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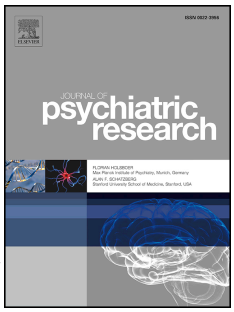

The prevalence of depression and anxiety disorders in indigenous people of the Americas: A systematic review and meta-analysis

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THE PREVALENCE OF DEPRESSION AND ANXIETY DISORDERS IN INDIGENOUS PEOPLE OF THE AMERICAS: A SYSTEMATIC REVIEW AND META-ANALYSIS.

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ABSTRACT

Indigenous populations are considered at higher risk of psychiatric disorder but many studies do not include direct comparisons with similar non-Indigenous controls. We undertook a meta-analysis of studies that compared the prevalence of depression and anxiety disorders in Indigenous populations in the Americas with those of non-Indigenous groups with similar socio-demographic features (Registration number: CRD42015025854). A systematic search of PubMed, Medline, PsycInfo, PsycArticles, ScienceDirect, EMBASE, and article bibliographies was performed. We included comparisons of lifetime rates and prevalence of up to 12 months. We found 19 studies (*n* =250, 959) from Latin America, Canada and the US. There were no differences between Indigenous and similar non-Indigenous groups in the 12-month prevalence of depressive, generalised anxiety and panic disorders. However, Indigenous people were at greater risk of PTSD. For lifetime prevalence, rates of generalised anxiety, panic and all the depressive disorders were significantly lower in Indigenous participants, whilst PTSD (on adjusted analyses) and social phobia were significantly higher. Results were similar for sub-analyses of Latin America, Canada and the US, and sensitivity analyses by study quality or setting (e.g. health, community etc.). Risk factors for psychiatric illness may therefore be a complex interaction of biological, educational, economic and socio-cultural factors that may vary between disorders. Accordingly, interventions should reflect that the association between disadvantage and psychiatric illness is rarely due to one factor. However, it is also possible that assessment tools don't accurately measure psychiatric symptoms in Indigenous populations and that further cross-cultural validation of diagnostic instruments may be needed too.

Keywords:

Indigenous people; Mental Health Disorders; Depression; Mood Disorder; Anxiety; Post-Traumatic Stress Disorder.

INTRODUCTION

Indigenous people are found throughout the Americas. These are peoples who are descendants of inhabitants who were present at the time of conquest or colonisation, and who they retain social, economic, cultural, and political institutions that distinguish them from the general population (Anderson et al., 2016).

Indigenous populations are generally considered to have worse mental health than the general population (Gracey and King, 2009). Possible explanations include socio-economic deprivation, unemployment, trauma, cultural disruption and loss of important ancient spiritual beliefs (Gracey and King, 2009; Gone, 2007). However, there is variability between and within countries, and findings are often limited by small sizes and heterogeneity, as well as the under-representation of certain groups. For instance, Indigenous peoples of Latin America are under-researched (Incayawar and Maldonado-Bouchard, 2009), as are Canadians such as Métis, urban Aboriginal People, and First Nations people not living on reserves (Young, 2003). In addition, many studies do not take into account other explanations for differences in psychiatric morbidity by comparing Indigenous people to similar non-Indigenous control, including techniques such as standardisation and/or multivariate analyses to further ensure comparability of groups.

We therefore undertook a meta-analysis of studies that compared the prevalence of common mental health disorders in Indigenous people from North and South (Latin) America with those of non-Indigenous groups with similar socio-demographic features. These areas share a common experience of European settlement that has left Indigenous people as a relatively small minority. We extended the search beyond English-speaking countries to include South America because even though Indigenous Peoples of America consist of heterogeneous nations, tribes and cultures, along with different colonisation experiences, they share common Paleoamerican origins and migration history (Rasmussen et al., 2014).

We investigated if the rate of common mental health disorders, such as depression and anxiety, remained higher in Indigenous people compared to the general population if the effect of other socio-demographic variables was minimised. We also investigated if there was any difference between diagnostic categories. One example was whether rates of post traumatic disorder were higher than those in the general population and whether morbidity was more comparable where there was a less direct association with trauma. We included cross-sectional, case control and cohort studies in the search

METHODS

The review was registered with PROSPERO (2016), an international database of prospectively registered systematic reviews in health and social care based in the United Kingdom (CRD42015025854) . Recommendations for the reporting of Meta-analyses Of Observational Studies in Epidemiology (MOOSE; Stroup et al., 2000) and the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) were both followed (Figure 1; Moher et al., 2009).

Inclusion and exclusion criteria

The primary focus of this review was to compare the prevalence of common mental health disorders (CMHDs) in Indigenous and non-Indigenous populations in the Americas. These disorders include depression, generalised anxiety disorder (GAD), panic disorder, obsessive-compulsive disorder (OCD), post-traumatic stress disorder (PTSD) and phobias (The National Institute for Health and Care Excellence, 2014).

Mental health disorders were determined in line with definitions of Axis I Disorders in the Diagnostic and Statistical Manual of Mental Disorders (DSM) (American Psychiatric Association, 1980; 1987; 1994; 2000) or according to the International Classification of Diseases, 10th Edition (ICD-10; World Health Organization, 1992). We included studies reporting lifetime prevalence (the proportion of individuals in the population who have ever

manifested a disorder at any given time in their lives), 12-month prevalence (the proportion of a population that has had the condition at any point in a 12 month period) and point prevalence (proportion of a population that had the condition at the time of the assessment). Potential designs included cross-sectional, case control and cohort studies. There were no limitations by language.

For inclusion in the review, studies had to have data on similar controls. This could either be collected by the authors themselves (internal controls) or come from a survey of a similar community (external controls). Establishing comparability meant checking how similar the groups were in their demographic characteristics, presenting data by age or gender, or the use of statistical techniques such as standardisation and/or multivariate analyses

We excluded articles for the following reasons:

1. Articles on suicide, substance use disorders, personality disorder, learning disability, or dementia
2. Articles that combined prevalence data for common mental disorders with other conditions such as substance use or bipolar disorders
3. There was no comparison with a similar non-Indigenous population
4. No appropriate or validated psychometric tool was used for diagnosis
5. There was a focus on intervention and/or framework development
6. Articles that commented on previously published studies

Search strategy

Relevant peer-reviewed journal articles were identified by searching PubMed, Medline, PsycInfo, EMBASE, PsycArticles, Sciencedirect and article bibliographies. A reference librarian provided expert consultation regarding keyword searches and databases prior to undertaking searches. We did a separate search for each geographical location using

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combinations of the following Boolean keywords, MeSH, or Emtree terms as appropriate: Indigenous people; Aboriginal; Native American; American Indian; Native Alaska; First Nations; Americas; Canada; USA; Latin America; prevalence; psychiatric disorders; mental health disorders; mental disorders; mental illness; mental illnesses; depression; depressive disorder; mood disorder; anxiety; affective disorder; post-traumatic stress disorder; PTSD. Overarching searches were also conducted that weren't restricted to a particular region.

Boolean keywords included the following: (Aboriginal OR Indigenous) AND prevalence AND (psychiatric disorders OR mental health disorders OR mental disorders OR mental illness OR mental illnesses OR depression OR depressive disorder OR mood disorder OR anxiety OR affective disorder OR post-traumatic stress disorder). Table 1 gives details of the PubMed search terms as an example.

The search extended from 1980 (the publication date of DSM –III) till the last search on 2 June 2016. Identified records were entered into the EndNote x7 (Thomson Reuters, 2013) library for each geographical location and the automatic 'Find Duplicates' function applied to remove duplicating articles. A manual search for further duplicates was then conducted. After all duplicates were removed, abstracts of remaining records were screened according to the eligibility criteria.

Titles, abstracts and papers were independently assessed by two reviewers, as was data extraction. In the case of disagreements, consensus was reached by seeking the opinion of a third reviewer.

Study quality

Study methodology was assessed by two raters using Loney et al.'s method of measuring the quality of epidemiological surveys (Loney et al., 1998). This uses an eight-point scale covering the following areas: sampling method, frame, and size; measures used; potential assessor bias; response rate and influences; confidence intervals and subgroup

analyses; and participant description. The higher the score obtained, the stronger the methodology. This rating scale is more appropriate for epidemiological surveys than alternative such as the Newcastle-Ottawa Scale that are primarily designed for case control & cohort studies (Stang, 2010). In addition, we assessed possible differences in socio-demographic characteristics between Indigenous and non-Indigenous participants, and strategies to reduce resulting confounding.

Statistical analysis

We used Review Manager Version 5.0 (The Cochrane Collaboration, 2014), a statistical software package for analysing a Cochrane Collaboration systematic review. Odds ratios for dichotomous variables were calculated since all the included studies were cross-sectional in design.

We assessed heterogeneity by using the I-squared statistic. An I-squared estimate of greater than or equal to 50% indicates possible heterogeneity. Scores of 75% to 100% indicate considerable heterogeneity (Higgins & Green, 2009). We used a random effects model throughout as there was heterogeneity in some of our analyses. In addition, where possible, we investigated heterogeneity in sensitivity analyses of omitting each study in turn. We divided outcomes into lifetime prevalence and diagnoses that were present within 12 months of assessment. In the case of the latter, we investigated if there was any difference between studies reporting morbidity at any time over the previous twelve months or over shorter periods such as a week or a month. Other sensitivity analyses included investigating the effect of gender, setting (e.g. health, criminal justice or community settings), location (urban or rural), region (the US, Canada, or Latin America), former colonial power (e.g. Britain, France or Iberia) and differences in comparison groups (e.g. Caucasian, African-American, Hispanic etc.). Finally, we did sensitivity analyses of only including better quality

studies, as well as those that used internal controls, structured interviews or adjusted results for a range of socio-demographic characteristics such as socio-economic status.

Where there were a sufficient number of studies ($n \geq 10$), we tested for publication bias using funnel plot asymmetry. We used Win-Pepi version 11.34 (Abramson, 2011). In tests for a skewed funnel plot, low P values suggest publication bias.

RESULTS

Study inclusion and characteristics

We found 11,121 citations of interest in the initial electronic searches, of which 7038 abstracts were screened (Figure 1). Of these, 354 full-text papers were potentially relevant and assessed for eligibility. Snowball sampling helped identify a further 37 publications. Of these, 30 papers were excluded, most because they were not comparison studies of mental health in Indigenous and non-Indigenous populations in the Americas, or did not include a relevant mental health outcome that could be incorporated into a meta-analysis (Figure 1). This left 19 studies from 20 papers that could be included in the meta-analysis (n =250, 959).

Key details of the included studies classified by geographical location (the United States, Canada and Latin America) are presented in Tables 1 and 2 sorted alphabetically by first author and year of publication. Details include sample size, characteristics, assessment method, study quality and limitations of the studies. The majority of the studies were from the United States (n = 10), followed by Canada (n = 6) and one each from Brazil, Guatemala and Chile. There were no studies from specifically francophone areas, although one did include Métis as part of the sample (Bowen & Muhajarine, 2006).

Setting, methodology, sampling strategy, and study design varied greatly between studies (Tables 2 - 3). Three studies were of people in the criminal justice system, eleven of community samples, and five of those in health care settings. Six of the eleven community surveys were from the United States (Table 2). All the community surveys were of residents

of reservations or rural areas. Two studies were of children or youths (Costello et al., 1997, Lemstra et al., 2011). Most studies focused on prevalence rates within the previous 12 months. Four studies also investigated lifetime prevalence.

Twelve studies used structured diagnostic interview schedules, while seven used questionnaires or rating scales administered in writing or verbally via interview (Tables 2 – 3). The most investigated diagnosis was depression, followed by PTSD, and GAD (Table 3). No more than three studies reported on panic disorder or agoraphobia (Table 3), while one gave lifetime prevalence rates for OCD (Hesselbrock et al., 2003).

In terms of study quality, ratings ranged from 1 to 8 (Tables 2 – 3). Ten studies scored 5 or more out of a maximum score of eight. Six of these were from the United States, and two each from Canada and Latin America. All but two studies (Fetzner et al., 2011; Li et al., 2008), considered the possible effect of differences in demographic features between Indigenous and non-Indigenous groups. Where it was not considered, it was generally because differences in psychiatric morbidity between Indigenous and non-Indigenous groups were not the focus of the paper. At the very least, studies took into account the effect of gender by presenting data for males and females separately. Several studies reported that their Indigenous and non-Indigenous samples were similar for the majority of a range of sociodemographic variables (Costello et al., 1997, Smith et al., 2006). Other strategies included stratification of the sample by age and gender, (Beals et al., 2005a; 2005b) the calculation of age-adjusted rates (C'De Baca et al., 2004) and multivariate analyses (Beals et al., 2002; 2005a; DeBaca et al., 2004; Lemstra et al., 2008; Melville et al., 2010; Filna et al., 2016; Vicente et al., 2005; Puac-Polanco et al., 2015; Wu et al., 2003). Two papers from one study used external controls from previous work but this was also one of the studies that employed multivariate techniques to minimise the difference between groups (Beals et al., 2005a; 2005b).

The overall prevalence rates of mental disorders for both indigenous and non-indigenous groups varied between regions. For example, the 12-month prevalence rates of major depression in Indigenous women in a Canadian pre-natal clinic was up to 38% (Bowen and Muhajarine, 2006). By contrast, community rates in Indigenous and non-indigenous people in Chile were only around 4% (Vicente et al., 2005).

Meta-analyses

One year prevalence rates

Nine studies reported 12 month prevalence rates (Tables 2 – 3) the remainder covering periods of less than three months. There were 14 studies of depression, all but three of which reported rates of major depression (Table 4). Four of these also reported on dysthymic disorder (Table 4). One further study that only gave full data for the adjusted results (Wu et al., 2003) could not be added to the main meta-analysis but was included in subsequent sensitivity analyses. There were no differences between Indigenous and non-Indigenous groups in the prevalence of any of the depressive disorders (Table 4) with there being a similar pattern irrespective of whether the study came from Canada, Latin America or the United States (Figure 2).

There were eleven studies of anxiety and, again, no differences between groups in the prevalence of a range of disorders including panic disorder and generalised anxiety (Table 4). However, Indigenous people did have significantly higher rates of post-traumatic stress disorder (Table 4). As with depressive disorders, there was a similar pattern across geographical areas (Figure 3).

There was evidence of significant heterogeneity in three out of the nine comparisons (Table 4).

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Lifetime prevalence

Eight studies reported differences in lifetime prevalence (Tables 2 - 3). Rates of GAD, panic and all the depressive disorders were significantly lower in Indigenous participants, while social phobia was significantly higher (Table 4). There was no evidence of significant heterogeneity in any of the results, the I-squared estimate being 0% in all cases.

Sensitivity analyses

In most cases, there were only sufficient studies to undertake sensitivity analyses of prevalence rates of up to twelve months. Six studies presented data by gender. In most cases, there was little change in the pattern of results with two exceptions. Rates of PTSD were only significantly higher in the male Indigenous group (Table 5) while rates of GAD and panic were significantly lower in the female Indigenous participants. Similarly, restricting the analyses to particular settings, locations (urban or rural) or regions (the US, Canada or Latin America) did not greatly alter the pattern of results. The one exception was that in the case of Latin America, Indigenous people had rates of illness that were lower or the same as the general population across all disorders. As there were no studies that were specific to francophone areas, sensitivity analysis by former colonial power was largely reflected in the analysis by region. For those studies that divided the non-Indigenous population into subgroups (Caucasian, African-American, Hispanic, etc.), restricting the comparisons to just the Caucasian and Indigenous groups made no difference to the results.

Sensitivity analyses of only including better quality studies (those with scores of 5 or above), or those that used diagnoses derived from structured interviews, did not alter the results. We also found similar results when we investigated if there was any difference between studies reporting morbidity at any time over the previous twelve months and those that measured rates over shorter periods such as a week or a month. Similarly, where studies

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gave weighted and unweighted prevalence rates, we assessed if using one or the other made any difference to the results and it did not. The same applied when we omitted the study with extremal controls except for current panic disorder where rates were significantly higher in Indigenous people (OR =2.06; 95% CI = 1.36 -3.12). Next, we explored heterogeneity through sensitivity analyses of the effect of omitting each study in turn; this again made little difference to the results.

Eight studies adjusted for a range of socio-demographic characteristics such as socio-economic status and educational level (Beals et al., 2002; 2005a; DeBaca et al., 2004; Lemstra et al., 2008; Melville et al., 2010; Filha et al., 2016; Puac-Polanco et al., 2015; Wu et al, 2003). It was possible to conduct sensitivity analyses of just including these studies for 2 outcomes, depression and PTSD. Figure 4 shows that Indigenous participants were no more likely to report current depression than controls. The same applied to lifetime depression (OR =0.50; 95% CI = 0.35-0.71). By contrast, they were significantly more likely to have PTSD in the three studies where this was reported, both currently (OR =1.42; 95% CI = 1.13 -1.78) or over a lifetime (OR =1.42; 95% CI = 1.13 -1.78).

Publication Bias

We were only able to test for publication bias for the concurrent prevalence of major depression as there were insufficient studies for the other disorders. The regression test for funnel plot asymmetry had a p-value of 0.96, suggesting our findings were reasonably robust against publication bias.

DISCUSSION

We have previously undertaken a systematic review on the prevalence of psychiatric disorders in Indigenous Australians (Black et al., 2015). To our knowledge, this is the first meta-analysis that compares rates of common mental health disorders in Indigenous

populations across the Americas with those of similar non-Indigenous people from the same countries. All the included countries share the same experience of European settlement that has left Indigenous people as a relatively small minority. We only included studies that assessed both groups using the same instruments and methodology. We found a wide variation between regions such that overall rates of psychiatric morbidity were lower for South America than North America. One possible reason for this variation is the smaller number of studies from South America compared to those from the other regions even though we included papers published in Spanish or Portuguese in our search. Other explanations might be a lack of resources or the socio-political situation in many of the relevant countries.

Irrespective of region, setting or locality, some disorders were more common in Indigenous peoples while the rate was the same or lower in other conditions. For instance, rates of post-traumatic stress disorder and lifetime social phobia were generally higher in Indigenous populations. By contrast, rates of other anxiety and depressive disorders were generally the same as the general population. In the case of lifetime generalised anxiety, panic and depressive disorders, the rates in Indigenous participants were lower than those of non-Indigenous groups.

One explanation might be that the assessment tools used in these studies may not accurately measure psychiatric symptoms in Indigenous populations. In addition, given that lifetime rates were particularly low in comparison with non-Indigenous populations, it is possible that the instruments were particularly subject to recall bias when used with Indigenous people. The applicability of diagnoses derived from ICD or DSM criteria to Indigenous populations is also unclear. For example, research on depression found differences in symptomatology across cultures (Thomas et al., 2010). For instance, depressive illness may present with anger while sadness or low mood are associated with anxiety rather than depression (Thomas et al., 2010). It has also been suggested that standard depression

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measures could miss important cultural expressions of depression in Native American (Manson et al., 1985). Another study suggested possible mismatches between DSM criteria and the symptoms of panic disorder, social anxiety disorder and generalised anxiety disorder in the light of specific cultural contexts (Lewis-Fernandez et al., 2010).

Other factors influencing the measurement of psychiatric morbidity may be different interpretations of what symptoms mean, as well as the effects of somatisation and stigma. For instance, the concept of mental illness is understood differently among American Indian and Alaska Native peoples compared to western interpretations of mental illness (Grandbois, 2005). For example, hallucinations can be seen as a culturally legitimate expression of grief in some circumstances (O'Nell, 1989). Moreover, it has been found that in some tribal groups there is no distinction between mental and physical symptoms of an illness (Thompson, 1994), and psychological distress is seen more as a somatic illness (Karasz, 2005). Lastly, Indigenous people may be reluctant to admit to mental illness because it may add to pre-existing prejudice and discrimination (Gary, 2005). As a result, negative connotations associated with mental illness, as well as different concepts of mental health, may be barriers to diagnosis and so distort the prevalence rates of psychiatric conditions. This is heightened by a focus on Western diagnostic categories that have ignored alternative beliefs or understandings of mental illness (O'Nell, 1989).

However, it is unclear why instruments would fail to detect disorders such as major depression, but not others such as PTSD. Another possibility might therefore be that the present findings reflect real differences among psychiatric disorders. Risk factors for psychiatric illness are a complex interaction of a range of educational, economic and socio-cultural factors that may vary from disorder to disorder (Lemstra et al., 2008). Consequently, risk factors that predispose to PTSD or social phobia may be different to those for anxiety or

depression. For instance, higher rates of trauma and discrimination may increase the risk of PTSD and social phobia, in particular, but not necessarily of other diagnoses.

Common mental health disorders are increasingly seen as indicators of a smaller number of underlying dimensions. Krueger has suggested a 3-factor model of two internalizing factors (*anxious-misery* and *fear*), as well as a broader externalizing factor (Krueger, 1999). Generalised anxiety and depression are manifestations of the *anxious-misery* aspects of internalising while phobic avoidance of others and the world represent the *fear* aspect. By contrast, externalizing patterns are associated with alcohol and substance use disorders. It is therefore interesting to note that the literature reflects to some extent this division. For instance, we found that there were no differences in depression and generalised anxiety between Indigenous and non-Indigenous groups (Table 3). By contrast, those disorders that are distinguished by fear such as post-traumatic stress disorders and lifetime social phobia (Table 3), or externalising (Smith et al., 2006; Huang et al., 2006), are more frequent in Indigenous populations. As a result, interventions need to take into account that disadvantage is rarely due to one factor.

These findings also highlight the resilience of Indigenous people in spite of the social disadvantage and marginalisation they face. Indeed, some authors have criticised a tendency to reduce Indigenous people to a range of indicators of deficit that may overlook wider societal issues and dimensions of health (Black and Richards, 2009). For instance, a Canadian survey found that 70% of First Nations adults living on reserves felt in balance physically, emotionally, mentally and spiritually (Khan, 2008).

The findings in this study are in marked contrast to the high rates of suicide in many Indigenous communities in countries as diverse as Australia, Canada, the United States and New Zealand (Government of Canada, 2006; Clifford et al., 2013). Suicide rates in Indigenous populations in these countries are two to three times higher than the general

population, particularly in males. As noted previously, one possibility is that the scales used to measure depression and other common mental disorders do not accurately capture symptoms in Indigenous populations (Khan, 2008). Another explanation might be that depression among men may present as alcohol or drug problems, violence or conflict with the law (Khan, 2008).

There are a number of limitations to this study. One is the limited number of Indigenous peoples covered, especially in Latin America (n = 3). To put this into context, there are approximately 642 indigenous groups in Latin America with a population of between 30 and 50 million (Economic Commission for Latin America and the Caribbean, 2006), and 734,000 registered Aboriginal people in Canada (Statistics Canada, 2006). In the United States, there are over two million Native Americans from 565 federally recognized tribal communities or non-reservation areas (United States Census, 2010). Furthermore, only six studies reported on lifetime prevalence rates so limiting the generalisability of findings for these outcomes.

Another limitation is that definitions of Indigenous status may vary by study. For instance, in the United States, some studies surveyed members of federally recognized tribes (Beals et al., 2005a; b) while others recruited nationally representative samples of self-identified Indigenous people (Fetzner et al., 2011; Huang et al., 2006). In addition, a nationally representative sample may not accurately reflect Indigenous people in the absence of the appropriate oversampling and weighting.

The limited number of studies also restricted the sensitivity analyses of possible contributions to psychiatric morbidity. For instance, although Indigenous and non-Indigenous participants came from the same settings in each study, it is possible that our results could have been confounded by differences between Indigenous and non-Indigenous populations in terms of socio-demographic characteristics such as age, sex employment status and

educational status. However, we believe that the following factors reduce this possibility. Firstly, all but three studies considered differences in demographic features between groups by a number of means. These included stratification of the sample by age and/ or gender, checking that groups were similar for the majority of socio-demographic variables, the calculation of age-adjusted rates, or the use of multivariate analyses. Secondly, we tried to minimise differences by gender through undertaking separate analyses for males and females. Thirdly, given the marginalisation of many Indigenous people, any bias would be in the direction of increasing their risk of psychiatric disorders. It would not explain our finding that prevalence rates for many of the CMHDs were the same, or lower, than non-Indigenous participants. Indeed, where studies adjusted for a range of socio-demographic factors, any effect was to generally lessen the association between Indigenous status and psychiatric morbidity, not increase it. This applied to both 12 month prevalence (Beals et al., 2002; 2005a; Lemstra et al., 2008; Melville et al., 2010; Vicente et al., 2005; Wu et al., 2003) and lifetime rates (Beals et al., 2005a; DeBaca et al., 2004). For instance, an unadjusted risk for depression that was higher in Indigenous participants changed to a non-significant difference in the final model (Lemstra et al., 2008). In addition, a sensitivity analysis restricted to those studies that adjusted results for a range of socio-demographic characteristics such as socio-economic status confirmed that rates for depression were not significantly higher in Indigenous participants while they were for PTSD.

Some of our results showed heterogeneity. We explored this further through sensitivity analyses of the effect of omitting each study in turn, but this made no difference to the results where heterogeneity was present. Accordingly, we used a random-effects model throughout to incorporate heterogeneity into our analyses. However, although we have tried to minimize the effects of heterogeneity, results where this is present should still be treated with caution. On the other hand, there was little evidence of heterogeneity in several key

results such as the 12 month prevalence rates of dysthymia, agoraphobia, social phobia, PTSD and overall anxiety (Table 3). Similarly, the results for major depression were no longer heterogeneous when analyses were limited to those studies that adjusted outcomes for a wide range of socio-demographic characteristics (Figure 4). In addition, the lifetime results for all the anxiety and depressive orders showed no heterogeneity at all (Table 3).

In conclusion, we found comparatively few studies comparing prevalence rates of mental health disorders in Indigenous and non-Indigenous populations in the USA, Canada and Latin America. Results from such a small number of Indigenous peoples may therefore not reflect inter-band variety. Further research is also indicated on differences between urban, rural and reservation areas. This is crucial for assessing the burden of mental disorders and unmet needs for treatment.

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Conflicts of Interest

All the authors have no competing interests to declare.

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Table 1: Search terms used in PubMed

(Indigenous[All Fields] OR Aboriginal[All Fields]) AND ("epidemiology"[Subheading] OR "epidemiology"[All Fields] OR "prevalence"[All Fields] OR "prevalence"[MeSH Terms]) AND (("depressive disorder"[MeSH Terms] OR ("depressive"[All Fields] AND "disorder"[All Fields]) OR "depressive disorder"[All Fields] OR "depression"[All Fields] OR "depression"[MeSH Terms]) OR depressive[All Fields] OR ("anxiety"[MeSH Terms] OR "anxiety"[All Fields]) OR ("anxiety"[MeSH Terms] OR "anxiety"[All Fields] OR "anxious"[All Fields]) OR ("stress disorders, post-traumatic"[MeSH Terms] OR ("stress"[All Fields] AND "disorders"[All Fields] AND "post-traumatic"[All Fields]) OR "post-traumatic stress disorders"[All Fields] OR "ptsd"[All Fields]) OR ("affect"[MeSH Terms] OR "affect"[All Fields] OR "mood"[All Fields]))
(American [All Fields] AND Indian [All Fields]) AND ("epidemiology"[Subheading] OR "epidemiology"[All Fields] OR "prevalence"[All Fields] OR "prevalence"[MeSH Terms]) AND (("depressive disorder"[MeSH Terms] OR ("depressive"[All Fields] AND "disorder"[All Fields]) OR "depressive disorder"[All Fields] OR "depression"[All Fields] OR "depression"[MeSH Terms]) OR depressive[All Fields] OR ("anxiety"[MeSH Terms] OR "anxiety"[All Fields]) OR ("anxiety"[MeSH Terms] OR "anxiety"[All Fields] OR "anxious"[All Fields]) OR ("stress disorders, post-traumatic"[MeSH Terms] OR ("stress"[All Fields] AND "disorders"[All Fields] AND "post-traumatic"[All Fields]) OR "post-traumatic stress disorders"[All Fields] OR "ptsd"[All Fields]) OR ("affect"[MeSH Terms] OR "affect"[All Fields] OR "mood"[All Fields]))

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Table 2. Studies reporting prevalence of mental health disorders in Indigenous People in USA

Study	Sample size *(N)*	Assessment[1]	Sample Characteristics[2]	Sampling strategy[3]	Methodology rating[4] and Limitations: **A. Study-identified** **B. Review-identified**
Beals et al.(2002)	487	Two stages: 1.Screening interview 2. SCID 1 month and lifetime prevalence	Southwest American Indian *n* = 118, Northern Plains American Indian *n* = 100, Hispanics *n* = 73, African American *n* = 86, White American *n* = 95	Vietnam theatre veterans from a Northern Plains tribe and from a Southwest tribe.	5/8 **A**. Vietnam era veteran or civilian counterparts were not included as controls (as was done in prior research). Only male Vietnam theatre veterans were recruited, and restricted to those living on or close to their reservations. Only two tribes were sampled. PTSD was retrospectively measured. The screening tool was not validated for use with Native Americans and does not produce a diagnosis. Given that this method was used to identify possible PTSD cases (who were invited for re-interview), it is possible that false negatives prevented identification during the second step (clinical re-interview with the SCID). **B**. The SCID is based on dated criteria from DSM-III-R. There were demographic differences between ethnic groups. On multivariate analyses, only combat exposure predicted PTSD symptoms
Beals et al.(2005a; 2005b)	3084 subjects who were compared with 8089 participants from the National Comorbidity	An adapted University of Michigan Composite International Diagnostic Interview. The SCID-I/NP was also used to	3,084 tribal members (1,446 in a Southwest tribe and 1,638 in a Northern Plains tribe) age 15–54 years living on or near their home reservations: males Southwest Tribe (*n* =617) Northern Plains Tribe (*n*	Participants were aged 15–54 years old, were enrolled members of two Northern Plains tribes and a Southwest tribe. Tribal rolls were used to stratify by group, gender, and age, with random selection employed. Of those located and eligible, 73.7% in the Southwest and 76.8% in the Northern Plains tribes agreed to participate.	7/8 **A.** Samples were limited in cultural representation, age range, and residence. The diagnostic measure relied on retrospective self-report, and lay interviewers were employed. The cultural appropriateness and validity of the diagnostic interview was unclear. **B**. The SCID-I/NP is based on the dated DSM-III-R criteria.

[1] Type of the assessments used for diagnosis of mental health disorders
[2] Sample characteristics described, including ethnicity, gender, age (range and mean), and location.
[3] The sampling and recruitment strategy used by the study as well as the location of the study and sample type.
[4] This was done using Loney et al.'s methodology, which assigns a score out of 8. Criteria used include: design and sampling method, size, and frame; response rate; participant description; measurement of the health outcome, and potential for bias; and the provision of confidence intervals and subgroup detail when prevalence or incidence is reported.

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	Survey (NCS)	re-interview more than 10% of participants by blinded clinical psychologists and psychiatrists. 12 month and lifetime prevalence	=790) NCS Participants (*n* = 3.847) Females: Southwest Tribe (*N* = 829) Northern Plains Tribe (*n* = 848) National Comorbidity Survey (NCS) Participants *n* = 4251 The NCS was conducted in a stratified, multistage area probability sample of 8,098 U.S. residents age 15–54 years in 1990–1992		Demographic differences between ethnic groups were not presented. However all samples were stratified by age and gender.
C'De Baca et al.(2004)	Driving while impaired offenders: 758 females, 631 males.	Diagnostic Interview Schedule (DIS; Robins et al, 1981) administered by lay interviewers. Lifetime prevalence	Non-Hispanic White *n* = 495 (females *n* = 265) Hispanic *n* = 660 (females *n* = 366) American Indian = 191 (females *n* = 105), Other ethnicities *n* = 43 (females *n* = 22)	Participants had been arrested for driving under the influence of alcohol, and selected from a database at the Lovelace Comprehensive Screening Program	4/8 **A**.DSM-III-R is outdated and it is possible that diagnostic criteria are open to interpretation of members of the minority groups. There was also no validation of diagnosis by mental health professionals, a relatively small number of American Indian participants, tribal heterogeneity and the fact that only one geographic region was taken into consideration. **B**. Interviewers, whilst trained, were not qualified to be making psychiatric diagnoses. Only 54% of the eligible sample participated. Ethnic groups were similar in terms of gender and marital status, and results were also adjusted for age. However there were differences in income and educational level
Costello et al. (1997)	1256	The Child and Adolescent Psychiatric	American Indian children *n* = 323 (girls *n* = 151), White children *n* = 933	All 9-, 11-, and 13-year-old American Indian children in an 11-county area of the southern Appalachians were recruited, together with a	7/8 **A**. Data collected during a 'single wave'.

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		Assessment (CAPA) 3 month prevalence	(girls *n* = 411)	representative sample of the surrounding population of White children. A stratified sampling design was used.	**B**. Both groups were similar in age and gender but the Indigenous participants were more likely to come from a rural area
Fetzner et al. (2011)	34,653	The Alcohol Use Disorder and Associated Disabilities Interview Schedule—IV (AUDADIS-IV) for the presence of any Axis I or II disorder. This study was restricted to alcohol use and PTSD Participants were coded as having PTSD if they reported full DSM-IV criteria at any time during Wave 1 or 2. Current prevalence	Native American *n* = 578 Non-Hispanic white *n* = 20161 African American -6587 Hispanic 6359 Asian -968	Participants were from Waves 1 and 2 of the National Epidemiologic Survey of Alcohol and Related Conditions (NESARC), a nationally representative survey of adults residing in America and the District of Columbia. In the case of alcohol use, subjects were a subset of patients recruited in Wave1 who were described in Huang et al., 2006 (see below)	5/8 **A**. Diagnoses were made by trained, lay interviewers using a fully structured interview, which may not be as accurate as those made by trained clinicians. **B**. There were demographic differences between diagnostic groups. Adjusted analyses were not presented for any comparisons of the prevalence of psychiatric morbidity as this was not the main purpose of the study.
Hesselbrock et al., (2003)	2117	The Semi-Structured Assessment for the Genetics of Alcoholism Psychiatric diagnoses were derived from computer algorithms for DSM-	All subjects met the DSM-III-R criteria for alcohol dependence and had inpatient treatment for the same. The sample consisted of 854 Caucasian men, 323 Caucasian women, 260 African American men and 101 African American women, 67 Hispanic men and 16 Hispanic women,	The Caucasian, Hispanic, and African American subjects were participants in the Collaborative Study on the Genetics of Alcoholism (COGA). They were recruited from consecutive admissions to both inpatient and outpatient alcohol-treatment facilities. The Alaska Native subjects were recruited from consecutive admissions to three public alcohol-treatment facilities in Anchorage	2/8 **A.** Nil **B**. Results were similar when reported separately for males and females. However, there were demographic differences between ethnic groups in age, marital status, employment and income.

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		III-R diagnoses. Lifetime prevalence	and 267 Alaska Native men and 219 Alaska Native women.		
Huang et al. (2006)	43,093	The Alcohol Use Disorder and Associated Disabilities Interview Schedule—IV (AUDADIS-IV) for the presence of any Axis I or II disorder. 12 month prevalence	Native American *n* = 701 Non-Hispanic white *n* = 24507 African American -8245 Hispanic 8308 Asian -1332 Participants aged ≥18 years.	Participants were from Wave 1 of the National Epidemiologic Survey of Alcohol and Related Conditions (NESARC), a nationally representative survey of adults residing in America and the District of Columbia. Response rate 81%.	6/8 **A**. Nil reported. **B**. Diagnoses were made by trained, lay interviewers using a fully structured interview, which may not be as accurate as those made by trained clinicians. Only major DSM categories were reported on, rather than data for individual disorders.
Li et al, (2008)	18,814	The Patient Health Questionnaire diagnostic algorithm. Two week prevalence	Participants diagnosed with diabetes. The sample consisted of non-Hispanic whites (71.2%), non-Hispanic blacks (12.2%), Hispanics (9.4%), Asians (1.6%), Native American/Native Alaskans (2.1%), and 3.5% other ethnic groups. Mean participant age was 62 years.	Standardised telephone survey, the 2006 Behavioural Risk Factor Surveillance System in the U.S.	4/8 **A.** The study relied on self-reported diabetes status. **B**. There was no information on demographic differences between ethnic groups and results were unadjusted.
Melville et al., (2010)	1,888	Patient Health Questionnaire, short form Two week prevalence	Mean participant age was 30.4 years. Participants identified as white (71.1%), Asian (11.2%), Hispanic (10.2%), African American (7.9%), Native American or Native Alaskan (3.0%) Pacific	Participants were receiving prenatal care at a university medical centre. All women had ongoing obstetric care and completed at least one clinical questionnaire from the second trimester onward	3/8 **A**. The outcome measure was not a diagnostic one, generalisability was limited, and non-participant information was lacking. **B**. Whilst the overall sample was large, there was only a small number of Native American participants (*n* = 53), thus limiting

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			Islander (1.4%), Mixed race (5.3%), or undeclared (6.7%).		the findings for this group. There was no information on demographic differences between ethnic groups. However results were unchanged when adjusted for a range of demographic factors.
Smith et al., (2006)	43,093	The AUDADIS-IV 12 month prevalence	White (*n* = 24 507), 11.1% Black (*n* = 8245), 2.1% Native American (including Alaska Natives) (*n* = 701), 47.66% males, 4.4% Asian (including Pacific Islanders) (*n* = 1332), and 11.6% Hispanic (*n* = 8308). 18+ years	This was a nationally representative survey of the general population, conducted by the National Institute on Alcohol Abuse and Alcoholism (NIAAA).	8/8 **B**. Whilst trained, lay interviewers administered the diagnostic schedules to reach a psychiatric diagnosis; these assessors were therefore not qualified to make medical diagnoses. Native Americans were less affluent and less likely to be over 65 years old than Caucasians. There were no differences for other variables. Adjusted analyses were not presented for any comparisons of the prevalence of psychiatric morbidity as this was not the main purpose of the study

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Table 3. Studies reporting prevalence of mental health disorders in Indigenous People in Canada and Latin America

Study	Sample size	Assessment[1]	Sample Characteristics[2]	Sampling strategy[3]	Methodology rating[4] and Limitations: A. Study-identified B. Review-identified
Canada					
Bowen and Muhajarine, (2006)	39	Edinburgh Postnatal Depression Scale 7 day prevalence	Pregnant Women; mean age = 23.2; Aboriginal women (including Metis) 64% (*n* = 25)	50 pregnant women attending prenatal outreach program in Saskatoon, Canada, were invited to participate.	3/8 **A.** Small and specific sample of Aboriginal women. **B.** Use of a self-administered 10 item screening tool. The small sample lacked statistical power. The two groups had different socioeconomic characteristics.
Bowen et al., (2009).	402	Edinburgh Postnatal Depression Scale 7 day prevalence	Literate Pregnant Women; mean age = 22.8; Aboriginal women 65% (including Metis)	pregnant women primarily enrolled in 2 prenatal outreach programs	3/8 **A**. The data were collected as part of the intake process in two community-based outreach programmes, which limited the number of questionnaires administered. The women were cared for by up to 60 different physicians, therefore it was not feasible to confirm the diagnosis of depression in individual women. **B**. Use of self-administered screening tool The two groups had different socioeconomic characteristics. However, there was no difference in the results when adjusted for these.
Brink, Doherty, and Boer (2001)	202	Computer-Assisted version of the SCID-I.	Newly sentenced offenders in a region of Canada Caucasian 67.8% of	Approached a random sample of newly-sentenced prisoners to one prison in Canada.	4/8 **A**. Not all Axis I Disorders assessed; Axis II disorders not assessed.

[1] Type of the assessments used for diagnosis of mental health disorders
[2] Sample characteristics described, including ethnicity, gender, age (range and mean), and location.
[3] The sampling and recruitment strategy used by the study as well as the location of the study and sample type.
[4] This was done using Loney et al.'s criteria, which assign a score out of 8. Criteria used include: design and sampling method, size, and frame; response rate; participant description; measurement of the health outcome, and potential for bias; and the provision of confidence intervals and subgroup detail when prevalence or incidence is reported.

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		1 month & lifetime prevalence	sample Aboriginal 17.8% (n = 36) East Indian 3.5% Black 3.5% Other 3%		**B**. Only assessed newly-sentenced offenders (and not all of this group were approached), so is not representative of people within the prison system. Potential for bias by assessors due to reviewing psychiatric history prior to assessment. Only major DSM categories reported by ethnicity.
Derkzen et al., 2013	88 women	Computerized Diagnostic Interview Schedule (C-DIS-IV). 12 month and lifetime prevalence	Caucasian (54.4%) and Aboriginal (31.6%) women with an average age in the mid-30s.	Nova Institution for Women (6.8%, n = 6); Edmonton Institution for Women (23.9%, n = 21); Fraser Valley Institution 11.4%; n=10; Joliette Institution (19.3%; n=17); Okimaw Ohci Healing Lodge (10.2%; n = 9); Grand Valley Institution for Women (26.1%; n = 23); and Philippe Pinel Institute3 (2.3%; n =2).	4/8 **A**. There was only a 17% response rate. Although women in the study sample were similar to the remaining offender population, it is possible that the participants were a self-selected subsample with more extensive mental health issues. **B.** No exact prevalence rates reported for Aboriginal and non-Aboriginal female offenders for anxiety disorders, mood disorders, schizophrenia and other psychotic disorders
Lemstra et al. (2008)	3871	20-question Center for Epidemiologic Studies Depression Scale 7 day prevalence	Aboriginal- 319 Caucasian 3133 Other 419	Students between grades 5 and 8 in the city of Saskatoon, Saskatchewan	6/8 **A.** Low representation of boys and low-income neighbourhood, meaning results may not be representative of this cohort. **B**. Low response rate (41.1%) may have biased findings. Depressed mood assessed by written questionnaire. There was no information on demographic differences between ethnic groups but adjusted results were also presented.
Wu et al. (2003)	70538	University of Michigan Composite International Diagnostic Interview short form (UM-CIDI). 12 month prevalance	East and Southeast Asian - 624 Chinese - 1 800 South Asian - 809 Aboriginal - 975 Black 788 Arabic/West Asian - 325 Latin American 176 Jewish 197 French 5,580 English 9,281 "Other" Whites 50,294	Data from the second cycle of the National Population Health Survey conducted by Statistics Canada in 1996-97. The survey included a sample of 70, 538 Canadians from all provinces who completed the mental measures, except those living in Indian Reserves, Canadian Forces Bases, institutions, and some remote areas. The data were collected primarily by telephone	7/8 **A.** The data were collected primarily by telephone. Only 70, 538 out of the eligible 81,804 participants completed the mental measures, **B.** Full data were only presented for the adjusted results

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Latin America					
Puac-Polanco et al, (2015)	1452	Spanish version of the Composite International Diagnostic Interview (CIDI) for DSM-IV translation required for some local Mayan regions/dialects Lifetime prevalence	Indigenous n = 409 Non-Indigenous n = 1043	Representative sample of adults from across Guatemala, as part of the 2009 Guatemalan National Mental Health Survey (GNMHS), a large population-based mental health survey conducted across multiple regions of Guatemala; multiple ethnicities and languages included within sample. Two stage design with 1 person per household randomly selected for the CIDI interview	7/8 **A.** The self-reported data may be affected by recall or other bias; difficulty quantifying response rate; translators required for some participants which may cause translation difficulties. **B.** The comparison of prevalence rates in Indigenous and non-Indigenous participants were not adjusted for other sociodemographic factors as the primary focus of the paper was factors associated with mental health problems following exposure to violence
Filha et al. (2016)	23,894	Edinburgh Postnatal Depression Scale, used to assess postnatal depression. 7 day prevalence	Brazilian sample of women post-partum. Indigenous n = 99 White n = 8,079 Black n = 2,051 Brown n = 13,402 Yellow n = 257	Fixed samples (n = 90) recruited from hospitals with >500 births per year across regions in Brazil. Women were recruited shortly post-birth from hospital.	3/8 **A.** Symptoms measured between 6 and 18 months postpartum, potentially interfering with recall of post-birth symptoms. This also affected the attrition rate. **B.** Use of 10 item screening tool for diagnosis used via telephone interview. Women giving birth outside hospital or in smaller hospitals not captured.
Vicente et al. (2005)	599	Spanish version of the Composite International Diagnostic Interview (CIDI) for DSM-III-R. [5,6] 12 month and lifetime prevalence	75 Mapuche, 434 non-Mapuche; Mapuche: 45.4% male 54.6% female; Non-Mapuche 47.6 % male, 52.4 female Age range 15-65	Mapuche from four counties in the province of Cautin, Chile; One person per household randomly selected	6/8 A. Small sample size limited results. The interview schedule was not validated for use with this population, so it is unknown whether there is respondent bias. B. Interviewers were not qualified to make medical diagnoses. Diagnoses based on the now-dated DSM-III-R. Mapuche participants had lower educational levels but otherwise had similar socio-demographic characteristics. Adjusting for this did not alter the results.

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Table 4: 12-month and lifetime prevalence

	12-months			Lifetime		
	Studies	N	Odds Ratio (M-H, Random, 95% CI)	Studies	N	Odds Ratio (M-H, Random, 95% CI)
Anxiety	10			6		
GAD	4	38245	0.72 [0.34, 1.54]	3	13037	0.46 [0.37, 0.59] ***
Panic	3	36899	1.34 [0.64, 2.79]	3	13354	0.71 [0.57, 0.89] *
OCD	0	0	Not estimable	1	2112	0.79 [0.44, 1.42]
Agoraphobia	2	25717	1.67 [0.87, 3.20]	2	2172	1.23 [0.72, 2.13]
Social phobia	3	26973	1.19 [0.85, 1.66]	1	1663	1.68 [1.06, 2.64] *
PTSD	5	48239	1.47 [1.28, 1.69] ***	4	14452	1.56 [0.88, 2.78]
Any anxiety	3	26666	1.14 [0.79, 1.64]	1	509	0.61 [0.31, 1.21]
Depression	14			5		
Dysthymic disorder	4	38245	1.16 [0.79, 1.71]	3	13037	0.81 [0.68, 0.96] *
Major depression	11	87209	1.30 [0.76, 2.23]	5	16152	0.61 [0.55, 0.68]***
Any depression	7	76839	1.09 [0.56, 2.10]	2	11691	0.58 [0.52, 0.66] ***

Note. * $P < 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$.

$I^2 \leq 50\%$ for 12-month prevalence rates of dysthymia, agoraphobia, social phobia, PTSD and overall anxiety, as well as all lifetime comparisons

GAD = Generalised Anxiety Disorder; *OCD* = Obsessive Compulsive Disorder; *PTSD* = Post-Traumatic Stress Disorder; *SUD* = Substance Use Disorder.

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Table 5: Prevalence of up to 12 months by gender (lower odds ratios favour Indigenous people)

	Males			**Females**		
	Studies	N	Odds Ratio (M-H, Random, 95% CI)	Studies	N	Odds Ratio (M-H, Random, 95% CI)
Anxiety						
GAD	2	5866	0.58 [0.29, 1.17]	2	6664	0.38 [0.26, 0.56] ***
Panic	1	5256	0.93 [0.53, 1.61]	1	5928	0.64 [0.46, 0.89] **
Social phobia	1	694	1.31 [0.50, 3.47]	1	562	1.47 [0.64, 3.37]
PTSD	3	6338	1.70 [1.31, 2.20] ***	2	6664	1.23 [0.93, 1.63]
Any anxiety	2	5950	1.09 [0.84, 1.41]	2	6490	0.89 [0.74, 1.08]
Depression						
Dysthymic disorder	2	5866	1.30 [0.58, 2.93]	2	6664	0.85 [0.61, 1.18]
Major depression	2	5866	0.65 [0.50, 0.84]	6	32825	1.12 [0.64, 1.94]
Any depression	2	5950	0.55 [0.42, 0.72]	2	6490	0.64 [0.53, 0.77]

Note. * $P \leq 0.05$; ** $P \leq 0.01$; *** $P \leq 0.001$.

GAD = Generalised Anxiety Disorder; *OCD* = Obsessive Compulsive Disorder; *PTSD* = Post-Traumatic Stress Disorder; *SUD* = Substance Use Disorder.

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Figure 1: PRISMA flow chart of included and excluded studies

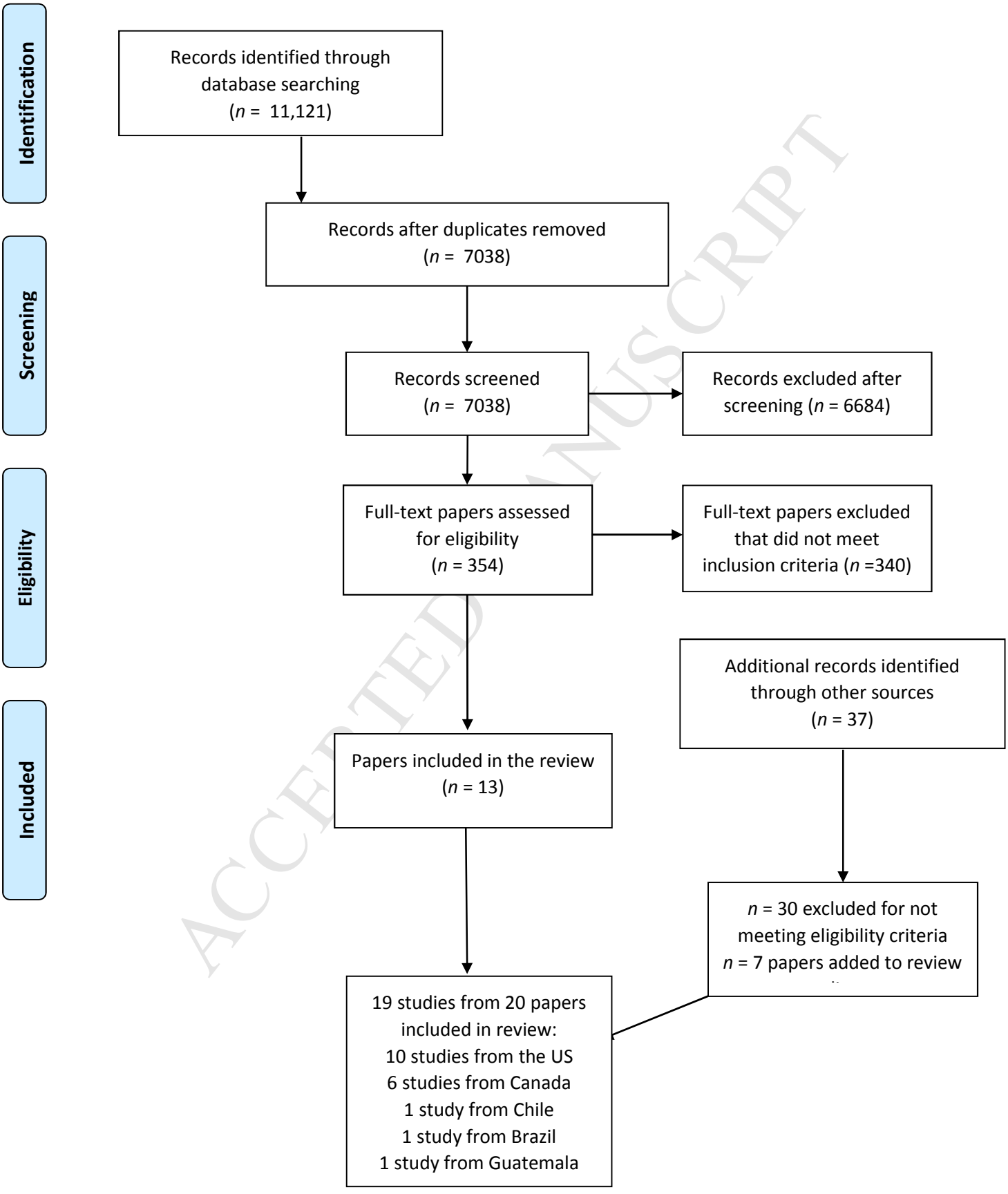

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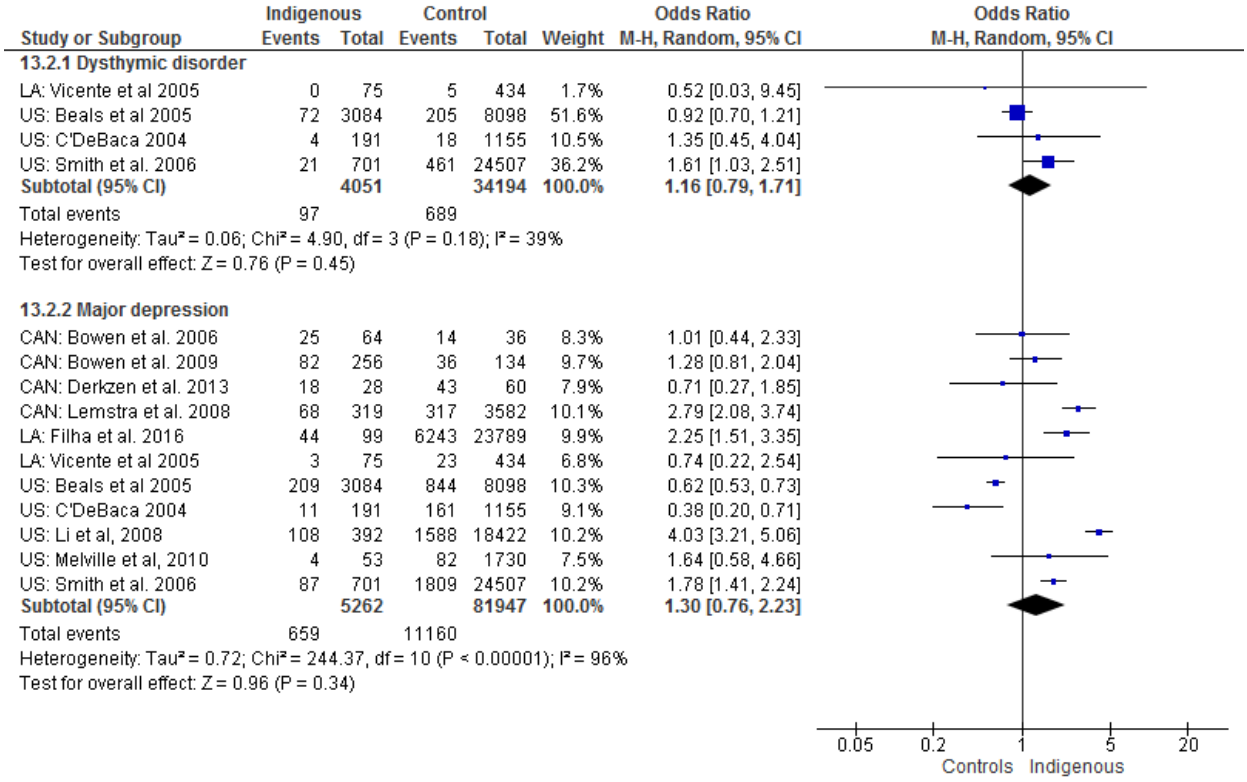
Figure 2: Dysthymic and major depressive disorders – 12 month prevalence



CAN: Canada
LA: Latin America
US: United States

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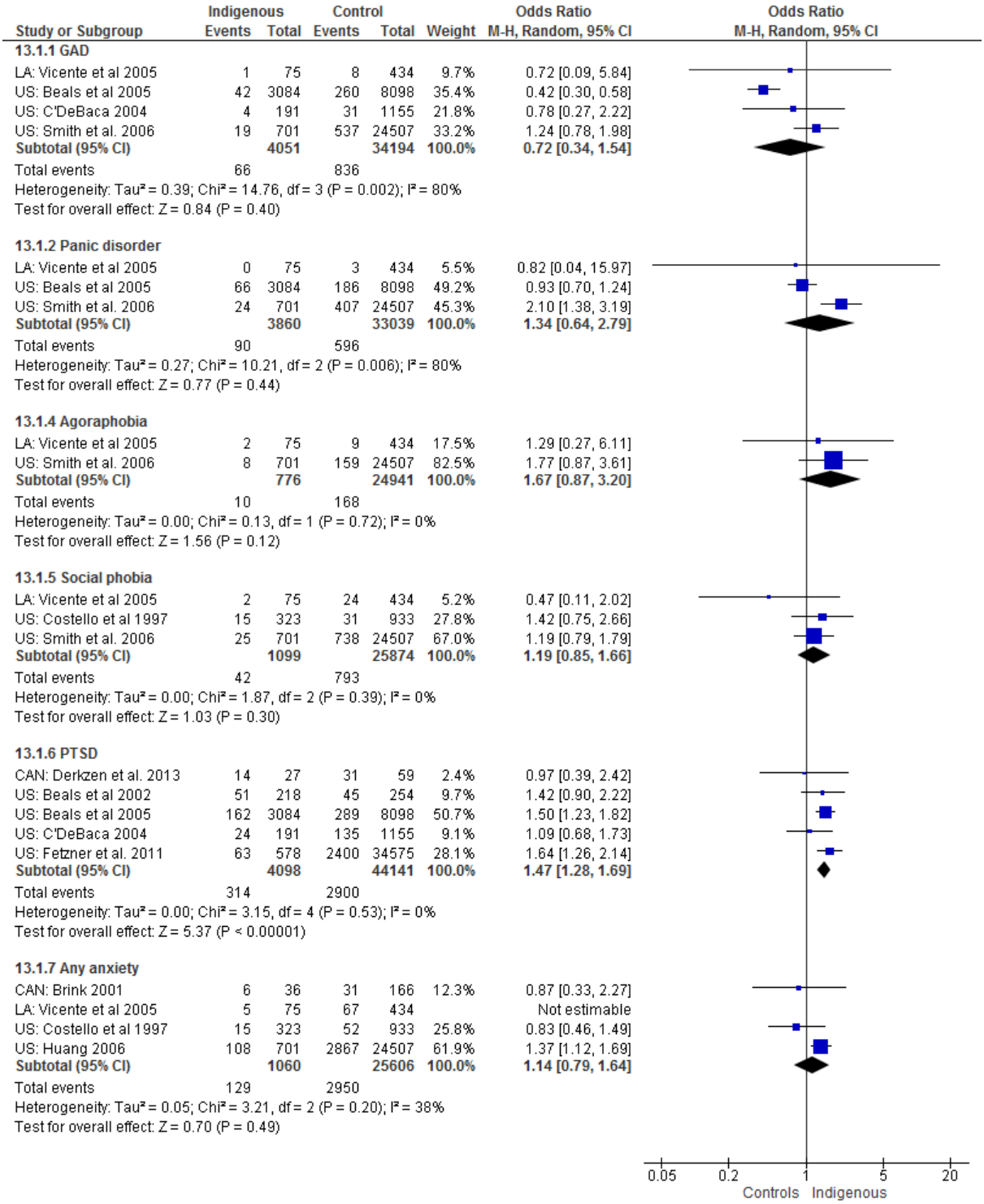
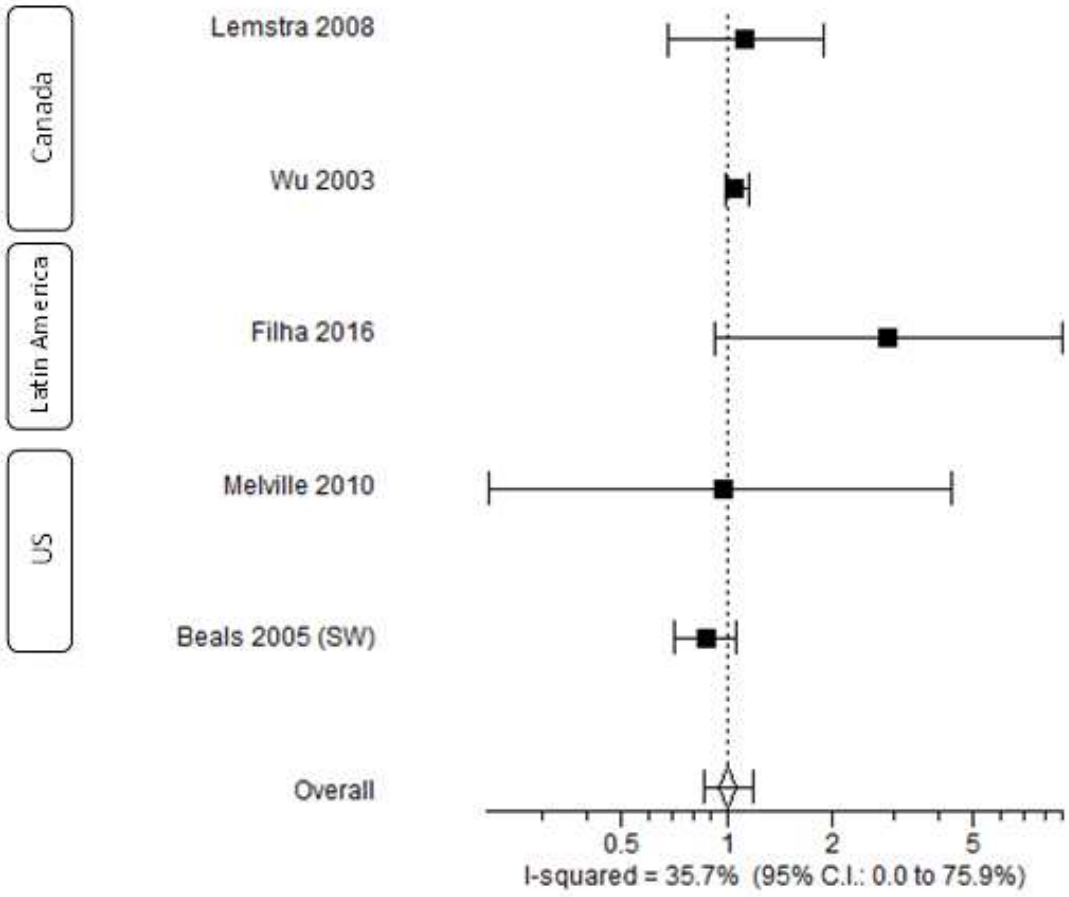
Figure 3: Anxiety disorders – 12 month prevalence



CAN: Canada
LA: Latin America
US: United States

Figure 4: Multivariate analyses comparing rates of depressive disorders between Indigenous and non-Indigenous people in studies adjusting for socio-demographic variables



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Contributions

MT had the original idea for the paper. The analysis plan was developed by SK. The literature searches, selection of papers and extraction of data were conducted by KA and EB. SK was available to resolve any differences between raters. SK conducted the meta-analysis. KA and SK wrote the first draft. This was then revised critically for important intellectual content by the other authors.

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