigated [12–15,17]. The study by Goodwin and colleagues on a German population sample [11], an exception to these limitations, investigated the association between asthma and a range of DSM-IV mental disorders in a general population sample of adults in Germany. They found lifetime severe asthma was significantly associated with a number of

anxiety disorders, with bipolar disorder and with any severe mental disorder. Lifetime non-severe asthma was significantly associated with any anxiety disorder, anxiety disorder not otherwise specified, and with any somatoform disorder. Current severe asthma was associated with a number of anxiety disorders, and current non-severe asthma was associated with any affective disorder, though not with major depressive disorder on its own. This latter result may have been a power issue, suggested by the fact that the odds ratio for the association between current non-severe asthma and any affective disorder was significant, while the odds ratios for the two components of the 'any affective disorder' group (major depressive disorder and bipolar disorder) were of a similar magnitude to that for any affective disorder, yet not significant.

In summary, the findings from the adult population studies suggest that both mood and anxiety disorders are associated with asthma, yet in the most informative of these studies [11], asthma was more consistently associated with anxiety disorders, rather than with major depressive disorder. One of the challenges in determining the association of comorbid mental and physical conditions is obtaining samples big enough to provide sufficient numbers with both conditions. The current study aims to extend this literature in two main ways. First, it provides information on the association between mental disorders and lifetime asthma from a meta-analysis of surveys from the World Mental Health (WMH) Surveys, an approach that has the advantage of being able to provide pooled estimates that overcome the problems of small sample sizes from individual surveys. Second, this study is based on general population surveys that used consistent diagnostic measures of a range of mental disorders, representing both developed and developing regions of the world, thus providing a more global perspective on the association between asthma and mental disorders than has been available thus far. The WMH surveys have been conducted in over 20 countries using the latest structured psychiatric interviews generating DSM-IV diagnoses for a range of mental disorders, as well as collecting information on chronic physical conditions and other covariates.

The objectives of this paper are: 1) to determine which common mental disorders (depressive disorders, anxiety disorders, alcohol use disorders) are significantly associated with asthma after controlling for age and sex; 2) to assess whether the associations of mental disorders with asthma are consistent across adult populations in diverse countries in Europe, the Americas, Asia and the Middle East.

## METHODS

### Samples

Eighteen surveys were carried out in 17 countries in the Americas (Colombia, Mexico, United States), Europe (Belgium, France, Germany, Italy, Netherlands, Spain, Ukraine), the Middle East (Israel, Lebanon), Africa (Nigeria, South Africa), Asia (Japan, separate surveys in Beijing and Shanghai in the People's Republic of China) and the South Pacific (New Zealand). An effort was made to recruit as many countries as possible in the initiative. The final set of countries was determined by availability of collaborators in the country who were able to obtain funding for the survey. All surveys were based on multi-stage, clustered area probability household samples. All interviews were carried out face-to-face by trained lay interviewers. The six Western European surveys were carried out jointly [18]. Sample sizes range from 2372 (Netherlands) to 12,992 (New Zealand), with a total of 85,088 respondents. Response rates range from 45.9% (France) to 87.7% (Colombia), with an overall weighted response rate of 70.8%.

The WMH-CIDI is a long interview, so to reduce respondent burden a strategy of short (Part 1) and long (Part 1 + Part 2) forms of the interview was adopted by most countries. A subsample of respondents who completed the first half of the interview (Part 1) which included the core

diagnostic assessments, and who reported having no lifetime history of disorder, were terminated at mid-point of the interview. All respondents who met criteria for any lifetime mental disorders in the Part 1 interview were retained in the second half of the interview (Part 2), along with a probability subsample of non-cases. The default value for the non-case probability of selection was 25%, although this varied across countries depending on their survey priorities. Part 2 samples typically retained between 33–67% of Part 1 respondents. Part-2 respondents were weighted by the inverse of their probability of selection for Part-2 of the interview to adjust for differential sampling. Analyses in this article were based on the weighted Part-2 sample (N=42,697). Additional weights were used to adjust for differential probabilities of selection within households and to match the samples to population socio-demographic distributions. The samples showed substantial cross-national differences in age structure (younger in less-developed countries) and educational status (lower in less-developed countries).

### Training and Field Procedures

The central World Mental Health (WMH) staff trained bilingual supervisors in each country. Consistent interviewer training documents and procedures were used across surveys. The WHO translation protocol [19] was used to translate instruments and training materials. Two surveys were carried out in bilingual form (Dutch and French in Belgium; Russian and Ukrainian in Ukraine). In Nigeria, interviews were conducted in four languages, Yoruba, Hausa, Igbo, and Efik, being the dominant languages in the regions where the survey was carried out. Others were carried out exclusively in the country's official language. Persons who could not speak these languages were excluded. Standardized descriptions of the goals and procedures of the study, data uses and protection, and the rights of respondents were provided in both written and verbal form to all potentially eligible respondents before obtaining verbal informed consent for participation in the survey. Quality control protocols, described in more detail elsewhere [20], were standardized across countries to check on interviewer accuracy and to specify data cleaning and coding procedures. The institutional review board of the organization that coordinated the survey in each country approved and monitored compliance with procedures for obtaining informed consent and protecting human subjects.

### Mental disorder status

All surveys used the World Mental Health Survey version of the WHO Composite International Diagnostic Interview (WMH-CIDI, now CIDI 3.0) [21], a fully structured diagnostic interview, to assess disorders and treatment. Mental disorders considered in this paper were present in the prior 12 months, and included anxiety disorders (generalized anxiety disorder, panic disorder and/or agoraphobia, post traumatic stress disorder and social phobia), depressive disorders (dysthymia and major depressive disorder), and alcohol use disorders (abuse and dependence). Disorders were assessed using the definitions and criteria of the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)* [22]. CIDI organic exclusion rules were imposed in making all diagnoses. Methodological evidence collected in the WHO-CIDI Field Trials and later clinical calibration studies showed that all the disorders considered herein were assessed with acceptable reliability and validity in the original CIDI [23], and the WMH-CIDI [20].

### Asthma status

In a series of questions about chronic conditions adapted from the U.S Health Interview Survey, respondents were asked about the lifetime presence of selected chronic conditions. Respondents were asked “Did a doctor or other health professional ever tell you that you had any of the following illnesses...asthma?”. Clinical guidelines for diagnosis of asthma such as those issued by the American Thoracic Society recommend a combination of methods

including a medical history, physical examination and respiratory function tests [1,11], but such methods are not feasible in large epidemiology surveys, and indeed the international asthma prevalence surveys such as the European Community Respiratory Health Survey (ECRHS) have used self-reported symptoms of asthma to determine the condition [1,24]. An investigation of the correspondence of self reported chronic conditions in the US National Health Interview Survey with medical records abstracted in the prior three years, found self-reported current asthma to be in fairly good agreement with medical record, though under-reported by 2030% [25]. The definition of asthma used in this survey was self-report of a diagnosis of asthma, not simply self-report of asthma, so it may correspond more closely still to actual medical records. The German population study by Goodwin et al. [11], which has used the most comprehensive methods of assessing asthma among the population surveys investigating asthma-mental disorder comorbidity, reported physician confirmation of lifetime asthma in about 78% of those endorsing a screening question about current asthma. That study reported a prevalence of lifetime asthma in the German population of 5.7%, which is fairly comparable with the estimate of lifetime asthma this study observed for the German population of 4.5%.

### Analysis Methods

Prevalence of specific mental disorders was estimated separately among respondents with and without lifetime asthma. Odds ratios of the association between lifetime asthma and specific mental disorders, and between lifetime asthma and mental disorder groups (any depressive disorder, any anxiety disorder, any alcohol use disorder) were calculated in each survey with at least 25 respondents who reported having asthma. The odds-ratios were calculated in logistic regression equations that adjusted for age and sex. Associations were not further adjusted for socioeconomic status as some research suggests that socioeconomic status may be part of the background vulnerability giving rise to asthma-mental disorder comorbidity [16]. For countries in which the cross-classification of mental disorder and asthma status had a null cell, the odds ratio was not calculated. Ninety-five percent confidence intervals for the prevalence estimates and for the odds ratios were estimated using the Taylor Series method [26] with SUDAAN software [27] to adjust for clustering and weighting. Pooled estimates of mental disorder prevalence rates were not reported due to significant variation in mental disorder prevalence rates across surveys.

Using meta-analytic methods to summarize results across surveys, pooled estimates of the odds ratios were developed describing the association of each mental disorder, and of mental disorder groups, with asthma across surveys. The pooled estimate of the odds ratio was weighted by the inverse of the variance of the estimate for each survey with a reported odds ratio. The confidence intervals for the pooled estimate of the odds ratio were estimated using methods described by DerSimonian and Laird [28]. For each association of a specific mental disorder with asthma, we assessed whether the heterogeneity of the odds ratio estimates across surveys was greater than expected by chance [28], using a conservative alpha value of  $< .05$ .

Funnel graphs plot the odds ratio for each survey on a log scale (y-axis) against the precision of the estimate of each odds ratio (x-axis). Precision is the reciprocal of the standard error of the odds ratio estimate. The “funnel” in these graphs shows the 95 percent confidence intervals around the pooled estimate of the odds ratio at varying levels of precision. Each survey’s estimate was plotted on the funnel graph, showing whether it falls within the 95% confidence interval of the pooled estimate given the estimated precision of the individual survey estimate. The less precise estimates are to the left (where the funnel is wider), the more precise estimates are to the right (where the funnel is narrower). These graphs provide a visual summary of both the overall (pooled) relationship between asthma and depressive disorders, anxiety disorders

and alcohol use disorders, and of the extent to which individual country estimates cluster around the pooled estimate.

## RESULTS

### Sample characteristics

The proportion of the sample that was age 60 or greater was higher in the developed countries than the developing countries, and the percent with 12 or more years of education was also generally higher in the developed countries (see Table 1). The sample size numbers provided in Table 1 are the number of respondents completing Part 2 of the interview, including the question concerning the presence of asthma. Consistent with the multi-country ECRHS [24, 29], lifetime asthma prevalence was highest in the two English-speaking, developed countries: New Zealand and the United States (Table 1). Also consistent with the ECRHS findings, age and sex patterns in asthma prevalence were not consistent across countries (data not shown).

### Depressive disorders and asthma

Prevalence estimates for major depression among persons with asthma varied from 2–26% across the surveys (Table 2), but generally fell in the 5–10% range. The prevalences of dysthymia among those with asthma were typically lower. Age and sex adjusted odds ratios measuring the association of major depression with asthma were significant for 7 of the 16 surveys for which odds ratios were calculated, and for 5 of the 14 surveys in the case of dysthymia. Variability in the odds ratio estimates across the surveys was not found to be greater than expected by chance for either major depression ( $p=0.26$ ) or dysthymia ( $p=0.25$ ). The pooled odds ratios indicate that both major depression (OR: 1.6) and dysthymia (OR: 1.7) are significantly associated with asthma.

Figure 1 shows the funnel graph of the age-sex adjusted odds ratios for depressive disorders for the all the surveys. The central line indicates the pooled estimate of the association between asthma and mood disorder (OR: 1.6, [1.4, 1.8]). The curved funnel lines show the 95% confidence interval around the pooled estimate for a given level of precision. Two important observations can be made from this graph: first, that all of the estimates except those for Spain and Columbia fell within the 95% confidence intervals of the pooled estimate, and second, that the estimates of those countries within the funnel cluster in fairly close proximity to the pooled estimate. These observations support a conclusion that persons with lifetime asthma are more likely to experience depressive disorders than otherwise comparable persons without lifetime asthma.

### Anxiety disorders and asthma

The prevalences of the specific anxiety disorders among people with and without asthma are reported in Tables 3A and 3B. Because the specific anxiety disorders were less common than the depressive disorders, it was not possible to estimate odds ratios for many of the participating surveys. Given the relatively small sample sizes, it is not surprising that the odds ratio estimates were significant for some surveys but not for others, even when the confidence intervals of the odds ratio estimates included the pooled estimate. The heterogeneity test for variability among the odds ratios was non-significant for generalized anxiety disorder ( $p=0.71$ ), agoraphobia/panic ( $p=0.07$ ), and PTSD ( $p=0.14$ ), though it was significant for social phobia ( $p=0.02$ ). Given the limited number of cases available in each survey, the pooled estimate of the odds ratio provides a more precise estimate of the association of the anxiety disorder with asthma. Across the four anxiety disorders, the pooled odds ratios were all significantly greater than one, and fell in the 1.3–1.8 range.

The association of any anxiety disorder with asthma (Figure 2) showed a pattern similar to that observed for any depressive disorder. The pooled estimate of the odds ratio was 1.5 (1.4, 1.7). Of the survey-specific estimates, all but one (Ukraine) fell within the 95% confidence interval of the pooled estimate. These results indicate that the strength of the association of anxiety disorders, as a class, with asthma is comparable to that observed for depressive disorders.

### Alcohol use disorders and asthma

The prevalence of alcohol abuse or dependence among those with asthma was highly variable across countries, reflecting the large cross-national differences in prevalence (Table 4). Odds ratios for the association of alcohol abuse or dependence with asthma were significantly greater than one in only two of the 15 surveys with estimable odds ratios, but the estimates were not found to be heterogeneous across surveys ( $p=0.45$ ). The pooled estimate for the association of alcohol abuse or dependence and asthma was 1.7 (1.4, 2.1), with 14 of the 15 survey estimates falling within the 95% confidence interval of the pooled estimate (Figure 3). These results suggest that alcohol abuse or dependence tends to occur with greater frequency among persons with asthma.

## DISCUSSION

This report provides the first cross-national, population-based assessment of the association of lifetime asthma with a range of common mental disorders among adults. Although the prevalence of 12-month mental disorders and asthma varies greatly across individual surveys, the association of the two shows much less cross-national variability, with the survey estimates for the vast majority of countries of the association between asthma and the mental disorder groups (depressive, anxiety, alcohol use) clustering around the pooled estimates. This consistency of results across surveys is notable in light of the fact that the participating surveys included countries that differ markedly in culture, language and level of socioeconomic development. Key findings are that depressive, anxiety and alcohol use disorders are all significantly, albeit modestly associated with asthma, and that the degree of association is fairly similar across the mental disorder groups.

Previous research on the adult general population has been suggestive of a relationship between asthma and both anxiety and mood disorders, but in the most comprehensive population study investigating a range of DSM-IV disorders the relationship was more consistently observed for anxiety disorders than it was for mood disorders, and it was not observed at all for substance use disorders [11]. The current study replicates the finding for anxiety disorders, confirms a similar magnitude relationship with depressive disorders, and demonstrates for the first time a relationship with alcohol use disorders. The magnitude of the associations observed here is similar to previous population studies, with associations between asthma and the any depressive disorder and any anxiety disorder groups in this study of 1.5 and 1.6, compared with 1.5–2.1 in other population studies using diagnostic measures of mental disorders [11, 16,17].

A strength of this study is that the estimates are pooled across a large number of consistently conducted surveys. The individual surveys might appear to yield disparate results if examined individually, yet whether or not the country-specific odds ratios are statistically significant varies largely as a function of variation in sample or cell size. More important is the fact that the country-specific odds ratios do not typically differ significantly from each other, allowing confidence in the pooled estimates, and that the estimates from most of the individual surveys fall within the 95% confidence intervals of the pooled estimates. This result reflects the usefulness of a meta-analytical approach when investigating the co-occurrence of mental and physical problems (where the smaller number of people with both disorders reduces power in an individual survey).

These results need to be interpreted in light of the limited assessment of asthma. There are two main aspects to this limitation. First, it is a lifetime measure, not a measure of current symptoms; second, although it is a measure of asthma diagnosis, it is self-reported diagnosis. With regard to the issue of time period (lifetime vs current), the study by Goodwin et al. [11] found that associations between any severe mental disorder were virtually identical for lifetime severe vs current severe asthma (though only significant in the former) and somewhat stronger for current non-severe asthma relative to lifetime non-severe asthma. Other research by Goodwin and colleagues [15] found that panic attacks were associated with current asthma under treatment, but not with remitted asthma, which suggests that the lifetime measure used here could have resulted in somewhat attenuated estimates of the association between asthma and mental disorders. However, as noted above, the estimates obtained in this study are in line with other population studies using diagnostic measures of mental disorders. Additionally, our measure of reported diagnosis rather than symptoms means that the associations observed are not likely to be an artifact of the known relationship between symptoms of anxiety and depression and self-report of symptoms of asthma [13], since this bias is not observed with self-reported diagnosis of asthma [13,30].

With regard to the second issue relating to asthma ascertainment, it is not clear how much discrepancy there might be between self-reported diagnosis and physician-confirmed diagnosis of lifetime asthma. Goodwin et al. [11] report the proportion with physician-confirmed lifetime asthma from amongst those who endorsed a screening question about current asthma so this is not directly comparable to the current study. While acknowledging this limitation, it is reassuring to note that the estimates of asthma prevalence for the German population across the two studies are fairly comparable (with the present study being the more conservative of the two), as are the associations obtained between lifetime asthma and mental disorders.

Lastly, on the limitations of the asthma ascertainment, it should be noted that there were no measures of asthma severity, nor of asthma medication use. The associations reported are therefore averaged across the full spectrum of asthma severity, and as such, are likely to underestimate the magnitude of the relationship between mental disorders and severe asthma.

Due to the cross-sectional nature of the surveys, the observed associations do not inform with regard to the direction of the relationship between asthma and mental disorders. Other research suggests that, in contrast to earlier thinking on the role of psychological factors in asthma, mental disorders are probably not etiologic; atopic and immunologic factors are more probably the prime causal candidates for the development of asthma [1]. A study by Goodwin and colleagues on a longitudinal sample from New Zealand of 18–21 year olds [16] found that the associations between asthma and mental disorders disappeared altogether when adverse childhood conditions and other unspecified correlates were controlled for, allowing the possibility that asthma and mental disorders are associated through other common factors. Adverse childhood conditions may well explain the association observed here between asthma and alcohol use disorders. It does not, however, mean that the link between asthma and mental disorders is spurious. By whatever mechanisms they come to be associated, the interplay of mental disorders with asthma may be mutually self-perpetuating. Katon and colleagues [31] have developed a model of the possible cognitive and behavioural mechanisms that link anxiety and depressive symptoms with asthma, each serving to maintain the other. Other research too, confirms the important clinical consequences of the co-occurrence of depressive and anxiety disorders with asthma. Anxiety and depression have been found to influence perception of and response to asthma symptoms [3,32], reduce treatment adherence and increase hospitalization [32–35], and reduce quality of life [9,14,32,35,36].

Given these clinical ramifications, the results of this study confirm the importance of awareness among clinicians, in whichever setting they work, of the significant overlap of asthma with mental disorders.

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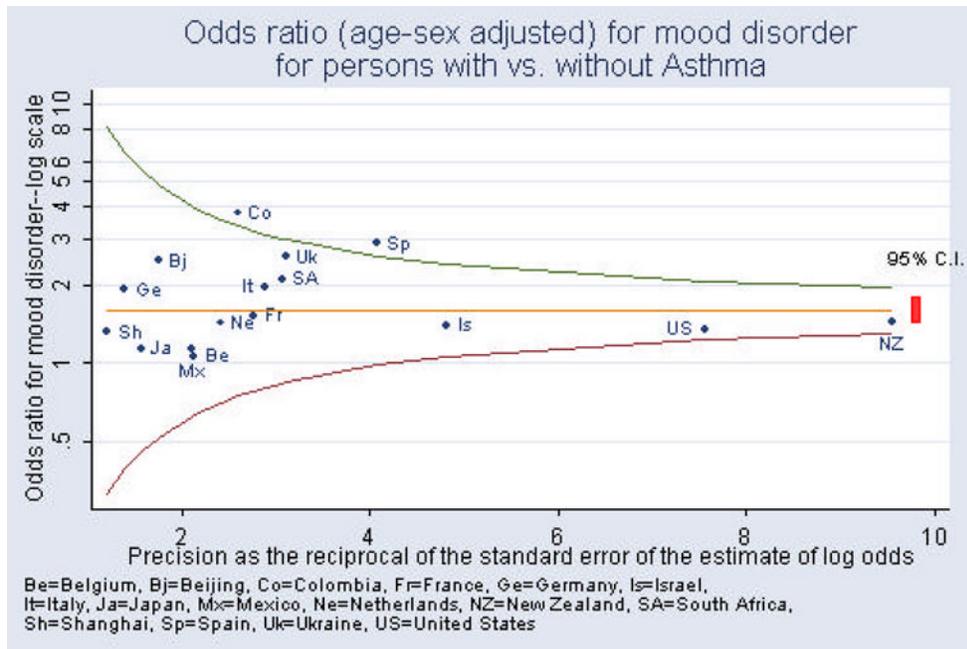
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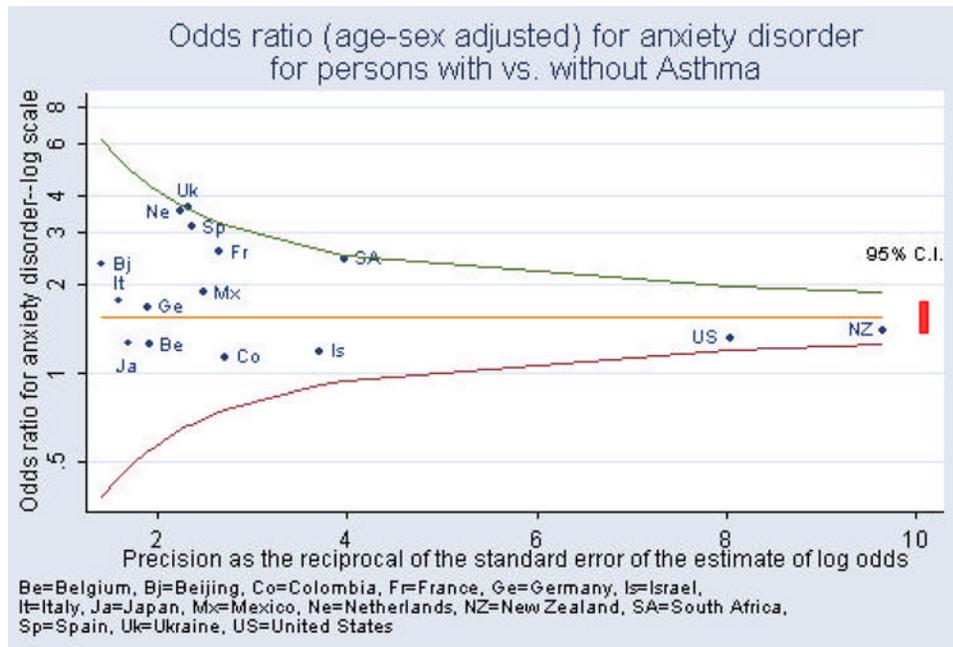
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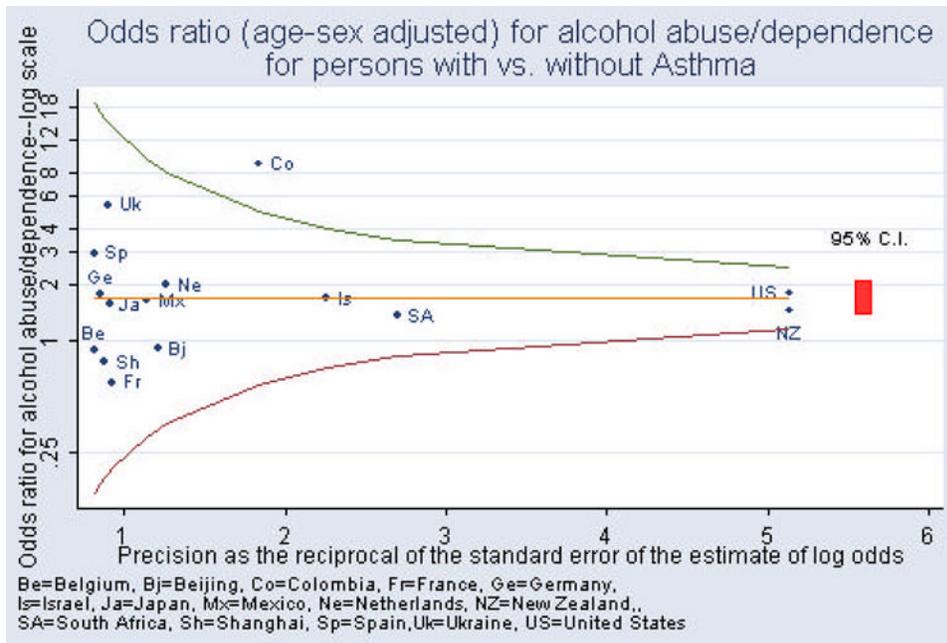
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**Figure 1.** Pooled odds ratio (and 95% CI) of the association between any depressive disorder and asthma, with survey-specific odds ratios plotted as a function of the precision of the estimate.



**Figure 2.** Pooled odds ratio (and 95% CI) of the association between any anxiety disorder and asthma, with survey-specific odds ratios plotted as a function of the precision of the estimate.



**Figure 3.** Pooled odds ratio (and 95% CI) of the association between any alcohol use disorder and asthma, with survey-specific odds ratios plotted as a function of the precision of the estimate.

**Table 1**  
Sample Characteristics, and Asthma Prevalence

Country	Part 1 sample (N)	Part-2 sub-sample (N)	Mean age <sup>φ</sup>	% 60 yrs. or older	% women	Education secondary or greater %	Asthma Prevalence <sup>φφ</sup>	
							Number	Weighted prevalence %
<i>Americas</i>								
Colombia	4426	2381	36.6	5.3	54.5	46.4	93	3.0
Mexico	5782	2362	35.2	5.2	52.3	31.4	63	2.2
United States	9282	5692	45.0	21.2	53.0	83.2	751	11.6
<i>Asia &amp; S. Pacific</i>								
Japan	2436	887	51.4	34.9	53.7	70.0	57	5.4
PRC-Beijing	2633	914	39.8	15.6	47.5	61.4	37	2.3
PRC - Shanghai	2568							
New Zealand	12992	7312	44.6	20.7	52.2	60.4	1357	17.2
<i>Europe</i>								
Belgium	2419	1043	46.9	27.3	51.7	69.7	61	5.8
France	2894	1436	46.3	26.5	52.2	NA	111	7.5
Germany	3555	1323	48.2	30.6	51.7	96.4	63	4.5
Italy	4712	1779	47.7	29.2	52.0	39.5	86	4.6
Netherlands	2372	1094	45.0	22.7	50.9	69.7	102	8.5
Spain	5473	2121	45.5	25.5	51.4	41.7	130	5.7
Ukraine	4725	1720	46.1	27.3	55.1	79.5	54	1.8
<i>Middle East and Africa</i>								
Lebanon	2857	602	40.3	15.3	48.1	40.5	9	1.2
Nigeria	6752	2143	35.8	9.7	51.0	35.6	17	0.6
Israel	4859	4859	44.4	20.3	51.9	78.3	353	7.2
South Africa	4315	4315	37.1	8.8	53.6	38.9	256	5.8

<sup>φ</sup> Age range  $\geq 18$ , except for Colombia, Mexico (18–65), Japan ( $\geq 20$ ) and Israel ( $\geq 21$ )

<sup>φφ</sup> Lifetime diagnosis of asthma

**Table 2**

Prevalence (%) of depressive disorders among persons with versus without asthma, and age-sex adjusted odds of association.

Country	Major Depression			Dysthymia		
	Without asthma %	With asthma %	OR (CI) (adjusted for age and sex)	Without asthma %	With asthma %	OR (CI) (adjusted for age and sex)
Colombia	5.7	19.7	3.8 (1.8, 8.3) *	0.9	6.7	7.5 (1.6, 34.7) *
Mexico	4.1	5.0	1.2 (0.4, 3.0)	0.9	0.7	0.7 (0.1, 3.5)
United States	7.9	11.3	1.4 (1.1, 1.7) *	2.1	3.7	1.7 (1.1, 2.6) *
Japan	2.2	2.8	1.2 (0.3, 4.3)	0.8	0.6	0.9 (0.1, 7.1)
Beijing	2.3	4.0	2.5 (0.8, 8.1)	0.3	1.3	2.8 (0.3, 26.9)
Shanghai	1.7	2.2	1.4 (0.2, 7.8)	0.4	0.0	- (-,-)
New Zealand	6.0	9.5	1.5 (1.2, 1.8) *	1.7	2.6	1.5 (1.0, 2.1) *
Belgium	5.5	6.5	1.2 (0.4, 3.2)	1.4	0.3	0.2 (0.0, 2.2)
France	5.8	9.3	1.5 (0.7, 3.2)	1.5	3.2	2.6 (0.7, 9.9)
Germany	2.9	5.6	2.1 (0.5, 9.4)	0.8	4.3	5.4 (0.8, 37.3)
Italy	3.0	5.9	2.2 (1.1, 4.4) *	1.0	1.6	1.6 (0.4, 5.9)
Netherlands	5.1	7.2	1.4 (0.6, 3.5)	1.7	2.6	1.6 (0.6, 4.4)
Spain	3.8	8.8	2.7 (1.6, 4.5) *	1.3	2.7	2.5 (1.1, 6.0) *
Ukraine	9.2	25.5	2.7 (1.4, 5.2) *	3.9	16.7	3.6 (1.5, 8.6) *
Lebanon	1.8	3.8	- (-,-)	0.7	0.0	- (-,-)
Nigeria	1.1	8.8	- (-,-)	0.2	0.0	- (-,-)
Israel	5.9	8.1	1.4 (0.9, 2.1)	1.2	1.4	1.1 (0.5, 2.7)
South Africa	4.6	9.5	2.1 (1.1, 4.0) *	0.1	0.0	- (-,-)
<b>Pooled Odds</b>	-	-	<b>1.6 (1.4, 1.8) *</b>	-	-	<b>1.7 (1.4, 2.1) *</b>

\* p <0.05

Odds ratio not listed and % with asthma column shown as 0.0 if fewer than 25 respondents have asthma, or if the cross classification of the mental disorder and asthma was a null cell

**Table 3A**

Prevalence (%) of anxiety disorders among persons with versus without asthma, and age-sex adjusted odds of association.

Country	Generalized Anxiety			Agoraphobia or Panic Disorder		
	Without asthma %	With asthma %	OR (CI) (adj for age and sex)	Without asthma %	With asthma %	OR (CI) (adj for age and sex)
Colombia	1.0	0.7	0.6 (0.1, 5.9)	2.1	4.5	2.0 (0.8, 5.2)
Mexico	0.6	0.0	- (-,-)	1.3	1.1	0.7 (0.2, 3.4)
United States	3.7	6.7	1.7 (1.2, 2.5) *	3.5	4.7	1.3 (0.9, 1.8)
Japan	1.5	2.2	1.7 (0.4, 7.8)	0.7	0.7	0.8 (0.1, 6.7)
Beijing	1.1	3.6	2.9 (0.5, 17.2)	0.4	0.0	- (-,-)
Shanghai	0.8	0.0	- (-,-)	0.1	0.0	- (-,-)
New Zealand	2.7	4.7	1.7 (1.2, 2.2) *	2.0	3.2	1.5 (1.0, 2.1) *
Belgium	0.9	3.5	4.0 (0.8, 19.6)	1.6	0.0	- (-,-)
France	1.8	5.3	2.8 (1.0, 7.7) *	1.4	1.2	0.8 (0.1, 4.1)
Germany	0.5	0.0	- (-,-)	1.0	3.2	4.1 (1.4, 12.0) *
Italy	0.5	0.0	- (-,-)	1.0	0.4	0.4 (0.1, 3.3)
Netherlands	1.1	0.6	0.6 (0.1, 3.3)	1.5	4.1	3.0 (0.7, 12.9)
Spain	0.9	2.2	2.8 (0.8, 10.0)	0.8	1.2	1.6 (0.5, 5.7)
Ukraine	2.3	3.4	1.2 (0.2, 6.1)	1.7	10.6	6.0 (2.1, 16.8) *
Lebanon	0.2	0.0	- (-,-)	0.2	0.0	- (-,-)
Nigeria	0.0	0.0	- (-,-)	0.3	0.0	- (-,-)
Israel	2.6	3.2	1.2 (0.6, 2.3)	0.9	1.5	1.7 (0.7, 4.1)
South Africa	1.7	5.1	2.7 (1.1, 6.5) *	5.1	12.5	2.6 (1.5, 4.3) *
<b>Pooled Odds Ratio</b>	-	-	<b>1.7 (1.4, 2.1) *</b>	-	-	<b>1.7 (1.4, 2.0) *</b>

\* p<0.05

Odds ratio not listed and % with asthma column shown as 0.0 if fewer than 25 respondents have asthma, or if the cross classification of the mental disorder and asthma was a null cell

**Table 3B**

Prevalence (%) of anxiety disorders among persons with versus without asthma, and age-sex adjusted odds of association.

Country	Social Phobia			PTSD		
	Without asthma %	With asthma %	OR (CI) (adjusted for age and sex)	Without asthma %	With asthma %	OR (CI) (adjusted for age and sex)
Colombia	2.8	3.3	1.1 (0.3, 3.6)	0.6	0.0	- (-,-)
Mexico	1.9	5.7	2.9 (1.1, 7.5)*	0.5	2.1	3.6 (0.9, 15.1)
United States	6.8	7.5	1.0 (0.8, 1.3)	3.4	4.9	1.3 (0.8, 1.9)
Japan	0.5	1.9	3.8 (0.7, 22.1)	0.3	1.6	4.3 (1.0, 19.6)
Beijing	0.3	0.9	5.0 (0.8, 29.4)	0.3	0.0	- (-,-)
Shanghai	0.0	0.0	- (-,-)	0.1	0.0	- (-,-)
New Zealand	4.9	6.0	1.1 (0.9, 1.4)	2.6	5.1	1.8 (1.3, 2.6)*
Belgium	1.1	1.1	0.9 (0.1, 6.8)	0.7	0.3	0.5 (0.1, 4.4)
France	2.4	5.6	2.1 (0.7, 6.9)	2.0	6.6	3.3 (0.9, 12.3)
Germany	1.8	1.5	1.0 (0.2, 4.5)	0.7	0.0	- (-,-)
Italy	1.0	2.8	3.2 (0.5, 20.6)	0.7	1.7	2.8 (0.5, 14.5)*
Netherlands	1.2	1.8	1.4 (0.5, 4.1)	1.9	9.1	5.5 (1.5, 20.8)*
Spain	0.5	3.7	8.1 (1.8, 35.8)*	0.4	1.7	3.8 (1.2, 12.7)*
Ukraine	2.1	1.1	0.8 (0.1, 5.2)	2.6	13.0	4.1 (1.0, 17.8)
Lebanon	0.6	0.0	- (-,-)	1.7	1.1	- (-,-)
Nigeria	0.3	0.0	- (-,-)	0.0	0.0	- (-,-)
Israel	-	-	- (-,-)	0.6	0.3	0.6 (0.1, 4.2)
South Africa	1.7	5.0	3.1 (1.5, 6.5)*	0.6	0.5	0.8 (0.1, 6.2)
<b>Pooled Odds Ratio</b>	-	-	<b>1.3 (1.1, 1.5)*</b>	-	-	<b>1.8 (1.4, 2.3)*</b>

\* p<0.05

Odds ratio not listed and % with asthma column shown as 0.0 if fewer than 25 respondents have asthma, or if the cross classification of the mental disorder and asthma was a null cell

**Table 4**

Prevalence (%) of alcohol use disorders among persons with versus without asthma, and age-sex adjusted odds of association.

Country	Alcohol Abuse or Dependence		
	Without asthma	With asthma	OR (CI) (adjusted for age and sex)
Colombia	2.2	12.5	8.9 (3.0, 26.5) *
Mexico	2.2	2.7	1.6 (0.3, 9.4)
United States	2.8	5.1	1.8 (1.2, 2.7) *
Japan	1.1	1.6	1.6 (0.2, 14.9)
Beijing	2.5	1.0	0.9 (0.2, 5.0)
Shanghai	0.5	0.2	0.8 (0.1, 8.0)
New Zealand	2.5	4.1	1.5 (1.0, 2.1)
Belgium	1.3	1.2	0.9 (0.1, 11.3)
France	0.8	0.5	0.6 (0.1, 5.4)
Germany	1.2	1.7	1.8 (0.2, 19.5)
Italy	0.1	0.0	- (-,-)
Netherlands	1.6	3.0	2.0 (0.4, 10.3)
Spain	0.3	1.0	2.9 (0.2, 34.6)
Ukraine	6.0	13.2	5.4 (0.6, 50.1)
Lebanon	1.1	0.0	- (-,-)
Nigeria	0.7	0.0	- (-,-)
Israel	1.1	1.7	1.7 (0.7, 4.0)
South Africa	4.9	5.9	1.4 (0.6, 2.9)
<b>Pooled Odds Ratio</b>	-	-	<b>1.7 (1.4, 2.1) *</b>

\*  $p < 0.05$ ; - (-,-) means information unavailable

Odds ratio not listed and % with asthma column shown as 0.0 if fewer than 25 respondents have asthma, or if the cross classification of mental disorder and asthma was a null cell.