Systematic Review and Meta-Analysis of Anxiety and Depression Among American Indian and Alaska Native Adolescents in the United States

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Abstract: *American Indian and Alaska Native (AI/AN) adolescents experience considerable mental health disparities, yet research on the prevalence of anxiety and depression remains limited. The objectives of this study were to assess available depression and anxiety data among AI/AN adolescents in the literature and to estimate depression prevalence and mean scores. A systematic review of the Medline, Embase, and PsycINFO databases identified publications reporting on anxiety or depression in AI/AN adolescents aged 10-19. Gray literature was searched in ProQuest Dissertation and Theses to minimize publication bias. Meta-analyses using random-effects models in R estimated the aggregate prevalence and mean scores of depression. Covariates included mean age, percent of male participants, geographical region, and setting. The systematic literature review extracted 82 relevant studies, with 77 citations reported depression data, 15 citations reported anxiety data, and 4 citations reported depression and anxiety prevalence data together but did not discriminate between the two conditions. Aggregate depression prevalence measured by the Center for Epidemiological Studies Depression (CES-D) scale was 34.6% (95% CI: 11.5-68.4%) across three studies (N=664), while the Children's Depression Index (CDI) indicated a prevalence of 14.5% (95% CI: 2.5-52.9%) in two studies (N=365). The aggregate CDI mean score was 9.81 (95% CI: 9.50-10.13) out of 54. No covariates significantly influenced depression outcomes (p>0.05). Generalized Anxiety Disorder 7-item*

(GAD-7) scale was the most frequently reported measurement of anxiety, in three studies. Due to limited data, meta-analyses for anxiety were not conducted. The results of this systematic review highlight the scarcity of data on depression and anxiety in AI/AN adolescents. This underscores the urgent need for culturally appropriate, evidence-based mental health research and services for AI/AN adolescents.

INTRODUCTION

In the United States, major depression and anxiety are among the most prevalent mental health disorders, with an estimated prevalence of 8.3% and 19.1%, respectively (NIMH, 2023; NIMH, n.d.). The American Indian and Alaska Native (AI/AN) population had the highest depression rate (11.2%) among all racial and ethnic groups, except for people who were associated with two or more races (NIMH, 2023; NIMH, n.d.). Research shows that mental health disorders like depression and anxiety can manifest at any age, including adolescence. Anxiety disorders in adults often begin as high levels of anxiety in childhood (NIMH, 2024). These mental health disorders can have direct impacts on quality of life, underscoring the urgent need to understand and address these mental health challenges among AI/AN youths.

Anxiety and depression have strong associations with substance abuse and are risk factors for suicide (Cheref et al., 2019). Specifically, adolescents aged 12 to 17 years with depressive symptoms are at higher risk of poor academic achievement (Tyser et al., 2014) and substance abuse and misuse, including cigarette smoking (Moon et al., 2020). AI/AN adolescents have the highest rates of cigarette smoking (Yu & Whitbeck, 2016) and suicide ideation (Baiden et al., 2020) among all racial and ethnic groups in the United States and are the only ethnic minority group with higher rates than Whites. Suicide is the second leading cause of death among AI/AN adolescents (Asher BlackDeer & Patterson Silver Wolf, 2020), which marks anxiety and depression as major public health concerns in the United States, especially for the AI/AN population.

Despite elevated mental health risks, the AI/AN population faces various barriers when seeking mental healthcare, including stigma associated with mental health problems, shortage of Indigenous service providers, and chronic underfunding of the Indian Health Service (IHS) (Gone & Trimble, 2012; Goodkind et al., 2010; Grandbois, 2005). Adding to the severity of the mental healthcare landscape, AI/AN adolescents remain underrepresented in mental health research (Alcantara & Gone, 2007; Storck et al., 2009). Considerable disparities and knowledge gaps in the mental health of AI/AN adolescents are formally recognized by major professional medical organizations (American Academy of Pediatrics, 2023; American Medical Association, 2021; American Psychological Association Services Inc, 2023; National Alliance on Mental Health, n.d.). Preventing, diagnosing, and treating mental illness during adolescence may help improve the

disproportionally high rates of substance abuse and suicide among the AI/AN population (Whitbeck, 2011).

Although 9.7 million people in the United States self-identify as AI/AN, either alone or in combination with other races (Sanchez-Rivera et al., 2023), there are a relatively small number of publications on anxiety and depression in the AI/AN population. As a population, AI/AN communities are culturally and geographically diverse, with members belonging to over 500 federally recognized tribes in 48 contiguous states and Alaska (United States Census Bureau, 2025). However, the vast majority of the AI/AN population (87%) do not live on one of the 324 federally recognized American Indian reservations or off-reservation trust land. Instead, most of the AI/AN population (70%) live in urban instead of rural areas of the United States (U.S. Department of Health and Human Services, Office of Minority Health [USDHHS OMH], 2025). An existing study suggested regional differences as a factor for variations in the prevalence of depression within the AI/AN population, as the tribes in the Northern Plains were found to have slightly higher percentage of adolescents experiencing depression compared to adolescent tribal members from the Southwest region, and this regional difference may be related to the more individualist culture among tribes in the Northern Plains compared to those in the Southwest (Novins et al., 1999).

The scarcity of available mental health data related to AI/AN adolescents partly stems from the data limitations within prominent health databases, such as those maintained by the National Institute of Mental Health (NIMH). The NIMH summary of major depression in adolescents excluded AI/ANs due to the small sample size in this racial group (NIMH, 2023; NIMH, n.d.). IHS does collect extensive individual-level mental health data of the AI/AN population (IHS, 2018); however, as healthcare eligibility through the IHS typically requires tribal membership (IHS, n.d.-a) and approximately only half of AI/AN tribal members receive health services through IHS (USDHHS OMH, 2025), the IHS electronic health records database might not be representative of the AI/AN population in the United States, and the database is also not focused on the adolescent population. Furthermore, the use of electronic health records to estimate the prevalence of health conditions could be associated with biases such as underrepresentation (Chen et al., 2022).

Given the limitations on available data, systematic reviews and meta-analyses, as the highest level in the hierarchy of evidence (Cochrane UK, 2023), offer a critical method for synthesizing existing research and identifying prevalence patterns in AI/AN adolescents across

various geographic and cultural contexts. While past reviews have examined the potential risk and protective factors for mental health among AI/AN individuals, families, and communities (Ka'apu, 2019), they lack a focus on examining the specific prevalence estimates for depression and anxiety. For depression, the authors recognized that, in general, older age and lower educational level were risk factors, and high level of social support and self-efficacy were protective factors, but significant variability in the risk factors was found between gender and geographic regions. However, the authors did not identify the endpoints used to quantify anxiety and depression in the six citations included in the systematic review.

A criterion on the measurement tools utilized to assess anxiety or depression is important when performing systematic reviews or meta-analyses of mental health problems in AI/AN populations. Because AI/AN communities may articulate and express distress in culturally specific ways, instruments developed primarily with non-Indigenous samples could misclassify, as well as over- or under-detect symptoms (Ka'apu, 2019). Moreover, stereotypes about AI/AN peoples and culturally divergent understandings of mental illnesses can amplify public and self-stigma, shaping help-seeking, disclosure, and engagement with care, which in turn may decrease identification in research and clinical screening (Gone & Trimble, 2012; Goodkind et al., 2010; Grandbois, 2005). Given the limited mental health data, evidence synthesis can provide an important interim approach. To our knowledge, no prior systematic review or meta-analysis has reported on the prevalence of anxiety or depression among AI/AN adolescents.

To address these gaps, we conducted a systematic review and meta-analysis to estimate the prevalence and mean scores of depression and anxiety among AI/AN adolescents. The study's objectives include: 1) evaluate the extent of available data; and 2) estimate prevalence and mean scores to investigate any potential variations between geographic regions.

METHODS

The protocol for the systematic review and meta-analysis was developed based on the Joanna Briggs Institute Manual for Evidence Synthesis (Joanna Briggs Institute, n.d.) and the Preferred Reporting Items for Systematic reviews and Meta-Analyses Protocols (PRISMA-P) checklist (Moher et al, 2015; Shamseer et al., 2015).

Search Strategy

A systematic search was conducted on three electronic databases: Medline, Embase, and PsycINFO. Medline and Embase are two large databases with concentrations in the biomedical field, while PsycINFO is a database specializing in the field of psychology, which encompasses the study of anxiety and depressive disorders. The search included citations from Ovid Epub Ahead of Print, In-Process, In-Data-Review, and other Non-Indexed Citations. To minimize publication bias, gray literature was searched in ProQuest Dissertation and Theses. The primary key terms, shown in Supplemental Table 1 in the Supplemental File, were developed based on the Population, Intervention, Comparison, and Outcome (PICO) framework (Higgins & Green, 2009). An experienced medical information specialist at the Imperial College London (ICL) library reviewed the search strategy to ensure relevance and feasibility.

Inclusion and Exclusion Criteria

A set of inclusion and exclusion criteria (Table 1) was determined prior to identifying relevant studies. According to the World Health Organization (World Health Organization, n.d.), adolescents are defined as 10 to 19 years of age. This definition was selected to maintain consistency with global adolescent mental health research. To extract the maximum number of citations, there were no limitations on the study sample size or the publication year.

Study Selection

Search was conducted via the ICL library online access, with the search results downloaded and duplicates removed using EndNote 21 (Clarivate Analytics, Philadelphia). Only English language citations were considered. After the removal of duplicates, titles and abstracts from the citations were screened for topical relevance. For citations lacking clear abstracts, full texts were reviewed during the study selection process. Two independent reviewers assessed each study's eligibility through title and abstract screening and full-text review. Discrepancies between reviewers were resolved through discussion until a consensus was achieved.

Quality Assessment

The methodological quality and risk of bias of the included studies were evaluated using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cross-sectional studies (University of Bern Institute of Social and Preventive Medicine, n.d.).

Table 1.
Inclusion and exclusion criteria of studies to be assessed for the systematic review

	Studies were included if:	Studies were excluded if:
Population	• The study population consisted of subjects between 10 and 19 years, or a separate breakdown of prevalence by age group, or at least included an age range covering most of the 10 to 19 years, was reported • The study focused on a special population (e.g., adolescents with psychological disorders or exposed to trauma), as long as a control group was also included in the study, but studies of pregnancy in adolescents or COVID-19 pandemic were not considered as special conditions as they are not automatically correlated with a mental or behavioral issue	• The study population was not located in the continental United States (i.e., data from Native Hawaiians/Pacific Islanders and indigenous people in other parts of North/South America were excluded)
Outcome	• The study examined the effectiveness of anxiety or depression treatments and the validation of assessment tools, as long as a control group or baseline measurement was also included in the study • The prevalence of anxiety or depression was determined using standardized validated instruments, self-reported questionnaires, or clinically structured interviews • The prevalence was reported either as percentages, or at least enough information was provided so that the point prevalence, one-year prevalence, or lifetime prevalence could be calculated	• The study did not report the prevalence or mean scores of either anxiety or depression independently from other mental health disorders
Other considerations	• Any study design, including cohort, case-control, and cross-sectional studies	• No primary data analysis was published (e.g., review, editorial, systematic review, meta-analysis types of manuscript) • The study results were not reported in English

Data Extraction and Derivation

The two reviewers independently undertook data extraction following a standardized format based on the PRISMA checklists. Extracted data included: study identification (title, publication year, author), study setting and study design (geographical region, geographical setting, number of participants), subject characteristics (age, gender, special population, disorder),

and outcome (measurement tool, reported prevalence/mean score of anxiety and/or depression). For results reported in graphical format, data were extracted using WebPlotDigitizer (v4.5) (Automeris LLC, n.d.).

In addition to data extraction, the database-building process included data derivations to support the meta-analysis. If prevalence was not reported, the value was calculated using the sample size as the denominator, and the reported number of those with depression or anxiety as the numerator. Additionally, if a study lacked both standard error (SE) value and 95% confidence interval (95% CI), SE was calculated using this equation: SE = sqrt(p*(1-p)/n), where sqrt(p) is the square root of the proportion of the cases reported, and *n* is the denominator of the prevalence estimate (Ferrari et al., 2013).

Meta-analysis

Meta-analyses were conducted to estimate the prevalence of anxiety or depression among AI/AN adolescents, based on the two most commonly utilized measurement tools each for anxiety and depression in the systematic review, when there was sufficient data extracted from the literature.

Both fixed-effect and random-effects models were first examined to assess the impact of data heterogeneity by comparing results from the two approaches (Borenstein et al., 2010). The random-effects model was then selected to estimate the 95% CI of the summary effect and to test for covariate effect (Han & Eskin, 2011), using subgroup analysis for categorical covariates or regression analysis for continuous covariates. For prevalence endpoints, meta-analyses for estimating aggregate proportion values were performed using the generalized linear mixed model (GLMM) with log-transformed data, as proportion measurements are restricted to positive values. Calculation for the random-effects estimate CI was based on the Hartung and Knapp method (Knapp & Hartung, 2003). For mean score endpoints, meta-analyses for estimating aggregate mean values were performed using log-transformed means, with 500 bootstrap replicates to calculate the prediction intervals. Forest plots were used to present the prevalence for each subgroup and the aggregated prevalence estimates. For covariate analysis, a p-value of <0.05 was considered as statistically significant.

The heterogeneity across studies was assessed using I^2 statistics, with thresholds of 25% or below representing low heterogeneity, between 25% and 50% representing medium heterogeneity, and 75% or above representing high heterogeneity (Higgins et al., 2003).

Publication bias was assessed through visual inspection of Begg's funnel plot (Begg & Mazumdar, 1994; Duval & Tweedie, 2000) and Egger's test for small study effects (Egger et al., 1997).

All analyses were conducted using R software (v4.3.2) (R Core Team). The "metaprop" and "metamean" functions from the meta package (v6.5-0) (Schwarzer, 2007) were used to estimate aggregate prevalence (Wang, 2023) and mean score, respectively. Covariates as potential risk factors and confounders were investigated using the "metareg" function and subgroup analysis.

Ethics and Dissemination

No ethical approval was required because this study used data from previously published studies where informed consent was obtained by the original investigators. The systematic review was registered with PROSPERO (CRD42024555983).

RESULTS

Systematic Review

Study Characteristics

A total of 1,632 potentially relevant citations were retrieved on March 28, 2024, from the initial search of the three databases, using search terms from the pre-specified search strategy (Supplemental Table 2). After removing duplicate citations from databases, a review of the abstracts and available full text was conducted. Additionally, one relevant citation (Lau et al., 2012) was identified through reference list screening and included in the final dataset.

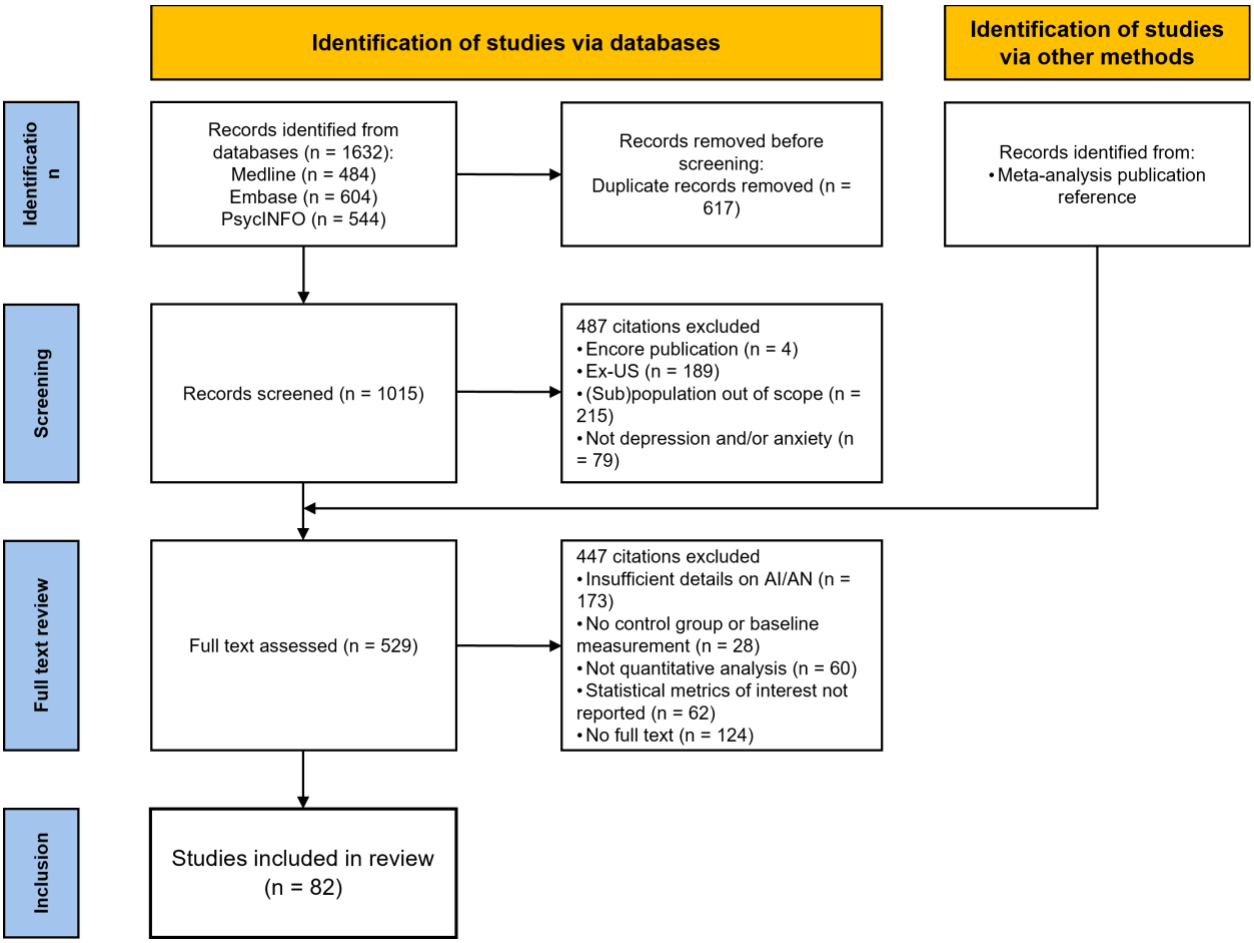
In total, 82 citations with data on depression and/or anxiety prevalence or mean score data were selected for inclusion in the meta-analysis dataset (Supplemental Table 3). A flow chart detailing the screening and exclusion process is displayed in Figure 1. Of the 82 citations, 65 (79%) were cross-sectional in study design.

In the meta-analysis dataset, 77 citations reported depression data, 15 citations reported anxiety data, and 4 citations reported depression and anxiety prevalence data together but did not discriminate between the two conditions. Specifically, out of the 82 citations,

- 63 citations reported depression data only
- 2 citations reported anxiety data only

- 3 citations reported depression + anxiety data together without discrimination between the two conditions
- 13 citations reported both depression and anxiety data but as separate conditions
- 1 citation reported depression data alone and depression + anxiety data together without discrimination between the two conditions

Figure 1. Flow chart of database and analysis data



Note: AI/AN=American Indian/Alaska Native, EX-US=outside of the United States.

Supplemental Table 4 displays the summary statistics of the study covariates of interest including publication year, percent of male study participants, and mean age as continuous variables, as well as geographical region and geographical setting as categorical variables. The publication year ranged from 1976 to 2024. The mean age, rather than the median age of the study participants, was more likely to be reported (49 vs. 3 studies). The distribution of male participants was bimodal (Supplemental Figure 1), with seven studies including only female participants (i.e.,

0% males). In addition, low to moderate correlation (correlation coefficient < 50%) existed between the continuous variables (Supplemental Figure 1). Among the categorical variables, the most represented geographical region was the Northern Plains (29.3%), while 28.0% of studies either spanned multiple regions or had missing information regarding geographical region. The reservation setting was the most prevalent, representing 35.4% of the studies, with 41.5% of the studies conducted at multiple geographical settings or lacking geographical setting information. Studies conducted on reservations were primarily located in the Northern Plains or Southwest, whereas studies conducted in rural areas were mostly located in the Southeast, specifically in North Carolina (Supplemental Table 5).

No imputation of the covariates was performed due to data heterogeneity in a relatively small analysis dataset. The analysis dataset with the list of citations is provided in the Supplemental File.

Quality Assessment

The 82 citations in the analysis dataset were assessed for reporting quality using a checklist for cross-sectional studies (University of Bern Institute of Social and Preventive Medicine, n.d.), with individual scores for each citation detailed in Supplemental Table 6. The quality assessment revealed that 68 out of 82 citations (82.9%) lacked information on missing data, and 30 out of 82 citations (36.6%) did not disclose a funding source for the study. Notably, 22 of the 82 citations were dissertations in fulfillment of degree programs. These dissertations were less likely to identify funding sources for their projects but were more likely to address missing data or include raw data in an appendix section.

Meta-analysis of Depression Endpoints

Depression prevalence was initially the primary outcome measure assessed using meta-analysis. Due to limited prevalence data, however, depression mean scores were also analyzed drawing on the mean score data from the systematic review.

Prevalence

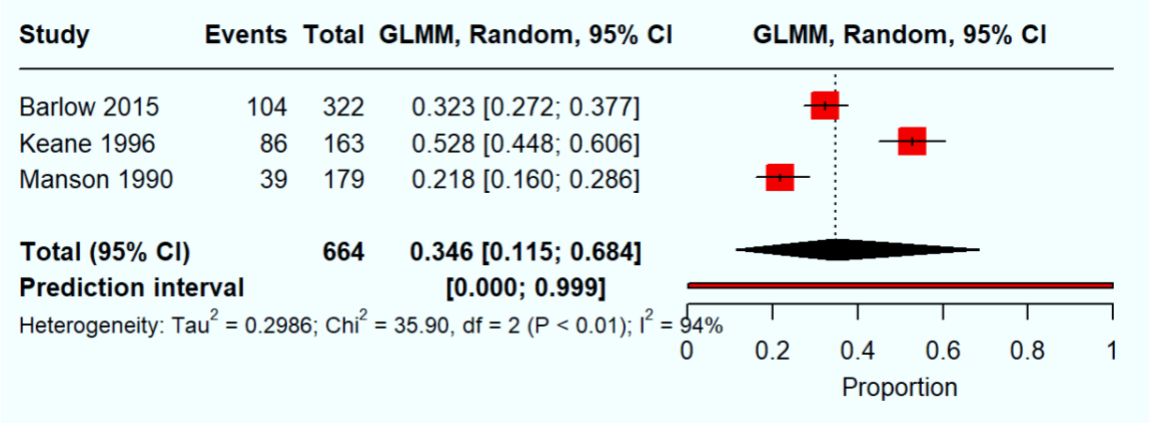
In the analysis dataset, depression prevalence was most frequently measured using the 20-item Center for Epidemiological Studies Depression (CES-D) scale (Radloff, 1991). Three studies, with a total sample of 664 participants, reported prevalence data based on the CES-D using a cutoff score of 16 (out of a maximum of 60), as cutoff for clinical significance for depression. Of the three studies, the population and setting included teen mothers in reservation communities in the

Southwest region (Barlow et al., 2015), students at a tribally administered secondary boarding school of undisclosed location (Keane et al., 1996), and students at a tribal boarding school in a rural area of southeastern United States (Manson et al., 1990). From the meta-analysis, the aggregate point prevalence of depression of the three studies was 34.6% (95% CI: 11.5 to 68.4%, $\tau^2 = 0.299$, I^2=94%) (Figure 2). There was a statistically significant, high-level of heterogeneity among the studies ($p < 0.01$), but the percent of male participants and publication year were not statistically significant covariates. There were insufficient data to test the impact of other covariates of interest.

The Children's Depression Index (CDI) was the second most commonly used tool for measuring depression prevalence, with a 27-item format (Kovacs, 1985). In two studies totaling 365 participants, depression prevalence was calculated based on CDI scores using a clinical cutoff score of 19 or 20 (out of a maximum of 54) for depression. Meta-analysis estimated an aggregate point prevalence of 14.5% (95% CI: 2.5-52.9%, $\tau^2 = 0$, I^2=22%) for depression (Figure 3). In contrast to CES-D, the heterogeneity among CDI-based studies was low and not statistically significant ($p = 0.26$), and covariate analysis was not performed due to the limited number of studies.

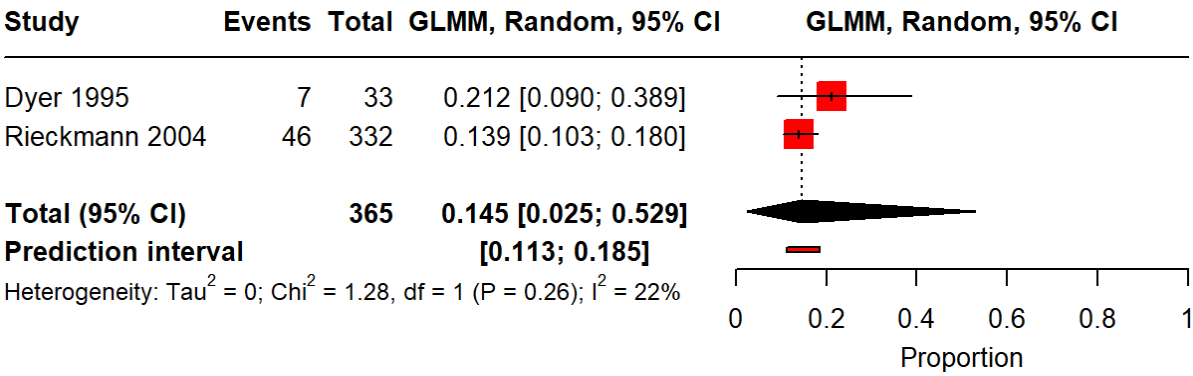
A comprehensive list of all instruments used across the studies can be found in the Supplemental File (Supplemental Table 3).

Figure 2. Forest plot of depression prevalence based on the Center for Epidemiologic Studies Depression (CES-D) scale



Note: CI = confidence interval, df = degrees of freedom, GLMM = generalized linear mixed model. The vertical dash is the observed prevalence for the study, the horizonal whisker is the 95% CI, and the size of the squares is proportional to the study weight. The vertical dashed line is the aggregate prevalence, and the width of the diamond represents the CI of the aggregate prevalence.

Figure 3. Forest plot of depression prevalence based on the Children's Depression Inventory (CDI)



Note: CI = confidence interval, df = degrees of freedom, GLMM = generalized linear mixed model. The vertical dash is the observed prevalence for the study, the horizonal whisker is the 95% CI, and the size of the squares is proportional to the study weight. The vertical dashed line is the aggregate prevalence, and the width of the diamond represents the CI of the aggregate prevalence.

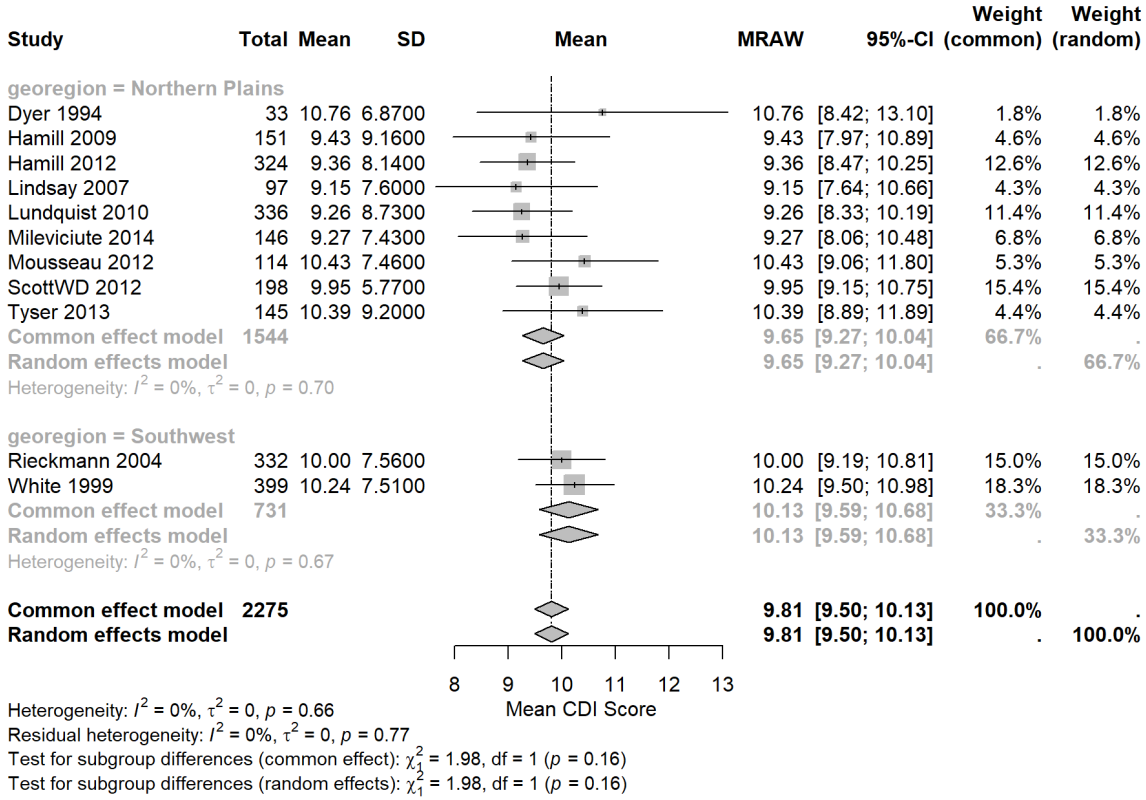
Mean Score

Mean score data from screening or diagnostic tests for depression were more widely available than prevalence data in the systematic review, with the CDI (27 items) and CES-D (20 items) being the most commonly used instruments to measure depression. As such, meta-analysis was conducted on outcome measurements from these two instruments to assess aggregate mean scores for depression.

Children's Depression Index (CDI). The distribution of CDI mean scores from 2,275 participants across 11 studies is shown in Supplemental Figure 2, with scores ranging from 9.15 to 10.76 out of a possible score of 54. Meta-analysis produced an aggregate mean score of 9.81 (95% CI: 9.50-10.1, $\tau^2 = 0$, I^2=0%), with no statistically significant heterogeneity among the studies (p = 0.66) (Figure 4).

Out of the 11 studies, nine were conducted among AI/AN populations in the Northern Plains and two in the Southwest. Stratified subgroup analysis estimated an aggregate mean score of 9.65 (95% CI: 9.27 to 10.0) for the Northern Plains and 10.1 (95% CI: 9.59 to 10.7) for the Southwest (Figure 4). This analysis revealed a strong overlap in the aggregate mean scores between the two geographical regions; however, the difference was not statistically significant (*p* = 0.16). Regression analysis revealed that publication year, percent of male participants, and mean age of participants were not statistically significant covariates with p-values of 0.147, 0.151, and 0.251, respectively. Therefore, no covariates were included in the final meta-analysis model for CDI mean score.

Figure 4. Forest plot of Children's Depression Inventory (CDI) mean score for depression and stratified by geographic region (Northern Plains and Southwest)

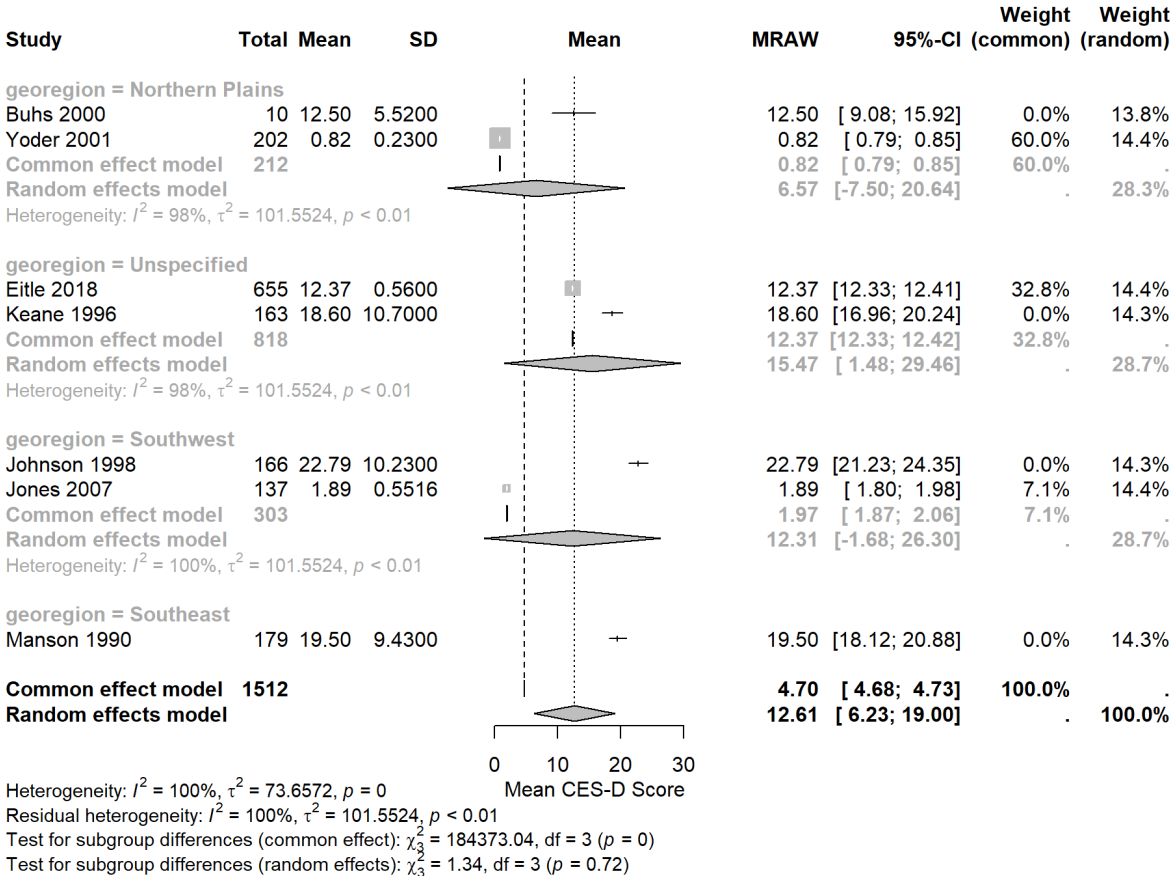


Note: CI = confidence interval, df = degrees of freedom, MRAW = raw or untransformed mean that is pooled for the summary measures, SD = standard deviation. The vertical dash is the observed mean score for the study, the horizonal whisker is the 95% CI, and the size of the squares is proportional to the study weight. The vertical dashed line is the aggregate mean score, and the width of the diamond represents the CI of the aggregate mean score.

The funnel plot indicated a lack of publication bias from small studies (Supplemental Figure 3), and the Egger's test was not statistically significant for asymmetry (p = 0.967). Influence analysis detected no outlier studies (Supplemental Figure 4).

Center for Epidemiologic Studies Depression (CES-D). The CES-D mean scores were reported for 1,512 participants across seven studies, with scores ranging from 0.82 to 22.8 (Supplemental Figure 5). The meta-analysis estimated an aggregate mean score of 12.6 (6.23 to 19.0, τ^2 = 73.7, I^2=100%), as shown in Figure 5. With fewer than 10 studies, the Egger's test was not conducted.

Figure 5. Forest plot of Center for Epidemiologic Studies Depression (CES-D) scale mean scores for depression and stratified by geographic region (Northern Plains, Southeast, Southwest, Unspecified)



Note: CI = confidence interval, df = degrees of freedom, MRAW = raw or untransformed mean that is pooled for the summary measures, SD = standard deviation, Unspecified = multiple or unknown. The vertical dash is the observed mean score for the study, the horizDnal whisker is the 95% CI, and the size of the squares is proportional to the study weight. The vertical dashed line is the aggregate mean score, and the width of the diamond represents the CI of the aggregate mean score.

The seven studies represented four geographical regions. Based on subgroup analysis, the difference in CES-D mean scores was statistically significant among geographical regions (p<0.0001), as indicated in Figure 5. Stratified subgroup analysis estimated an aggregated mean score of 6.57 between the two studies conducted in the Northern Plains and an aggregated mean score of 15.47 (95% CI: 1.48 to 29.46) among the two studies with multiple/unspecified geographic location. These scores contrasted the mean scores of 12.3 and 19.5 from two studies conducted in the Southeast and one study conducted in the Southwest regions, respectively. Subgroup analysis was also performed using geographical setting categories of reservation, rural, urban, and unspecified/multiple settings. Although the difference in CES-D mean scores among

geographical setting categories was statistically significant ($p<0.0001$), data up to only three studies were included in each category (Supplemental Figure 6). Among the other covariates investigated, publication year and percent of male participants were not statistically significant (p-values 0.246 and 0.146, respectively).

Anxiety

Anxiety prevalence and mean score data were available in 15 citations from the systematic review as measured across 10 different instruments. Among the 15 citations, 4 had prevalence data and 12 had mean score data (i.e., one citation had both prevalence and mean sore data). Three out of the 15 studies assessed anxiety with unspecified measurement tools. One study was conducted solely in Alaska (Harvey et al., 1976). The Generalized Anxiety Disorder 7-item (GAD-7) scale (Spitzer et al., 2006) was the most frequently used instrument, with one citation reporting anxiety prevalence data and two citations reporting mean score data. In the study by D'Amico and colleagues, 18% of AI/AN adolescents in urban areas reported experiencing clinically significant anxiety in 2020 during the COVID-19 pandemic (D'Amico et al., 2020). Due to minimal data reporting anxiety prevalence or mean score using GAD-7, no meta-analysis was conducted for anxiety.

Combined Depression and Anxiety

Four citations in the systematic review reported the prevalence or mean scores for combined depression and anxiety without distinguishing between the two conditions. Due to the lack of consistent measurement tools, no meta-analysis was performed on these combined outcomes.

DISCUSSION

This study aimed to examine variations in the prevalence of anxiety and depression among AI/AN adolescents, with a particular focus on the impact of geographical region as a potential driver of these disparities. To our knowledge, this is the first meta-analysis to provide aggregate prevalence estimates and mean scores for depression in AI/AN adolescents. As such, this study offers a foundational understanding of mental health within this population.

The systematic review confirmed that data on anxiety prevalence were minimal, while depression data were limited. As such, additional meta-analyses were conducted on depression

mean scores, which were more frequently reported than prevalence data. However, due to the large variations in measurement tools used across studies, only small subsets of studies were selected for the meta-analysis. Meta-analysis revealed distinct aggregate prevalence estimates for depression, with 14.5% based on the 27-item CDI from two studies and 34.6% on the 20-item CES-D from three studies. The CDI was developed to evaluate depression symptoms in children and adolescents, where age is a significant factor in depression scores, whereas the CES-D, originally designed for the general adult population, has been validated for use among adolescents across certain racial and ethnic groups, including Native Americans (Heo et al., 2018; Wiegman et al., 1994). Given the varying sensitivity and specificity of these tools (US Preventive Services Task Force et al., 2022), differences in prevalence estimates between CDI and CES-D methods are expected. Compared to previously reported CES-D prevalence estimates from other adolescent populations in the United States, the 34.6% aggregate prevalence estimate for AI/AN adolescents is higher than the prevalence reported in the National Longitudinal Study of Adolescent Health (28.7%) (Rushton et al., 2002), lower than the prevalence reported for Black adolescents living in urban public housing (42.4%) (Lu et al., 2017), but similar to the prevalence observed among White adolescents in rural areas (34%) (Peden et al., 2005). IHS reported depression prevalence estimates for AI/AN adolescent patients, using diagnosis based on various tools in electronic health records, and found estimates ranged between 14.42 and 130.94 per 10,000 AI/AN adolescent patients (IHS, 2018). Unsurprisingly, these diagnostic prevalence estimates are lower when contrasted to the screening depression prevalence estimates in the current analysis.

Similar to prevalence estimates, mean scores measured using CES-D also showed large variability (0.82-22.8) among the seven studies included in the meta-analysis. The limited and heterogeneous nature of the data were less likely to provide accurate aggregate estimates from the meta-analyses for the three prevalence estimates. Mean scores measured using CDI (27 items) were less heterogeneous, and it was also the most prevalent outcome measure from the systematic review. Based on the meta-analysis, the aggregate CDI mean score for AI/AN adolescents is 9.81, which is below the clinical significance cutoff of 16 for mild severity of depression among adolescents but is higher than their White, Asian, Black, and Latino counterparts, whose CDI mean scores ranged from 5.13 to 8.31 in a large, racially and ethnically diverse study conducted in the United States (Vaughn-Coaxum et al., 2016). The trend of elevated depression mean score is also consistent with that of the higher rate of suicide ideation observed among AI/AN adolescents compared to other racial and ethnic groups (Baiden et al., 2020).

The AI/AN population is geographically diverse. The 82 citations included in the meta-analysis dataset encompass data from all five geographical regions (i.e., Northern Plains, Northwest, Southeast, Southern Plains, Southwest). However, large percentages of the studies either spanned multiple geographical regions/settings or had missing region/setting information. Stratified subgroup analysis used to investigate potential covariate effects indicated that geographical region (Northern Plains vs. Southeast vs. Southwest vs. multiple/unspecified) had a statistically significant impact in the estimation of CES-D mean score. There was a large range in the model estimated mean scores among geographical regions, from 6.57 in the Northern Plains to 19.5 in the Southeast, probably because the data are limited and overly heterogeneous. Thus, the results were not likely to be reliable.

None of the other tested covariates showed statistical significance for any of the four measured outcomes, even for subgroups that are known to have different depression prevalence estimates. One source of this discrepancy could be attributed to ecological bias, where a risk factor (or lack of) identified at the summary-level is not detected at the individual-level (Greenland & Morgenstern, 1989). For example, female adolescents are known to have higher prevalence of depression compared to males (NIMH, 2023). However, the percent of male study participants was not a statistically significant covariate in the meta-analyses. This could be due to the reduced granularity of the summary-level data, where the majority of the studies included for the meta-analysis had a similar percentage of male participants (around 50%). The inability to identify known covariates in the meta-analysis also could be caused by the fairly large number of missing values in covariates, which limited the statistical power of the analysis. Furthermore, only a few covariate values were reported at the summary-level from each study, and potentially more impactful covariates exist but were unavailable in this meta-analysis. Publication year was available for all studies included in the analysis and ranged from 1976 to 2024. A small portion of the studies in the analysis dataset (12 out of 82 studies, 14.6%) were published after 2020. Although publication year was not a statistically significant covariate, it is unknown if the COVID-19 pandemic lockdown would have an independent impact on the depression or anxiety prevalence or mean scores.

Public Health Implications

This study provides comprehensive evidence from published results through a systematic review and a meta-analysis to identify, evaluate, and summarize the prevalence of anxiety and

depression among AI/AN adolescents. The evidence generated from this study contributes to the knowledge base of mental health issues among AI/AN adolescents. However, the limited number of studies and participants included in this systematic review and meta-analysis restricts the generalizability of the results. This limitation emphasizes the need for additional data and primary studies to more accurately determine the prevalence, variations, and risk factors of depression and anxiety specific to AI/AN adolescents, particularly across diverse geographical regions and settings. Comparable research on Indigenous adolescents in Canada estimated a pooled prevalence of mood and/or anxiety disorders at less than 2.9% (Owais et al., 2022). In response, the Canadian government recently proposed $630.2 million in mental health funding over two years for the First Nations and Inuit people (Crown-Indigenous Relations and Northern Affairs Canada, 2024) to address health inequities. In contrast, while mental health programs exist for the AI/AN populations in the United States through IHS (IHS, n.d.-b), chronic and severe underfunding has perpetuated a treatment gap (Warne & Frizzell, 2014), especially in rural and remote reservation areas. Addressing mental health disparities among AI/AN adolescents will require a dual approach: increased investment in mental health care resources and the collection of higher quality data. These approaches are essential for developing culturally appropriate, evidence-based interventions that can reduce mental health disparities and promote positive well-being among AI/AN adolescents.

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CONFLICT OF INTEREST

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