The prevalence of personality disorders in the community: A global systematic review and meta-analysis

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Background

Personality disorders are now internationally recognised as a mental health priority. Nevertheless, there are no systematic reviews examining the global prevalence of personality disorders.

Aims

To calculate the worldwide prevalence of personality disorders and examine whether rates vary between high and low and middle-income countries (LAMICs).

Method

We systematically searched PsycINFO, MEDLINE, EMBASE and PubMed from 1980 to May 2018 to identify articles reporting personality disorder prevalence rates in community populations (PROSPERO registration number: CRD42017065094).

Results

Forty-six studies (from 21 different countries spanning six continents) satisfied inclusion criteria. The worldwide pooled prevalence of any personality disorder was 7.8 % (95% Confidence Intervals: 6.1-9.5). Rates were greater in high income (9.6%; 95% CI: 7.9-11.3%) compared with LAMI (4.3%; 95% CI =2.6-6.1%) countries. In univariate meta-regressions, significant heterogeneity was partly attributable to study design (two-stage versus one-stage assessment), county income (high versus LAMI) and interview administration (clinician versus trained graduate). In multiple meta-regression analysis, study design remained a significant predictor of heterogeneity. Global rates of Cluster-A, B and C personality disorders were 3.8 % (3.2, 4.4%), 2.8% (1.6, 3.7%) and 5.0% (4.2, 5.9%).

Conclusions

Personality disorders are prevalent globally. Nevertheless, pooled prevalence rates should be interpreted with caution due to high levels of heterogeneity. More large-scale studies with standardised methodologies are now needed to increase our understanding of population needs and regional variations.

Key words: Personality disorder, prevalence, systematic review, meta-analysis, LAMIC

Introduction

Before the 1960s, personality disorders were viewed as unreliable diagnoses of limited clinical utility. Personality disorders are now recognised as important conditions, which are associated with morbidity, premature mortality, and great personal and social costs. [1-3]

A recent narrative review reported relatively high rates of personality disorders (4.4% - 21.5%) in community populations across the Western world.[4] To the best of our knowledge, however, there are no reviews examining global prevalence of personality disorders, and whether rates vary between high and low-and middle-income (LAMI) countries. This is important because personality disorders are often under-recognised in clinical practice, especially in LAMICs where there are limited resources and other disorders such as and psychosis tend to be prioritised.[5] Approximately 80% of the global population live in LAMICs, and mental health is now recognised as a public health priority in these areas.[6] Nevertheless, personality disorders are not included within the scope of policy-informing initiatives, such as the WHO Mental Health Gap Action Programme[7] and the Global Burden of Diseases Project. [8] Consequently, there are no data to guide health policy and planning for personality disorders in LAMICs. [9,10] Personality disorders are associated with high levels of mental, physical, and functional impairment and premature mortality. [1,11] Neglecting their effects at the population level is likely to impede progress in reducing the burden of disability.[8] Therefore, the main aim of this study was to conduct a systematic review of the literature on the prevalence of personality disorders to answer the following research questions:

- What is the global pooled prevalence of any personality disorder in the community?
- What is the prevalence of Cluster A, B, and C personality disorders in the community?
- Do pooled personality disorder prevalence rates differ between high and LAMI countries?

- Do methodological factors (population characteristics, sample characteristics, study and assessment methods) explain variability in prevalence estimates across studies?

Method

We conducted the review in accordance with PRISMA[12] and MOOSE guidelines.[13] The protocol was registered with PROSPERO prior to conducting searches (registration number: CRD42017065094). The completed review remains aligned with the original PROSPERO protocol in terms of search strategy, research questions and methodology; however, we could not examine the effects of some of the pre-selected potential moderators of prevalence figures (e.g., sex and ethnicity of sample) as there was insufficient data.

Eligibility criteria

We included studies:

1) That were cross-sectional or longitudinal (i.e., personality disorder were assessed during one wave of the study) [14] and reported a prevalence figure for any personality disorder or a Cluster A, B or C personality disorder. We did not limit to a specific diagnostic criteria (e.g., DSM-IV or ICD-10).[14]
2) Sampling adolescents (age 12-18 years) or adults from community or school populations. In line with recent Cochrane reviews,[15] we elected to include adolescent populations, supported by strong evidence for the validity of personality disorders in individuals under 18 years. [11,16,17]
3) Using validated interviews or self-report questionnaires. We included self-report questionnaires in the first instance to examine the impact (e.g., potential inflation) of this type of assessment on prevalence estimates.[18]

4) Published in any language with an English abstract (we found that all foreign language studies identified provided an English abstract).
5) Published in a peer-reviewed journal.

We excluded studies:

1) With participants from clinical, medical, psychiatric, or prison settings.

2) With selective samples (e.g., chronic pain groups, students in higher education, case-control samples).

3) With less than 100 participants.[19]

4) That adopted a retrospective diagnostic approach based on previously recorded data from primary or secondary care records or national registries.[20] Results from clinical records or administrative databases might diverge from epidemiological surveys, as personality disorders are often underdiagnosed in these sources, [21] while register-based diagnoses might lack the reliability achieved by well-trained interviewers. [22]

Search strategy, study selection and critical appraisal

We searched PsycINFO, MEDLINE, EMBASE, and PubMed from January 1980 to May 2017 for articles without language restrictions. We updated the search on the 24th May 2018. We combined the following three search strings: Personality disorder* OR Axis-II AND Prevalen* OR rate* OR frequency OR percentage AND epidemiolog* OR communit* OR general population OR population OR student* OR healthy sample OR normal population OR representative sample* (see online Table DS1 for more details on search strategy). Search results from each database were downloaded into EndNote X7 and merged into one file. We removed duplicates during the merging process and imported the endnote file into the Covidence web-based review management tool (https://www.covidence.org/about-us). We inspected the reference lists of retrieved articles and cross-referenced our findings against published reviews.[2-4,23,24] Following removal of duplicates, C.W. and A.B. independently screened titles and abstracts

of all potentially eligible articles for full text retrieval. C.W and A.B then independently screened full text articles for inclusion in the review. Screening at both stages was conducted within the Covidence review management tool, which allowed each researcher to vote 'yes' or 'no' for each article and record the reason for their decision.

Data extraction and critical appraisal

C.W. extracted data using a pre-determined form. Details included: first author and year, country, income status of country (LAMI versus high), sample (number, age and gender), sample frame (including origin, recruitment and estimation), diagnostic assessment method, evaluation instrument, diagnostic criteria, and personality disorder prevalence figure (and standard error).

C.W. critically appraised full text articles using an adapted version of the Joanna Briggs Institute Critical Appraisal Tool for prevalence reviews.[25] Each study was rated (0 = study did not satisfy category or it could not be determined; 1=study satisfied the category). We examined eight categories: 1) representativeness of target population; 2) recruitment of participants; 3) sample size; 4) description of study subjects and setting; 5) coverage of identified sample; 6) objectivity of assessment; 7) reliability of the assessment; and 8) appropriate statistical analysis. We calculated a critical appraisal score for each study ranging from 0 to 8, which was included as a moderator in the meta-regression analysis.

Summary measure

Prevalence figure was the principal summary measure. 'Any personality disorder' referred to the presence of one or more categorical personality disorder as defined and assessed in each of the included studies. Cluster A, B and C personality disorders correspond to the three-cluster model of personality disorders delineated in the DSM-5. Cluster A (also known as odd-eccentric) included any categorical paranoid, schizotypal, or schizoid personality disorder. Cluster B (also known as dramatic-erratic) included any categorical histrionic, borderline, narcissistic or

antisocial personality disorder. Cluster C (also known as anxious-fearful) included any categorical avoidant, dependent or obsessive compulsive personality disorder.[26] We also pooled the prevalence rates of individual personality disorders (e.g., borderline personality disorder) where the data was available (see data supplement).

Synthesis of results

We combined prevalence figures from individual studies quantitatively using meta-analysis. In meta-analysis, the pooled prevalence estimate is calculated by assigning a 'weight' to each study, which reflects the accuracy of each individual study estimate and is typically a function of sample size.[27] We used the *metaprop* command in STATA version 14. The metaprop command is an extension of the *metan* procedure designed for meta-analysis of proportions. As we anticipated heterogeneity across studies, we chose the random effects model with inverse variance weights.[28] We used the cimethod (exact) command and the Freeman-tukey double arcsine transformation (ftt) for meta-analyses when studies had zero prevalence rates (i.e., studies of individual personality disorders).[29] We report heterogeneity with the I^2 statistic (descriptive statistic representing proportion of total variability in prevalence estimates that can be attributed to heterogeneity), the Q statistic with p-value (measure of weighted squared deviations around the summary estimate), and Tau^2 (inter-study variance reported in the scale of the prevalence estimate).[30] We conducted the meta-analysis in the following stages: 1) we pooled prevalence figures for any personality disorder; 2) we pooled prevalence figures for Clusters A, B and C-personality disorders respectively; 3) we pooled prevalence figures for individual personality disorders.

Additional analyses

Sensitivity analysis and publication bias

We conducted sensitivity analysis to evaluate the influence of each study on pooled personality disorder prevalence using the *metaninf* command. [31] We also examined the impact of self-report questionnaires on prevalence figures, as they have been associated with the over-diagnosis of personality disorders. [32,33] We compared pooled rates of self-report questionnaire versus interview studies. In line with recent prevalence studies, we assessed publication bias by visually inspecting the funnel plot for asymmetry.[34,35]

Subgroup analysis and meta-regression analysis

We used sub-analysis and meta-regressions to examine the effects of study characteristics on personality disorder prevalence estimates. We selected study factors *a priori* based on previous reviews of mental health prevalence [14,36] and the assessment of personality disorder prevalence specifically. [37-39] We conducted univariate meta-regressions for each factor. Covariates associated with heterogeneity at the $p<0.05$ level were included in the multivariate analysis.

We considered the following factors for any personality disorder prevalence:

1) Population characteristics

- Income level of study country (1= high income; 2= LAMI - including upper-middle, lower-middle and low income). We used the World Bank definitions of country income status, which are based on Gross National Income per capita calculated using the Atlas method (www.worldbank.org).
- Study date (1= before median of 2009; 2= median date or later).[40]

2) Sample characteristics

- Sample size (1= below median: $n < 1,610$; 2= median or greater $n = \geq 1,610$).[41]

3) Study characteristics

- Representativeness and sampling strategy (1=country or large city/area weighted to represent population; 2=medium or small city/area with complex sampling to improve representativeness; 3= probably non-representative sample including a small area/sample with no complex sampling approach).[14]
- Study design (1=one-stage; 2= two-stage assessment). One-stage assessment included studies that administered one personality disorder assessment to the whole sample. Two-stage assessment included studies that administered a screening instrument to the entire sample, and then a diagnostic interview to a proportion of individuals screening positive and/or negative. [14]
- Critical appraisal score (on a scale from 0 to 8) based on the Joanna Briggs Institute Critical Appraisal Tool for prevalence reviews.

4) Assessment methods

- Diagnostic criteria according to the two most used most systems in psychiatry: the International Classification of Diseases and the Diagnostic Statistical Manual of Mental Disorders (1=ICD 8/9/10; 2=DSM-III/R; 3=DSM-IV)[14]
- Interview administration (1= interview by experienced clinician or psychiatrist 2= interview by trained graduates or research assistants; 3 = interview by trained lay person).[41]
- Diagnostic interview (1=clinical interview; 2=Structured Clinical Interview for DSM-IV: SCID-II; 3=International Personality Disorder Examination: IPDE; 4=Structured Interview for DSM-IV Personality/Revised: SIDP-IV; 5=other, e.g., assessment tool used in just one study, e.g., Standard Assessment of Personality).[14]

To avoid duplication, we did not repeat all the above subgroup analysis for Clusters A, B and C PD. We did, however, examine whether each of the clusters varied in prevalence according to country income level. [42]

Results

Study selection

Of the original 3876 abstracts, 535 articles were selected for full text review. There was an acceptable level of agreement between raters (*Kappa* = 0.80). The updated search yielded a further 458 abstracts, of which 20 full text articles were retrieved for inspection. Three articles were identified by hand search. In total there were 558 full text articles. Of the full text articles, 46 fulfilled our inclusion criteria (reporting on any, a Cluster A, B or C or an individual personality disorder). Inter-rater reliability was acceptable (*Kappa* = 0.82). The authors discussed discrepancies at the abstract and full text stage. Most discrepancies related to uncertainty relating to duplicate data or whether the study sample was selective (**Figure 1**).

[Insert Figure 1 here]

See online Table DS2 for a full list of excluded studies and reasons for exclusion. Main reasons for exclusion included: duplicate samples (e.g., National Epidemiologic Survey of Alcohol and Related Conditions), the use of selected samples (e.g., small undergraduate populations, case control studies) and very small sample size (<100 participants). Reasons for exclusion sometimes overlapped, e.g., studies with a small number of participants tended to use biased samples.

Study characteristics

Forty-six studies from twenty-one different countries satisfied our inclusion criteria. Thirty-four studies reported a prevalence figure for 'any personality disorder' and/or cluster A, B or C personality disorder (some of these studies also reported a prevalence figure for an individual personality disorder). Twelve studies only reported a prevalence figure for an individual personality disorder, e.g., Obsessive Compulsive Personality Disorder.[43] See online Table DS3 for an overview of included studies, including sample description, sampling frame, diagnostic

approach, and raw prevalence figures. One study from the WHO World Mental Health Surveys [42] provided independent prevalence estimates for eight different countries. Most studies were published in English language, excepting two German,[44,45] one Icelandic [46] and four Chinese [47-50] articles. A.W. translated and extracted data from the Chinese publications. We could not identify native speakers for the German and Icelandic articles. Thus, in line with previous studies [51,52] we used *Google Translate* for these articles.

Critical appraisal of included studies

Please refer to online table DS4 for an overview of the risk of bias analysis. Lower scores indicate a higher chance of bias in prevalence estimates (e.g., due to lack of sample representativeness or measurement reliability).[25] Studies ranged in scores between 2 and 7.5, with a mean score of 5.1. Generally, self-report questionnaire studies [46,53] and those with less robust recruitment strategies (e.g., non-randomisation) [54] yielded the lowest scores.

Sensitivity analysis

We included thirty studies (37 individual prevalence estimates) in the initial meta-analysis of the pooled prevalence of any personality disorder. Inspection of the forest plot highlighted one Jamaican study [55] as an outlier, with a personality disorder prevalence of 41.4%. Assessment in this study was conducted with the Jamaica Personality Disorder Inventory (JPDI), which identifies a cut-point of ≥10 as indicative of the presence of a personality disorder.[56] In a previous study of 200 Jamaican patients, the JPDI demonstrated a reasonable level of internal consistency, sensitivity, specificity and concurrent validity. [56] However, the authors described the JPDI diagnosis as existing on a continuum from mild to severe, which might explain the very high rates reported. Sensitivity analysis (online Table DS5) confirmed that removal of this study had a relatively substantive effect on overall pooled prevalence, thus we excluded it from further analysis.

Six of the included studies used validated self-report questionnaires. [32,46-48,53,57] Self-report questionnaire studies (11.2%; 95% CI: 3.7, 18.7%) yielded noticeably higher pooled personality disorder prevalence rates than the interview studies (7.7%; 95% CI: 6.0, 9.4%). We thus excluded these studies from the final analysis. Twenty-four studies (providing thirty-one independent prevalence estimates) were included in the final meta-analysis of any personality disorder. Twelve studies (nineteen estimates) reported on Cluster-A, Cluster-B, and Cluster-C personality disorders.

Pooled prevalence of any personality disorder

The global pooled prevalence of any personality disorder was 7.8% (95% CIs: 6.1, 9.5). There was substantial inter-survey heterogeneity amongst estimates (I^2 = 99.7%, Q = 8511.9, df=29, p<.001, Tau^2 = 0.002). See **Figure 2** for the forest plot of prevalence estimates from individual studies.

[Insert Figure 2 here]

Publication bias

The funnel plot (online figure DS1) indicated a possibility of a publication bias towards higher personality disorder rates as reflected by the higher number of study points on the right-hand side of the plot.

Subgroup analysis and univariate meta-regressions according to study characteristics

See **Table 1** for results of the sub-analyses and univariate (unadjusted) meta-regressions. Pooled prevalence rates of any personality disorder were significantly greater in high income compared to LAMI countries (**Figure 3**), with income status of country accounting for 18.7% of between study variance. Studies using two-stage assessments (e.g., screening tool then interview) yielded significantly lower pooled prevalence rates than one-stage assessments, accounting for 34.8% of

between study variance. Studies with interviews conducted by trained graduates or psychologists yielded significantly higher prevalence rates than those conducted by experienced clinicians (accounting for 19.5% of between study variance).

[Insert Figure 3 here]

[Insert Table 1 here]

Multiple meta-regression

In the multiple meta-regression analysis (adjusting for all significant moderators from the univariate meta-regression), study design (β = -.053, p = .013) remained a significant predictor of heterogeneity. The distinction between high and LAMI countries (β = .0002, p=0.994) and type of interviewer - experienced clinicians versus trained graduates (β = .041, p = .053) did not remain significant predictors of heterogeneity. The final model accounted for just under 40% of the heterogeneity in prevalence rates across studies (Adjusted R-squared: 39.6%).

Prevalence of Cluster A, B and C PDs

See **Figure 3** for an overview of Cluster A, B and C personality disorder prevalence rates by country income classification. Twelve studies (19 estimates) examined Cluster-A prevalence (pooled prevalence: 3.8 %; 95% CIs: 3.2-4.4; I^2 =94.3%, Q=317.6, df=18, p<.001, Tau^2=0.0002). Two studies (8 estimates) reported prevalence rates in LAMI countries (3.4%; 95% CI =2.3-4.5%; I^2 =94.8%, Q=134.8, df=7, p<.001) and eleven (12 estimates) in high income countries (pooled prevalence 4.2%; 95% CI: 3.3-5.0%; I^2 =94.2%, Q=173.4, df = 10, p<.001). Country income status was not significantly associated with Cluster-A prevalence estimates in the meta-regression analysis (β = .002, p=0.84).

Twelve studies (19 estimates) reported Cluster-B prevalence (2.8%; 95% CIs: 1.8-3.7; I^2 =98.8%, Q=1498.6, df=18, p<.001, Tau^2=0.0004). Three studies (8 estimates) reported

prevalence rates in LAMI countries (1.5%; 95% CI =0.9-2.1%; I^2 =93.2%, Q=103.3, df=7, p<.001) and ten (11 estimates) in high income countries (pooled prevalence 3.7%; 95% CI: 2.3-5.2%; I^2 =98.9%, Q=912.1, df=10. p<.001). Country income status was significantly associated with Cluster-B prevalence estimates in the meta-regression analysis (β = -.019, p=0.048).

Twelve studies (19 estimates) reported Cluster-C prevalence (5.0%; 95% CIs: 4.2-5.9; I^2 =98.1%, Q=737.6, df= 18, Tau^2 =0.0003). Three studies (8 estimates) reported prevalence rates in LAMI countries (3.3%; 95% CI =2.2-4.4%; I^2 =95.7%, Q=163.2, df=7, p<.001) and eleven (12 estimates) in high income countries (pooled prevalence 6.6%; 95% CI: 5.1-8.1%; I^2 =98.2%, Q=558.1, df=10, p<.001). Country income status was not significantly associated with Cluster-C prevalence estimates in the meta-regression analysis (β = -.028, p=0.165).

Pooled rates of individual personality disorders are reported in online Table DS6. The most common personality disorders were obsessive compulsive (3.2%), avoidant (2.7%) and paranoid (2.3%). Schizotypal (0.8%), histrionic (0.6%), and dependent (0.8%) personality disorders were rare. We did not examine pooled prevalence rates according to country income as most studies were from high income countries.

Discussion

We identified forty-six studies from twenty-one different countries spanning six continents (Africa, North America, South America, Asia, Australia/Oceania and Europe). Twenty-three studies (30 estimates) were included in the final meta-analysis for any PD, and twelve for the meta-analyses of Cluster A and B-personality disorders, and thirteen for Cluster C personality disorders. The global pooled prevalence of any personality disorder was 7.8% (95% CI: 6.1-9.5). This figure exceeds the WHO World Mental Health personality disorder prevalence estimate of 6.1%,[42] and global period prevalence rates of mood (5.4%) and anxiety (6.7%) disorders.[36] We found significant heterogeneity across studies, which was partly explained by study design (i.e., two-stage assessment led to significantly lower pooled prevalence). The pooled prevalence of any

personality disorder was significantly lower in LAMI (4.3%) than in high income (9.4%) countries in univariate meta-regression, although this difference became non-significant in the final meta-regression. Cluster B (1.5% *vs* 3.7%, p=0.048) and C personality disorders (3.3% *vs* 6.6%, *ns*) were also less common in LAMI countries.

There are several plausible explanations for these findings. First, there might exist a lower population risk in LAMICs due to key cultural or social factors.[2,36,58,59] Previous global reviews indicate lower rates of depression and anxiety in LAMICs, [36,60] and it is plausible that variations in behavioural norms across countries (e.g., individualistic versus collectivist societies) could have some bearing on personality disorder prevalence. For example, studies in urban and rural areas of Taiwan indicate very low prevalence rates of antisocial personality disorder. [61] It is hypothesised that these lower rates might be attributable to stronger social control mechanisms preventing the progression of antisocial behaviours. [62] Similarly, some diagnostic traits and categories might not be equally valid or meaningful in all countries. Avoidant, dependent and borderline personality disorder, for example, are not specified in the Chinese Classification of Mental Disorders.[58] We still know relatively little about the impact of culture, race and ethnicity on mental disorders in general, and personality disorders specifically.[58,63] It might be that certain illnesses, such as eating disorders (and possibly some forms of personality disorder), become more widespread with the increasing "Westernisation" of the world.[64] Paris and Lis have hypothesised that borderline personality disorder (BPD) is "socially sensitive" and that secular trends, such as the breakdown of social cohesion and social capital, which are increasingly evident with rising income and inequality, have given rise to increased prevalence of BPD. [65]

Second, it is recognised that mental disorders can present with different symptoms in different cultures [66] and current diagnostic tools and criteria might underestimate the prevalence of personality disorders in LAMICs.[67] Two Asian studies, conducted by Western psychiatrists, reported strikingly low personality disorder prevalence rates in China [68] and Bangladesh. [69] In contrast, the WHO mental health survey reported a prevalence of 4.1% in China when using the

cross-cultural International Personality Disorder Examination tool. [42,70] While the use of uniform (cross-cultural) assessment tools might improve inter-country comparisons, researchers should also consider cultural nuances in symptom clusters, which could moderate aetiology and illness presentation.[71]

Third, differences in pooled prevalence might be partly attributable to methodological confounders. Study design was a strong predictor of heterogeneity in both univariate and multiple meta-regression analysis, while country income and interview administration became non-significant predictors of heterogeneity in the final multivariate model. Thus, study design might have confounded the effect of study country on prevalence estimate (i.e., all one-step studies were from high income countries potentially inflating the gap between high and LAMI countries). To further explore the effects of this potential methodological confounder on prevalence rates in high versus LAMI countries, we conducted post hoc subgroup analysis including two-stage studies only. We found that prevalence rates in high income studies (6.6%; 95% CI: 3.4, 9.8.%) still exceeded prevalence rates in LAMI studies (4.3%; 95% CI: 2.6, 6.1%). The magnitude of the difference was reduced and no longer significant in the meta-regression analysis, though this could be attributable to reduced power as a result of restricting the number of studies (n=16). Further large scale multi-country studies, with standardised methodologies are needed to shed further light on whether true differences exist, [42] though current diagnostic tools may not adequately capture subtle cultural nuances.[72]

Cluster-A personality disorders were relatively common in high (4.2%) and LAMI (3.4%) countries. The relatively high global prevalence of Cluster-A personality disorders contrasts with low presentation of these disorders in clinical settings. [73] These three personality disorders (paranoid, schizoid and schizotypal) often receive the least research attention [74] despite being associated with chronic physical comorbidities including cardiovascular disease and arthritis and high levels of functional impairment.[4]

We noted that studies from Australia tended to report high personality disorder prevalence rates, though estimates varied across studies. Using the Structured Clinical Interview for DSM-IV, Quirk et al. [75] found a prevalence of 21.7% in an age-stratified female cohort. Moran et al. [76] found an informant-reported (using the Standardised Assessment of Personality) prevalence of 18.6% in a nationally representative cohort of young people. In a nationwide household study, Jackson, Burgess [77] reported a more conservative prevalence of 6.6% when using the International Personality Disorder Examination (IPDE). As personality disorders are increasingly recognised as a mental health priority in Australia, more population level data is expected. [78,79]

Methodological considerations and limitations

There are several limitations that should be noted when considering our review findings. First, we identified substantial inter-study heterogeneity across all models with high and significant I^2 values. We found that heterogeneity, while slightly reduced, remained high across all subgroup analyses. Pooled prevalence estimates were similarly heterogeneous in previous global prevalence reviews on ADHD [20] and common mental disorders.[14,36] It has previously been noted that heterogeneity statistics are sensitive to factors present in psychiatric epidemiology reviews.[36] Our meta-analyses included epidemiological studies of considerable magnitude (i.e., thousands of participants), likely leading to low within study variance, which can inflate heterogeneity statistics. [80,81] Nevertheless, it should be acknowledged that heterogeneity can affect the stability and interpretability of pooled prevalence estimates.[36] Second, only one of our *a priori* selected covariates had a significant impact on the variability of estimates in the multiple meta-regression. Other factors, such as diagnostic assessment, had a noticeable effect on pooled prevalence rates in the subgroup analysis, but were not significant predictors in the meta-regression. Despite our comprehensive search, we only identified a modest number of epidemiological studies. We limited our systematic search to published studies, which could have led to the omission of potential studies (thus reducing number of studies). This could have limited our power to detect

significant moderators, and fully disentangle the confounding effects of inter-related moderators.[82] Relatedly, the exclusion of unpublished studies could have potentially led to less precise pooled estimates.[83] We found a possible publication bias towards higher personality disorder prevalence rates, which could have led to a slight overestimation of pooled rate. It should be noted, however, that the interpretation of publication bias in prevalence reviews is not straightforward (i.e., in studies measuring prevalence there are no negative findings) and that specific methods for prevalence reviews are not well established.[84,85] Third, there were some potential moderating factors we could not include in our analysis due to insufficient data, or a difficulty in constructing meaningful categories. Factors such as age, sex, urbanicity and socioeconomic status could have an impact on personality disorder prevalence rates. [42,86] Fourth, because of the limited number of studies, we had to construct relatively crude categories for some moderators. For example, 'LAMICs' covered a wide variety of countries (both low-middle and high-middle) and included megacities [87] and rural areas, [69] all of which might vary in prevalence rates. Fifth, the inclusion of longitudinal cohorts could have led to an underestimation of personality disorder prevalence as disadvantaged or mentally ill participants are more likely to drop out of studies. However, the few included longitudinal studies reported high follow-up rates of approximately 80%. [88,89] Sixth, three of the included studies were translated using Google Translate. Google Translate is increasing used in systematic review studies and had been highlighted as a useful tool for reviewers to translate European articles. However, it is possible that this approach could have introduced inaccuracies.[90]

Finally, we only pooled categorical personality disorder prevalence figures. The assumption that personality disorders are categorical is highly contested. [37] Although the DSM-5 has retained the ten discrete personality disorders, [26] personality and personality pathology is dimensional.[4] Under direction from the WHO, the ICD-11 Working Group is developing a dimensional system for the diagnosis of personality disorders, which should be usable and useful for health care workers in lower-resource settings, and will consider the cross-cultural

applicability of categories, definitions and diagnostic descriptions. [91] [92] These developments could help in tackling the challenge of clinical utility to guide clinical decision-making and to inform health policy and planning across LAMIC and high-income countries.[93]

Conclusions

Despite substantial inter-survey heterogeneity, we found that personality disorders are prevalent globally affecting a substantial proportion of the population. Epidemiological research on personality disorders is relatively sparse, with a paucity of data from less developed countries, from which to draw comparative conclusions. While personality disorder prevalence rates are lower in LAMICs, they are still considerable.[87] As personality disorders are common across many areas of the world, they should be recognised as an important contributor to population mental health and disease burden. [2,4] Personality pathology continues to be overlooked in clinical practice [94] particularly in LAMICs where resources are limited [95] and personality disorders tend to be a lower priority. [42,87] Services in lower income countries need to be structured to accommodate these patients, and educational programs should be offered to both specialist and general practitioners.[87]

Treatments for patients with personality disorder have advanced considerably over recent years with the advent of a number of specialised psychotherapies [96] and early intervention programs. [79,97] Nevertheless, the evidence base is underdeveloped with the majority of studies pertaining to borderline personality disorder (and to a lesser extent) antisocial personality disorder. [74] Global prevalence rates for Cluster-A and C-personality disorders exceed those of Cluster-B personality disorders supporting the need for more treatment trials in these lesser studied disorders.[74]

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Table 1. Subgroup analysis and univariate metaregression results for the diagnosis of any PD								
Methodological factor	**Subgroup analysis**				**Meta-regression analysis**			
Subgroup categories (number)[a]	**Pooled prevalence % (95% CIs)**	**I^{2} %**	**Q statistic (df)**	***P*-value of heterogeneity**	**Coefficient (SE)**	**P value**	**Proportion of between-study variance explained**	**Tau-squared (REML estimation)**
Country classification (income level)							**Adjusted R^2**	
High income (*n*=20)	**9.6 (7.9, 11.3)**	98.4	1212.6 (19)	<0.001	(reference)			
LAMIC (*n*=10)	**4.3 (2.6, 6.1)**	99.3	1264.2 (9)	<0.001	**-0.048 (0.018)**	**0.011**	**18.7%**	**0.002015**
Study date								
Before median of 2009 (n=13)	8.6 (6.3, 11.0)	99.3	1771.9 (12)	<0.001	(reference)			
Equals median or later (n=17)	7.1 (5.5, 8.8)	98.8	1321.6 (16)	<0.001	-0.012 (0.02)	0.542	-2.49%	0.00254
Sample size								
Below median: *n* < 1, 610 (n=16)	9.6 (7.0, 12.3)	98.0	753.5 (15)	<0.001	(reference)			
Median or greater *n*= ≥ 1, 610 (n=14)	5.9 (3.4, 8.4)	99.8	7227.1 (13)	<0.001	-0.030 (0.018)	0.109	5.46%	0.002343
Sampling strategy								
Representative (n=17)	7.5 (4.8, 10.1)	99.8	7477.6 (16)	<0.001	(reference)			
Probably representative (n=6)	7.8 (4.9, 10.8)	98.4	305.7 (5)	<0.001	0.003 (0.025)	0.911		
Unlikely representative (n=7)	8.7 (5.0, 12.5)	97.8	270.0 (6)	<0.001	0.017 (0.024)	0.478	-6.04%	0.002628
Study design								
One-stage (n=14)	**10.6 (9.0, 12.2)**	96.7	390.91 (13)	<0.001	(reference)			
Two-stage (n=16)	**5.1 (3.6, 6.7)**	99.3	2076.7 (15)	<0.001	**-0.060 (0.015)**	**0.001**	**34.8%**	**0.001617**
Diagnostic criteria								
ICD 8, 9, 10 (n=5)	5.6 (2.7, 8.5)	99.6	1021.8 (4)	<0.001	(reference)			
DSM-III/R (n=5)	9.4 (2.4, 16.3)	98.9	349.7 (4)	<0.001	0.035 (0.033)	0.296		
DSM-IV (n=20)	7.9 (6.2, 9.6)	98.7	1421.7 (19)	<0.001	0.016 (0.026)	0.555	-2.73%	0.002546
Diagnostic assessment								
Experienced clinician (n=8)	4.5 (3.1, 6.0)	98.3	417.8 (7)	<0.001	(reference)			
Trained graduate (n=11)	**11.3 (8.5, 14.0)**	96.2	266.5 (10)	<0.001	**0.054 (0.022)**	**0.018**		
Lay interviewer (n=11)	6.0 (4.5, 7.5)	98.2	564.4 (10)	<0.001	0.008 (0.021)	0.712	**19.5%**	**0.001995**
Study instruments								
Clinical interview (n=2)	1.0 (0.4, 1.4)	N/A	N/A	N/A	(reference)			
SCID-II (n=7)	12.1 (8.7, 15.5)	92.2	76.4 (6)	<0.001	0.059 (0.040)	0.150		
IPDE (n=12)	5.7 (4.3, 7.1)	97.8	500.6 (11)	<0.001	0.010 (0.038)	0.790		
SIDP (n=3)	8.8 (4.2, 13.4)	N/A	N/A	N/A	0.043 (0.045)	0.358		
Other (n=6) [b]	8.0 (3.2, 12.8)	99.9	4617.9 (5)	<0.001	0.033 (0.041)	0.428	3.37%	0.002395
Critical appraisal score (continuous)[c]	-	-	-	-	0.009 (0.009)	0.336	0.23%	0.002472

REML: Restricted Maximum Likelihood method; LAMIC: Low- and middle-income countries; SCID-II: Structured Clinical Interview for DSM-IV; IPDE: International Personality Disorder Examination; SIDP: Structured Interview for DSM-IV Personality