The Burden of Depressive Symptoms in a Cohort of American Indians During the COVID-19 Pandemic: The Strong Heart C4R Study

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Abstract: *Depression increased during the COVID-19 pandemic, but little is known about this phenomenon in American Indian communities. We aimed to examine the prevalence and severity of depressive symptoms before and during the pandemic and identify associated factors. Strong Heart Study participants who completed the 10-item Center for Epidemiological Studies Depression Scale (CES-D-10) at both the baseline and follow-up exams were included in this analysis (n=1,013). Depressive symptoms were defined as a CES-D score ≥10. Univariable and multivariable analyses examined associations between covariates and depressive symptoms, adjusting for familial relatedness. Linear mixed models evaluated longitudinal changes in CES-D scores. The prevalence of depressive symptoms was approximately 22% pre-pandemic and 24% during the pandemic. Among participants without baseline depressive symptoms, self-reported COVID-19 infection was associated with significantly increased odds of experiencing depressive symptoms during the pandemic (OR: 1.76, 95% CI: 1.21, 2.56). After covariate-adjustment, mean CES-D scores did not change significantly during the pandemic (mean difference = 0.30, 95% CI: -0.16, 0.76). The impact of self-reported COVID-19 infection on the odds of experiencing depressive symptoms during the pandemic varied depending on whether individuals had depressive symptoms at baseline. These results provide evidence for targeted depression intervention in American Indians.*

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INTRODUCTION

Depression is a major mental health disorder that is known to be affected by many factors, including age (Zhang et al., 2018), sex (Kiely et al., 2019; Salk et al., 2017), smoking (Breslau et al., 1998), alcohol use (Nunes, 2023), socioeconomic status (Packness et al., 2025), genetics (Zięba et al., 2023), other mental health conditions like anxiety (Jacobson & Newman, 2017), and physical health conditions such as obesity (Lonergan et al., 2024; Shyam et al., 2024), hypertension (Ju et al., 2023; Rantanen et al., 2018), and diabetes mellitus (Holt et al., 2014; Roy & Lloyd, 2012). Previous studies have also reported associations between depression and sociocultural factors, including identification with Tribal traditions and perceived discrimination (Dillard et al., 2012; Whitbeck et al., 2002). During the global COVID-19 pandemic, public health measures were enacted that increased the burden of multiple mental health conditions, including a 27.6% increase in cases of major depressive disorders globally in 2020 (Collaborators, 2021; Daly & Robinson, 2022). Stressors related to the global pandemic, such as COVID-19 infections, a lack of job security, and few resources of reliable information about COVID-19 may have contributed to the increase in depression (Hynes et al., 2022). In addition, studies have shown that sex (Mazza et al., 2022) and persistent symptoms from COVID-19 infections (Yu & McCracken, 2024) have been associated with poor mental health during the pandemic.

Information about the burden of depression in American Indian communities during the COVID-19 pandemic is sparse. A nationally representative cross-sectional survey conducted between 2020 and 2021, including 500 American Indian and Alaska Native (AI/AN) participants, found comparable rates of moderate to severe anxiety-depression symptoms between AI/AN and White participants after adjusting for demographic variables and self-reported physical health (Nápoles et al., 2023). A longitudinal medical record–based study conducted in Southern California, including approximately 2,000 AI/AN children and young adults, found that depression rates increased from 2017 to 2021, and the AI/AN group had among the highest depression rates in each calendar year, except 2020 (Xiang et al., 2024). Other studies have examined mental health status among urban AI/AN populations during the COVID-19 pandemic without specifically focusing on depression (Haskins et al., 2024; Haskins et al., 2023). In addition, AI/ANs residing in rural areas or on reservations were not represented in the cited papers. Due to low data precision,

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some important AI/AN mental health indicators such as depression rates were omitted from the Behavioral Health Equity Report 2021 published by the federal government (Center et al., 2021). The lack of AI/AN-specific COVID-19 data might have masked disparities in COVID-19-related health outcomes among AI/AN populations (Skinner et al., 2022), potentially hindering the implementation of effective prevention and intervention strategies. AI/ANs experienced significant health disparities during the pandemic, with some of the highest COVID-19 infection, hospitalization, and mortality rates in the United States (Hatcher et al., 2020; Musshafen et al., 2022). The Strong Heart Study (SHS) is the longest running (over 35 years) and largest study of cardiovascular diseases in American Indian adults (Lee et al., 1990), with extensive pre-pandemic data collected from participants across 12 Tribal nations, primarily in rural areas and reservations in the Great Plains and southwestern United States. Most surviving SHS participants volunteered in the Collaborative Cohort of Cohorts for COVID-19 Research (C4R), a meta-cohort study of 14 NIH-funded prospective populations studies (Oelsner et al., 2022). C4R performed standardized, prospective ascertainment of COVID-19 and aimed to define risk and resilience factors for COVID-19 illness and its long-term sequelae, as well as to examine the impact of the pandemic on trajectories of health and disease. Accordingly, this study is well positioned to address the research question of whether depression burden changed from before to during the pandemic, as well as to identify associated risk factors. Understanding how the pandemic affected the burden of depressive symptoms among American Indian communities is important for informing the allocation of resources and interventions to those in need. Such knowledge will also help public health preparedness in Indigenous communities for future disease outbreaks.

We aimed to assess the prevalence of depressive symptoms before and during the pandemic among American Indians in the SHS. In addition, we planned to examine the relationship between baseline characteristics and depressive symptoms during the pandemic. Finally, we aimed to assess how the severity of depressive symptoms (measured using The Center for Epidemiological Studies Depression (CES-D) scale) changed during the pandemic and its relationship with baseline characteristics. We hypothesized that the burden and severity of depressive symptoms would increase during the pandemic compared with the pre-pandemic period and that certain risk factors would be associated with this change.

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METHODS

Study Population

The SHS and Strong Heart Family Study (SHFS) consists of participants from Arizona, Oklahoma, and North and South Dakota. The original SHS cohort was recruited and examined during 1989-1991 (Phase I) and was re-examined again in 1993-1995 (Phase II) and 1998-1999 (Phase III) (Lee et al., 1990). Family members of some of the original participants were recruited and examined in 2001-2003 (Phase IV) and again in 2006-2009 (Phase V) (North et al., 2003). A CES-D questionnaire was administered to participants in Phases IV and V and a Quality of Life (QOL) questionnaire with some questions similar to the CES-D questionnaire was administered in Phase III. C4R leverages pre-COVID-19 SHS data collected on clinical and subclinical diseases, along with their risk factors, including biomarkers, lifestyle factors, and socioeconomic determinants of health (Oelsner et al., 2022). A total of 1,144 SHS/SHFS participants completed the C4R Wave 2 Questionnaire (W2Q) between September 2021 and early 2022, which included the CES-D-10 questions. Of these participants, 1,013 completed all CES-D-10 questions in both C4R and SHS/SHFS and were included in this analysis. In this paper, "baseline" will refer to the most recent pre-pandemic SHS/SHFS exam (either Phase III, IV, or V) and "follow-up" will refer to the W2Q. The most recent SHS/SHFS baseline exams for these participants were Phase V (n=761), Phase IV (n=46), and Phase III (n=206). The process of the selection of study population was outlined in Figure 1. This study was approved by the institutional review boards of participating institutions and Tribes. All participants gave informed consent.

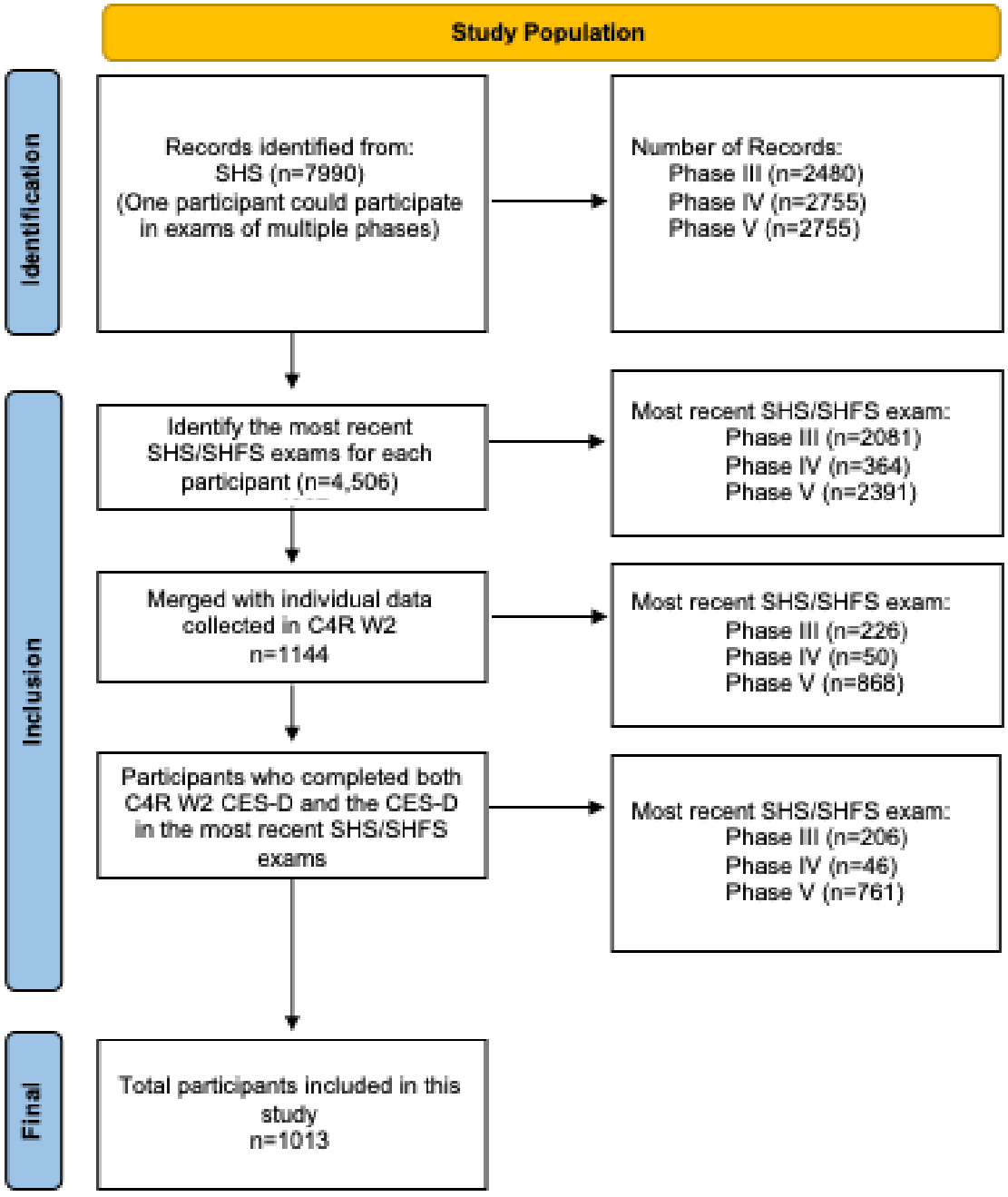
Measures

The primary outcome for this study was depressive symptoms, which were assessed using the CES-D-10 scale. The CES-D scale is a 20-question, self-reported questionnaire, but is often shortened to 10 questions (CES-D-10) to improve data collection in population research projects or for other purposes (Boey, 1999; Zhang W, 2012). While the questionnaire is not a diagnostic tool, several studies have shown that the CES-D-10 scale is reliable and valid in measuring depression (Boey, 1999; Mohebbi et al., 2018; Zhang W, 2012). Each response option for the CES-D questions is assigned a score from 0 ("Rarely or none of the time") to 3 ("All of the time"), with some questions reverse coded. Responses are summed up to obtain a total CES-D score, with higher scores indicating more severe depressive symptoms. CES-D questions were not

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administered in SHS Phase III, so 10 questions from the SHS Quality of Life (QOL) questionnaire were matched to CES-D questions and responses (see Appendices A and B).

Figure 1
Selection of Study Population



Note. SHS=Strong Heart Study; SHFS=Strong Heart Family Study; C4R W2=Collaborative Cohort of Cohorts for COVID-19 Research Wave 2 Questionnaire; CES-D=Center for Epidemiological Studies Depression

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QOL questions (Appendix C) include six response options ranging from "All of the time" to "None of the time." To align with the CES-D scoring, QOL responses were coded as follows: "All of the time" and "Most of the time" were scored as 3; "A good bit of the time" was scored as 2; "Some of the time" was scored as 1; and "A little of the time" and "None of the time" were scored as 0.

Based on literature review (Andresen et al., 1994; Bjorgvinsson et al., 2013), we defined the presence of depressive symptoms as a CES-D-10 score ≥ 10. CES-D-10 score was also analyzed as a continuous variable to study the change in the severity of symptoms. The CES-D questionnaire has been validated for the screening of depressive symptoms in American Indians (Curyto et al., 1998; Somervell et al., 1993)

Conventional risk factors for depressive symptoms were collected at participants' baseline SHS/SHFS exams. Baseline variables considered in this study were age in years, sex (male or female), smoking (yes or no), alcohol use (yes or no), BMI (kg/m2), depressive symptoms identified by CES-D unless otherwise indicated, hypertension, and diabetes. Current smokers are defined as those who have smoked at least 100 cigarettes in their entire life and currently smoke. Alcohol use status is defined as having consumed alcoholic beverages and having had a drink in the last 12 months. Hypertension is defined as those taking an antihypertensive drug; diuretics or beta-blockers or cardiac medications or vasodilators and history of hypertension; systolic blood pressure≥140 mmHg; or diastolic blood pressure≥90 mmHg. Diabetes is defined as taking insulin or a hypoglycemic agent; on renal dialysis or had a kidney transplant and reported a history of diabetes; or fasting glucose ≥ 126 mg/dL.

COVID-19 disease status was derived using the C4R Wave 2 Questionnaire. Participants were first asked whether they had ever been tested for COVID-19. Those who responded yes (n=792) were then asked whether they had ever received a positive test result. Participants who answered yes to both questions were classified as having had COVID-19 (n=334). Additional cases were identified based on self-reported COVID-19 experiences and health care provider diagnosis. Participants who reported that they thought they had COVID-19 and were told by a healthcare provider that they had COVID-19 were classified as cases (n=14). Three participants who reported having had COVID-19 but did not answer the healthcare provider question were also classified as cases. Overall, COVID-19 infection was defined as either a self-reported positive test or a healthcare provider–confirmed diagnosis, with the inclusion of three additional self-reported cases to minimize under-ascertainment. In total, 351 COVID-19 cases were identified.

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Statistical Methods

All analyses were conducted in SAS, version 9.4, and all tests used a significance level of 0.05. Demographic and clinical characteristics of the study population at baseline and follow-up were described by means (standard deviation) for continuous variables or median (the first quartile or Q1, the third quartile or Q3) if their distributions were skewed, and frequencies (percentages) for categorical variables.

Since SHFS participants were recruited within families, they could not be treated as independent observations in data analyses. Generalized estimating equations (GEE) were used to evaluate the associations between the presence of depressive symptoms and potential risk or protective factors, while adjusting for familial relatedness. Each family in the SHFS was treated as a cluster. Participants without family members in the study were counted as their own family. We first examined the univariable associations between the presence of depressive symptoms and age, sex, current smoking, current alcohol use, BMI, baseline CES-D score, hypertension, diabetes, and self-reported COVID-19 infection. Factors significantly related to depressive symptoms in the univariable models were considered for the multivariable model. Backwards selection was used to select the final model. Stepwise selection was also used in the exploratory analyses to ensure we captured all important covariates. All possible combinations of interactions between the remaining covariates in the final model were tested for effect modification.

To study how the severity of depressive symptoms changed during the pandemic, we used a mixed modeling method to examine the change in CES-D scores from baseline to follow-up exams. All covariates were considered for this model with backwards selection being used to select a set of covariates for the final model. Familial relatedness was adjusted in the same manner as described previously in the GEE models. The reported difference in CES-D scores was assessed using the least square means.

RESULTS

We first described the demographic and clinical characteristics at the baseline and follow-up exam. About 69% of participants were female and the average age at baseline was 45.4 years (SD: 14.1) (Table 1). At baseline, participants had a median CES-D score of 4.0 (first and third quartiles: 2.0, 9.0), with 22% of participants displaying depressive symptoms (CES-D≥10).

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Several risk factors like alcohol use (53%), smoking (36%), hypertension (34%), and diabetes (22%) were common among participants.

At follow-up, 24% of participants displayed depressive symptoms and the median CES-D score among all participants was 5.0 (first and third quartiles: 2.0, 9.0) (Table 1). During the C4R-W2Q follow-up data collection in the pandemic, 35% of participants reported having had a COVID-19 infection.

Table 1.
Characteristics of Study Population at Baseline and Follow-Up

	Baseline (SHS)		Follow-Up (C4R)	
Characteristics	**Measure**	**N**	**Measure**	**N**
CES-D Score	4.00 (2.00, 9.00)	1013	5.00 (2.00, 9.00)	1013
Depressive Symptoms (CES-D≥10)	218 (21.52%)		240 (23.69%)	
Age, years	45.39 (14.05)	1013	61.8 (15.8)	1010
Female [a]	699 (69.00%)	1013		
Current Smoking [a]	361 (35.81%)	1008		
Current Alcohol Use [a]	532 (52.83%)	1007		
BMI (kg/m^2) [a]	32.05 (27.73, 37.32)	1006		
Hypertension [a]	347 (34.42%)	1008		
Diabetes [a]	218 (21.73%)	1003		
Self-reported COVID-19 Infection [b]			351 (35.38%)	992

Note. SHS=Strong Heart Study; C4R=Collaborative Cohort of Cohorts for COVID-19 Research; CES-D=Center for Epidemiological Studies Depression Scale; BMI=Body Mass Index
Results for continuous variables are reported as mean (standard deviation) or, if skewed, median (Q1, Q3).
Results for categorical variables are reported as count (%).
[a] Collected at baseline only.
[b] Collected at follow-up only.

Second, we studied univariable associations between baseline characteristics and the presence of depressive symptoms at the follow-up exam during the COVID-19 pandemic. The associations between each baseline covariate and the presence of depressive symptoms at follow-up are displayed in Table 2. A one-year increase in age was associated with a 2% decrease in the odds of depressive symptoms (p value<0.001), while a one-unit (or 1kg/m^2) increase in BMI was associated with a 2% increase in the odds of depressive symptoms (p value = 0.010). Females

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(OR=1.79, 95% CI: 1.25, 2.56), current smokers (OR=1.45, 95% CI: 1.08, 1.96), and current alcohol users (OR=1.30, 95% CI: 0.996, 1.70) had significantly higher odds of having depressive symptoms at follow-up. Having depressive symptoms at baseline was associated with 2.96 (95% CI: 2.19, 4.00) times higher odds of having depressive symptoms at follow-up. Baseline CES-D score and reporting a COVID-19 infection were also associated with increased odds of depressive symptoms at follow-up.

Table 2.
Univariable Associations Between Baseline[a] Covariates and Presence of Depressive Symptoms at Follow-Up

Characteristics	Depressive Symptoms at Follow-Up			
	Present N=240	**None N=773**	**OR (95% CI)**	***p* value [b]**
Age, years	42.51 (13.93)	46.31 (13.97)	0.98 (0.97, 0.99)	**<0.001**
Female	187 (77.92%)	512 (66.24%)	1.79 (1.25, 2.56)	**0.001**
Current Smoking	101 (42.44%)	260 (33.77%)	1.45 (1.08, 1.96)	**0.015**
Current Alcohol Use	138 (57.98%)	394 (51.24%)	1.30 (0.996, 1.70)	0.054
BMI (kg/m^2)	34.48 (8.72)	32.84 (7.58)	1.02 (1.01, 1.04)	**0.010**
Baseline CES-D Score	8.60 (6.41)	5.23 (4.99)	1.10 (1.08, 1.13)	**0.013**
Baseline Depressive Symptoms (CES-D≥10)	90 (37.50%)	128 (16.56%)	2.96 (2.19, 4.00)	**<0.001**
Hypertension	72 (30.25%)	275 (35.71%)	0.78 (0.56, 1.12)	0.181
Diabetes	60 (25.10%)	158 (20.68%)	1.23 (0.90, 1.70)	0.199
Self-reported COVID-19 Infection	105 (44.49%)	246 (32.54%)	1.64 (1.19, 2.26)	**0.003**

Note. OR=Odds Ratio; CI=confidence interval; CES-D= Center for Epidemiological Studies Depression Scale; BMI=Body Mass Index
Results reported as mean (SD) for continuous variables or n (%) for categorical variables. Rates were calculated based on the participants who had complete information for each variable. ORs and *p* values were obtained using generalized estimating equations (GEEs) and were adjusted for familial relatedness.
[a]All covariates were collected at the baseline exams except self-reported COVID-19 infection status, which is only collected in the follow-up C4R exam.
[b]Bold indicates significance (*p* value<0.05).

Next, we conducted multivariable GEE modeling to identify baseline characteristics associated with depressive symptoms during the pandemic, adjusting for other covariates. After model selection, we found that sex, self-reported COVID-19 infection, and baseline CES-D score were significantly associated with depressive symptoms at follow-up (Table 3). In addition, a significant interaction was identified between self-reported COVID-19 infections and baseline

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CES-D score. Therefore, we calculated the stratified odds ratio for the presence of depressive symptoms at the follow-up exam, stratified by baseline depressive symptoms (CES-D ≥ 10 vs. CES-D<10). In this final model, being female was still associated with increased odds of depressive symptoms (OR=1.57, 95% CI: 1.12, 2.21). Among participants who had depressive symptoms at the baseline exams, COVID-19 infection was not significantly related to the follow-up depressive symptoms. However, among participants without depressive symptoms at baseline, COVID-19 infection (vs. no infection) was associated with a 1.76-fold increase in the odds of experiencing depressive symptoms at follow-up.

Finally, to find out how CES-D scores changed during the pandemic, we conducted a longitudinal analysis (Table 4). After adjusting for age, sex, current smoking, BMI, and self-reported COVID-19 infection, we found that average CES-D scores during the pandemic were 0.30 points (95% CI: -0.16, 0.76) higher than before the pandemic, though this change was not statistically significant.

Table 3.
Multivariable Model for Association Between Risk Factors and Presence of Depressive Symptoms

	Depressive Symptoms at Follow-Up	
Parameter	**OR (95% CI)**	***p* value [a]**
Sex (Female vs Male)	1.57 (1.12, 2.21)	**0.009**
Self-Reported COVID-19 (Yes vs. No)		
Baseline Depressive symptoms (CES-D ≥ 10)	1.07 (0.55, 2.07)	0.833
Baseline Depressive symptoms (CES-D < 10)	1.76 (1.21, 2.56)	**0.003**

Note. OR=Odds Ratio; CI=confidence interval; CES-D= Center for Epidemiological Studies Depression Scale; BMI=Body Mass Index
[a] Bold indicates significance (*p* value <0.05).

Table 4.
Difference Between CES-D Score at Baseline and Follow-Up

Comparison	**Estimated Difference (95% CI)**	**Standard Error**	***p* value [a]**
CES-D: Follow-Up vs Baseline [b]	0.30 (-0.16, 0.76)	0.234	0.198

Note. CI=confidence interval; CES-D =Center for Epidemiological Studies Depression Scale.
[a] Bold indicates significance (*p* value<0.05).
[b] Adjusted for age, sex, current smoking, BMI, and self-reported COVID-19 infection.

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DISCUSSION

Among those who did not have depressive symptoms at the baseline exam, self-reported COVID-19 infection is associated with significantly increased odds of having depressive symptoms during the pandemic. To the best of our knowledge, this is a unique finding that has not been previously reported. The next step is to investigate the underlying mechanisms.

While previous studies have indicated that the prevalence of depressive disorders may have increased considerably during the pandemic (Collaborators, 2021), our results showed an insignificant increase of 0.3 points of CES-D score. In the SHS cohort, the prevalence of depressive symptoms and median CES-D scores were similar both before and during the pandemic. The prevalence of depressive symptoms in our study was 22% pre-pandemic and 24% during the pandemic, which is similar to the pre-pandemic rates of depression reported in previous SHS publications (Santoni et al., 2025; Staff et al., 2023). The resilience of American Indians is being studied recently in the SHS and may help us to better understand this trend. The burden of depression varies among Tribal nations across the country (Gone & Trimble, 2012). A study of Alaska Natives 18 years or older reported a 17% depression rate (13% for men and 20% for women) (Dillard et al., 2012). Another study of 3,084 Tribal members 15–54 years from Southwest and Northern Plain found lifetime prevalence of major depressive episodes range from 7.2% to 14.3% among men and women based on the American Indian Service Utilization, Psychiatric Epidemiology, Risk and Protective Factors Project (AI-SUPERPF) algorithm (Beals et al., 2005). A report of 861 Tribally enrolled parents and caretakers aged 17-77 years from the Northern Midwest United States and Canada revealed a 17.1% (9.3% for male and 20% for female) lifetime prevalence of major depression (Whitbeck et al., 2006). It is important to report the disease burden in different AI/AN groups to meet the prevention and intervention needs.

Individually, we found that age, sex, baseline smoking status, baseline BMI, baseline CES-D score, and self-reported COVID-19 infection were significantly associated with depressive symptoms during the pandemic. Baseline alcohol use, hypertension, and diabetes status were not found to be significantly associated with depressive symptoms. Our multivariable model showed that sex, self-reported COVID-19 infection, and baseline CES-D score remained statistically significant.

In addition, we found that there was not a significant change in mean CES-D scores during the pandemic compared to pre-pandemic data after adjusting for age, sex, current smoking, BMI,

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and self-reported COVID-19 infection. While the result was unexpected based on reports from other ethnic groups (Ebrahimi et al., 2024; Shyam et al., 2024), one study reported that reservation-area American Indian students experienced decreased anxiety, loneliness, and depression compared to a national sample of students (Swaim et al., 2023). We hypothesize that the insignificant change in mean CES-D scores could be partially explained by the historical struggles that American Indian communities have gone through, possibly making them more resilient. In addition, elders in American Indian communities are highly respected as wisdom keepers and mentors of Tribal culture and traditions (Garrett et al., 2014; Whitewater et al., 2016). They nurtured younger American Indians in "Native Ways" of life, which provides the basis for enduring strength and resilience across generations in overcoming adversity (Garrett et al., 2014). Elders might have played an active role in making important decisions amid the COVID-19 pandemic, thus less likely to develop depressive symptoms. More research is needed to confirm this hypothesis. The covariates associated with longitudinal change in CES-D scores were similar to those that were associated with depressive symptoms during the pandemic.

One strength of our study is that we used data from an established cohort study, so baseline characteristics were measured in a reliable way. Moreover, we had a large sample of 1,013 American Indian participants. However, our study is limited by the loss of information on participants who died prior to W2Q. In addition, misclassification of depressive symptoms is also possible due to the re-coding of SHS Phase III QOL questions. While a CES-D cutoff score of 10 is commonly used (Andresen et al., 1994; Bjorgvinsson et al., 2013), optimal cutoff scores have previously been shown to be study specific (Agustini et al., 2019; Baron et al., 2017; Henry et al., 2018). More research may be needed to determine an optimal cutoff score for SHS/SHFS participants. Our study is also limited to the covariates available in the SHS/SHFS and does not include all potential risk factors for depression. For example, information on perceived discrimination was not collected in the SHS/SHFS, and measures of identification with Tribal traditions were not available at the baseline examination of the current study. It is possible that unmeasured variables may confound the associations presented. Furthermore, because the data were collected from participants in 12 Tribal nations involved in the SHS, the results may not be generalized to other American Indian populations.

Our research allowed us to better understand the relationship between some behavioral and clinical characteristics and the presence of depressive symptoms during the pandemic. While our

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results do not establish causal associations, they provide insights into potential target populations for depression interventions during disastrous events such as the COVID-19 pandemic.

CONCLUSION

Our research examined the prevalence and severity of depressive symptoms before and during the pandemic and identified associated risk factors. We found that being female and having a history of COVID-19 infection were associated with higher odds of depressive symptoms during the pandemic—particularly among individuals who did not report depressive symptoms prior to the pandemic. In multivariable analyses, the severity of depressive symptoms did not significantly change during the pandemic. These results can inform the development of targeted depression prevention strategies in American Indian communities. The findings provide new insights into mental health needs and associated factors during disasters such as a pandemic. The similar burden and severity of depressive symptoms observed before and during the pandemic in SHS communities warrant further research to determine whether community resilience plays a role.

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CONFLICT OF INTEREST

The authors declared no potential conflicts of interest.

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APPENDIX A

Harmonizing SHS Phase III Quality of Life Questions with CES-D-10 Questions

While SHS Phase III did not have CES-D-10 questions, it did contain similar questions in the Quality of Life form. These responses were matched to the closest CES-D questions and the 0 to 3 coded responses (see Table A1). The SHS Phases IV and V contained 20 CES-D questions and the C4R contained 10 CES-D questions (abstracted from the 20-item CES-D) that had 0 through 3 coded responses, so no re-coding was needed for these questions. Since the C4R exams only contained 10 CES-D questions, we decided to use the CES-D-10 scale.

Table A1.
CES-D-10 Questions and SHS Phase III Quality of Life Questions

CES-D-10 Question	SHS Quality of Life Question
I was bothered by things that don't usually bother me	Have you felt so down in the dumps that nothing could cheer you up?
I had trouble keeping my mind on what I was doing	Didn't do work or activities carefully due to emotional problems
I felt depressed	Did you feel downhearted and blue?
I felt that everything I did was an effort	Did you feel tired?
I felt hopeful about the future	Did you feel full of pep?
I felt fearful	Have you been a very nervous person?
My sleep was restless	Have you been a very nervous person?
I was happy	Have you been a happy person?
I felt lonely	Physical health or emotional problem interfered with your social activities
I felt like I couldn't do what I needed to do	Did you feel worn out?

Note. CES-D-10=Center for Epidemiological Studies Depression 10 Scale; SHS=Strong Heart Study

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APPENDIX B

Center for Epidemiological Studies Depression 10 (CES-D-10) Scale

Here is a list of some ways you might have felt or behaved in the PAST WEEK. Please indicate how many days you have felt this way during the past week.

CES-D 10 items	Rarely or none of the time (<1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of the time (3-4 days)	All of the time (5-7 days)
I was bothered by things that usually don't bother me				
I had trouble keeping my mind on what I was doing.				
I felt depressed.				
I felt that everything I did was an effort.				
I felt hopeful about the future.[a]				
I felt fearful.				
My sleep was restless.				
I was happy.[a]				
I felt lonely.				
I could not "get going."				

Note. CES-D-10=Center for Epidemiological Studies Depression 10 Scale
[a] This question is reverse coded.

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APPENDIX C

Quality of Life Questions Used in This Study

S-10

These questions are about how you feel and how things have been with you during the PAST 4 WEEKS. For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the PAST 4 WEEKS....

(Please Check One Answer Per Line)

		All of the Time	Most of the Time	a Good Bit of the Time	Some of the Time	a Little of the Time	None of the Time
23.	Did you feel full of pep?..QUA3_23	|___|1	|___|2	|___|3	|___|4	|___|5	|___|6
24.	Have you been a very nervous person?.....QUA3_24	|___|1	|___|2	|___|3	|___|4	|___|5	|___|6
25.	Have you felt so down in the dumps that nothing could cheer you up?..... QUA3_25	|___|1	|___|2	|___|3	|___|4	|___|5	|___|6
26.	Have you felt calm and peaceful?QUA3_26	|___|1	|___|2	|___|3	|___|4	|___|5	|___|6
27.	Did you have a lot of energy?.QUA3_27	|___|1	|___|2	|___|3	|___|4	|___|5	|___|6
28.	Did you feel downhearted and blue?.....QUA3_28	|___|1	|___|2	|___|3	|___|4	|___|5	|___|6
29.	Did you feel worn out?.....QUA3_29	|___|1	|___|2	|___|3	|___|4	|___|5	|___|6
30.	Have you been a happy person?QUA3_30	|___|1	|___|2	|___|3	|___|4	|___|5	|___|6
31.	Did you feel tired?.....QUA3_31	|___|1	|___|2	|___|3	|___|4	|___|5	|___|6

32. **During the PAST 4 WEEKS, how much of the time has your PHYSICAL HEALTH or EMOTIONAL PROBLEMS interfered with your social activities (like visiting with friends, relatives, etc.)?**

(Please Check One Answer) QUA3_32

All the time..... |___|1
Most of the time..... |___|2
Some of the time..... |___|3
a Little of the time..... |___|4
None of the time..... |___|5

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