

Relevance of ACE Scores in Teens with Depression and Anxiety: A Maui Pilot Study

Sharon Wong MD; Felicitas Livaudais MD, FAAP; Meliza Roman MS;
Devashri Prabhudesai MS; John J. Chen PhD

<https://www.doi.org/10.62547/TMQN6220>

Abstract

In the aftermath of the Covid pandemic and the notable rise of teen depression and anxiety (DA), there is an urgent need to focus on youth mental health. Another important variable to consider is the presence of adverse childhood experiences (ACE), which can be associated with chronic mental and physical health conditions. This pilot study explores how ACEs relate to DA for adolescents in Maui, Hawai'i. The cohort was 75 patients seen at a Kaiser Pediatric Clinic in the spring of 2022. Data was collected from standard questionnaires and the Pediatric ACEs and Life-Events Screener (PEARLS). There were significant associations between DA and a high ACE score (4+), as well as female sex. A high ACE score can alert providers to initiate a trauma informed dialogue with patients. The effects of trauma are not often discussed at routine visits. Mental health care needs and community support can also be addressed as needed. The PEARLS questionnaire is a standard tool to help clinicians be more trauma-informed. This study explores its relevance at routine adolescent visits.

Keywords

adverse childhood experiences, depression, anxiety, adolescents, trauma-informed care

Abbreviations

ACE = adverse childhood experiences
DA = depression and anxiety
GAD 7 = General Anxiety Disorder 7
HMO = health maintenance organization
LGBTQ = lesbian, gay, bisexual, transgender or queer
NH = Native Hawaiian
NHOPI = Native Hawaiians and Other Pacific Islanders
PEARLS = Pediatric ACEs and Related Life-Events Screener
PHQ-9 = Patient Health Questionnaire-9
SDH = social determinants of health

Introduction

Youth mental health is a universal concern in every community. The Hawai'i Department of Health estimated 11 000 teens had experienced at least 1 major depressive episode in the past year. The majority did not receive mental health services.¹ Native Hawaiian (NH) youth had significantly higher rates of psychiatric disorders (33%) vs non-NH youth (24%).² Untreated mental illness can increase risks for school dropout, juvenile imprisonment, or suicide attempt prompting medical

intervention.³⁻⁵ For the past decade, US Centers for Disease Control and Prevention (CDC) data show an upward trend of persistent feelings of sadness or hopelessness, especially in teenage girls.⁶ Screening for depression and anxiety (DA) and adverse childhood experiences (ACEs) alerts the clinician to potential serious conditions. ACEs are various types of abuse and family dysfunction that can induce a chronic stress response in developing brains and bodies.^{3,7,8} ACEs are common in all levels of society. However, scores trend higher with patients who have identified criteria for social determinants of health (SDH) needs such as food and housing insecurity.⁹ Teens with high ACEs (4+) were 4 times more likely to have poor mental health and 25 times more likely to have suicide attempts.⁹

The purpose of this study was to examine the relationship between ACE scores as they relate to patients with DA in teens ages 12-18 living in Maui, Hawai'i. Knowing a patient's ACE score intuitively helps clinicians provide trauma-informed care. For the patient, knowing their own ACE score can help with self-awareness, and identify triggers and protective factors.

Methods

Study approval was obtained through the Kaiser Permanente Institutional Review Board (IRB Protocol Number 13238). Data was collected using 3 questionnaires at the Kaiser Permanente Kihei Clinic in Maui from January to May 2022. A Kaiser provider screened for DA and suicidal ideation with 2 standard questionnaires: the Patient Health Questionnaire-9 (PHQ-9)¹⁰ and General Anxiety Disorder-7 (GAD-7).¹¹ The PEARLS (Pediatric ACEs and Related Life Events Screener) was added to screen for ACEs and SDH. The SDH part of the PEARLS screens for additional SDH factors such as bullying, housing insecurity, or loss of a caregiver, etc.^{10,21} Clinic staff were trained in questionnaire administration and some took the online course, "Becoming ACEs Aware in California Training."¹² Patients between the ages of 12 to 18 years were invited to participate with their guardian providing verbal informed consent. An introductory page was given explaining why ACEs matter. The de-identified version of the PEARLS questionnaire asks to count the number of ACEs without identifying specific trauma. This version was administered to lessen potential stigma that the patient and their guardian may feel

when responding to these very sensitive questions. The teen was asked to fill out the 3 questionnaires (PHQ-9, GAD 7 and PEARLS) independently from their guardian while they were in the same room. The guardian was asked to independently fill out a PEARLS questionnaire regarding their teen. Patients with a score of 5 or greater on the PHQ-9 and GAD 7 forms were diagnosed with depression or anxiety respectively, with a severity scale of mild, moderate, moderately severe, and severe. The 3 questionnaires were then scored by the clinician during the visit prior to beginning of the interview. Other demographic factors were obtained through the electronic health record and patient interview. These included primary ethnicity, insurance type, school type (private or public), sex, whether the patient was lesbian, gay, bisexual, transgender or queer (LGBTQ), and foster care status.

Data Analysis

De-identified data was manually entered onto a spreadsheet by a medical student. Any missing data was noted as “not available” and excluded from the analysis. Teen and guardian ACE scores were compared using the Wilcoxon signed rank test. If there was a discrepancy in ACE scores between the teen and guardian, the higher ACE score was used. Kaiser Permanente’s EPIC electronic medical record ICD-10 codes for Screening for ACEs scores into 3 categories: (0), (1 to 3), and (4+). Raw SDH scores were dichotomized into 2 groups, “0” and “1 or more” to compare if an absence or presence of SDH impacted ACE scores. Pearson’s Chi-squared tests and Fisher’s exact tests were performed to assess the associations between DA diagnosis and age, sex, ethnicity, body mass index, insurance type, ACE and SDH score groups, LGBTQ status, foster care status, and school type. Univariate and multivariable logistic regression models were used to estimate the association between diagnosis of DA and ACE score groups, sex, LGBTQ status, and SDH score groups. Odds ratios and their 95% confidence intervals (CI) were calculated from the logistic regression models. *P* values <.05 were considered statistically significant. Statistical analyses were performed using R software, version 4.1.0 (R Foundation for Statistical Computing, Vienna, Austria).

Results

A total of 75 families agreed to participate. Within this group, 73 patients with an average age of 15 years, filled out all 3 questionnaires, and all 75 guardians completed the PEARLS. The study population consisted of Whites (32%, *n*=24), Native Hawaiians/other Pacific Islanders (NHOPI) (29%, *n*=22), and Asians (29%, *n*=22), with 10% (*n*=7) identified as ‘Other’ races (Table 1). There were more females (57%, *n*=43) than males (42%, *n*=31) with 1 who declined to answer. Teens in the study

had an average BMI of 25.0. About 92% (*n*=66) of teens in the study attended public school while 8% (*n*=6) attended private or other type of school. In the study sample, 53% (*n*=39) of teens were insured with Medicaid and 47% (*n*=35) were insured under Kaiser Health Maintenance Organization (HMO). Teens identifying as LGBTQ comprised 16% (*n*=12) of the study population and were all female. Among the study population, 4% (*n*=3) of patients were under foster care. While 53% (*n*=39) of patients did not need to be referred to outside resources, there were 36% (*n*=27) referred to behavioral health services and 11% (*n*=8) that were referred to social work and nutrition.

Almost half of the teens (47%, *n*=35) were diagnosed with depression with the PHQ-9 screening. Similarly, almost half of the teens were diagnosed with anxiety with the GAD 7 (48%, *n*=36). Among the overall study population, there were 43% (*n*=32) with both depression and anxiety (DA). Factors significantly associated with diagnosis of DA were age, sex, ACE scores, SDH scores, and LGBTQ status. Teens with DA were slightly younger with an average age of 14.9 versus teens without depression (*P*=.039) and mostly female (78%, *n*=25). Among teens who self-identified as LGBTQ, 67% (*n*=8) had DA (*P*=.007).

At least 1 ACE was reported by 62% percent (*n*=45) of the teens studied, and 25% (*n*=18) reported 4+ ACEs, which is considered high. There was a significant difference in teen and guardian ACE scores. The median ACE score reported by teens (ACE = 1) was significantly higher than that recorded by their guardian (ACE = 0, *P*=.02). Teens with high ACEs (4+) had a DA prevalence of 67% (*n*=12) versus 14% (*n*=4) who had 0 ACEs (Table 1). Similarly, about 74% (*n*=23) of teens with DA had a SDH score of 1 or more while 26% (*n*=8) of teens with DA had an SDH score of 0. Table 2 shows the unadjusted odds ratios for DA by ACEs, sex, LGBTQ status and SDH score. After adjusting for sex, LGBTQ status, and SDH score, teens with a high ACE score of 4+ were 11 times more likely to have DA (adjusted odds ratio (AOR)=11.1 [95% CI: 1.34-126.32]), and those with 1-3 ACEs were almost 8 times more likely to have DA (AOR=7.8 [95% CI: 1.63-47.14]) than teens with 0 ACEs (Figure 1). Females were 7 times more likely to have DA than males (AOR=7.2 [95% CI: 1.91-33.31]). Teens positive for SDH and teens self-identified with LGBTQ status were more likely to have DA in the univariate analysis (Table 2) than in the multivariate analysis (Figure 1). However, when adjusting for other factors such as sex and ACE scores, the relationship between DA and the combination of self-identified LGBTQ status and positive SDH was not found to be significant. (Figure 1). Other variables such as BMI, type of insurance, public or private schooling, foster care status were not statistically associated with DA (Table 1).

Characteristic	Overall N=75 Count (%) ^a	Diagnosed with Depression & Anxiety, n = 32 Count (%) ^a	P-value ^b
Age (Mean (SD))	15.3 (1.4)	14.9 (1.6)	.039 ^c
Sex			
Male	31 (42%)	7 (22%)	.003 ^d
Female	43 (57%)	25 (78%)	
Declined	1 (1%)	0 (0%)	
Self-Reported Ethnicity			
White	24 (32%)	12 (38%)	.8 ^d
Native Hawaiian or Pacific Islander	22 (29%)	8 (25%)	
Asian	22 (29%)	9 (28%)	
Other	7 (10%)	3 (9%)	
Body Mass Index (BMI) (Mean (SD))	25.0 (7.6)	25.7 (8.4)	.9 ^c
Insurance Type			
Health Maintenance Organization (HMO)	35 (47%)	13 (42%)	.4 ^e
Medicaid	39 (53%)	18 (58%)	
Adverse Childhood Experience (ACE) Scores			
ACE Score = 0	28 (38%)	4 (13%)	<.001 ^d
ACE Score = 1-3	27 (37%)	15 (48%)	
ACE Score = 4-9	18 (25%)	12 (39%)	
Social Determinants of Health (SDH) Scores			
SDH Score = 0	31 (42%)	8 (26%)	.013 ^e
SDH Score = 1 or more	42 (58%)	23 (74%)	
Self-Identified as lesbian, gay, bisexual, transgender, or queer (LGBTQ)			
No	58 (80%)	19 (63%)	.007 ^d
Yes	12 (16%)	8 (27%)	
Declined	3 (4%)	3 (10%)	
Teen in Foster Care			
No	69 (96%)	29 (94%)	.6 ^d
Yes	3 (4%)	2 (6%)	
Type of School			
Public	66 (92%)	27 (90%)	.7 ^d
Private/Other	6 (8%)	3 (10%)	
Resources Referred To			
None	39 (53%)	11 (34%)	<.001 ^d
Behavioral Health Services	27 (36%)	20 (63%)	
Social/Nutrition	8 (11%)	1 (3%)	

^a Totals and percentages may not equal 100% due to unanswered or missing data.

^b Comparisons are between those with (shown) and those without (not shown) depression and anxiety.

^c Wilcoxon rank sum test

^d Fisher's exact test

^e Pearson's Chi-squared test

Characteristic	Unadjusted Odds Ratio (OR)	95% Confidence Interval (CI)	P-value
ACE Scores			
ACE Score = 0	Reference	NA	NA
ACE Score = 1-3	7.5	2.19 – 31.10	.002
ACE Score = 4-9	12	3.07 – 57.20	<.001
Sex			
Male	Reference	NA	NA
Female	4.76	1.75 – 14.20	.003
LGBTQ Status			
No	Reference	NA	NA
Yes	4.11	1.14 – 17.00	.036
SDH Score			
SDH Score = 0	Reference	NA	NA
SDH Score = 1 or more	3.48	1.31 – 9.97	.015

ACE=adverse childhood event; LGBTQ=lesbian, gay, bisexual, transgender or queer; SDH=social determinants of health

ACE Score	
ACE Score = 0	-
ACE Score = 1-3	7.82 (1.63-47.14, P=.01)
ACE Score = 4-9	11.14 (1.32-126.32, P=.03)
Sex	
Male	-
Female	7.15 (1.91-33.31, P=.01)
Identifies as LGBTQ	
No	-
Yes	3.81 (0.66-27.20, P=.15)
SDH Score	
SDH Score = 0	-
SDH Score = 1 or more	1.21 (0.24-5.83, P=.81)

ACE=adverse childhood event; LGBTQ=lesbian, gay, bisexual, transgender or queer; SDH=social determinants of health

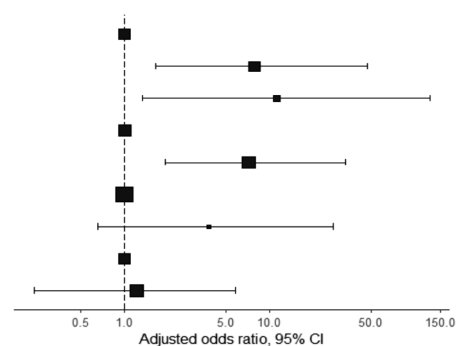


Figure 1. Forest Plot of Adjusted Odds Ratios of Depression and Anxiety Among Maui Teens by Significant Predictors

Discussion

In this study, when adjusting for ACE scores, sex, LGBTQ status, and SDH scores, the 2 variables most strongly associated with DA were high ACE scores (4+) and female sex. National data likewise reports teens with high ACEs (4+) were 25 times more likely to have suicide attempts.^{9,13} National data also shows that females in every age group have a higher rate of depression than males.¹⁴⁻¹⁶ CDC data also shows that 60% of teen females had depression symptoms in 2021, a 60% increase from a decade ago.¹⁷

LGBTQ teens comprised 16% of the study population and were statistically more likely to report DA. Of interest, subsequent generations starting with Traditionalists (born before 1946) to Generation Z (1997-2003) have reported a progressively higher incidence rate of self-identification as LGBTQ from 0.8 to 20.8 respectively.¹⁸⁻¹⁹ In 2021, CDC data shows 69% of LGBTQ+ students had persistent feelings of hopelessness/sadness and almost 1 in 4 attempted suicide.⁶ A follow-up study with a larger population may be able to further explore the possible associations between DA and LGBTQ status and SDH scores.

Teens in this Maui study were found to have higher ACE scores compared to national data. While the number of patients with at least 1 ACE was comparable (Maui 62% vs US 61%), there was a greater percentage of patients with 4+ ACEs (Maui 25% vs US 16%).⁶ Additionally, teens' ACE scores tended to be higher than guardians' scores. One reason could be the lack of guardian awareness. Another is the possible unwillingness for guardians to be open due to stigma. Hawai'i has a large Asian and NHPI population and a common cultural norm is to deflect shame from the family. The discrepancy could be further evaluated in a future study where root causes can be determined, along with comparison of teen patients' DA diagnoses for those who had discrepancies compared to their guardians, and those that did not. Additionally, there is the potential for generational trauma. Further studies could expand and look into how ACEs affect adults and how that may affect their parenting styles.

PEARLS quantifies the ACE and SDH score, which includes experiences like bullying, prejudice, housing, and food insecurity.²⁰ Both ACEs and SDH are linked to certain minorities and poverty.³ In the Maui study, there was no statistical difference in ACEs in regards to ethnicity, private or public school, private or HMO insurance. Interestingly, while those with poor socioeconomic status or disproportionalities in ethnicity tend to have higher ACEs, this can open the door to greater family resilience when able to overcome these adversities.²¹ This could shed a positive light on how awareness and the right resources can reframe these difficult situations.

Administration of the PEARLS survey provides the opportunity for teens, guardians and providers to become trauma-informed. Discussing these matters can strengthen relationships and trust, and allow for open discussion of stigmatized topics. The conversation may include preventative care, protective factors and coping skills for triggers. Moreover, this can increase provider empathy and understanding. Many of these variables, along with physician perspective and patient satisfaction, could be explored in another follow-up longitudinal prospective study, as this study was only a cross-sectional study of a small population.

Limitations

The sample size in this study was relatively small (n=75) due to administering the survey for a set amount of time and was based on a convenience sample which could imply a sample bias. Kihei, Maui may not reflect the general demographics in Hawai'i, since it is a tourist area with an ethnically and socio-economically diverse population. Although guardians and teens completed the questionnaires independently, they were in the same room when the questionnaires were filled out. This may have led to a less candid disclosure. Since paper questionnaires were administered to collect data, missing responses generated missing data. It would be ideal to convert questionnaires into a computerized survey that would not allow questions to be skipped, with an option of 'decline to answer' to ensure completeness in data collection.

There was a concern regarding the use of de-identified answers which was one way to destigmatize the PEARLS. However, some ACEs topics may be notably sensitive for the patient and their guardian, and may require building more rapport before being able to bring up specific details in conversation. More experience in the future will help the clinician become more comfortable with the specific identified ACEs.

Conclusion

Adding the PEARLS questionnaire with other mental health screening tools provided clinicians with a broader understanding of teens' mental health status and the challenges of addressing mental health issues. PEARLS can be a valuable tool for clinicians to identify, understand and mitigate risks of childhood trauma. In Hawai'i, there is a shortage of psychiatrists, most notably in the neighbor islands (islands not O'ahu). Clinicians can accommodate for the shortage by incorporating mental health screening tools into regular office visits to help patients find further support. In the future, it would be interesting to explore protective factors, positive childhood events and to identify ways to enhance community resilience.

Conflict of Interest

None of the authors identify a conflict of interest.

Acknowledgments

The project described was partially supported by the Office of the Dean through the Barry & Virginia Weinman Endowment. M.R. and J.J.C. were partially supported by the U54MD007601 (Ola HAWAII) grant from the National Institute of Health (NIH). The content is solely the responsibility of the authors and does not necessarily represent the official views of NIH.

Authors' Affiliations:

- John A. Burns School of Medicine, University of Hawai'i, Honolulu, HI (SW)
- Kaiser Hawai'i Permanente Medical Group, Kihei, HI (FL)
- Department of Quantitative Health Sciences, John A. Burns School of Medicine, University of Hawai'i, Honolulu, HI (MR, DP, JJC)

Corresponding Author:

Sharon Wong MD; Email: sharonmw@hawaii.edu

References

1. Ige DY, Char EA. Department of Health encourages move from awareness to acceptance for National Children's Mental Health Month. State of Hawaii, Department of Health. Published May 2022. Accessed September 29, 2022. <https://health.hawaii.gov/news/newsroom/departments-of-health-encourages-move-from-awareness-to-acceptance-for-national-childrens-mental-health-month/>
2. Sy-Layug R, Yoshimoto J, Goebert D, Guerrero APS, Alicata D. The Hawai'i child and adolescent psychiatry resources for primary care: An evidence-informed tool to improve quality of care. *Hawaii J Health Soc Welf*. 2020;79(5 Suppl 1):76-79.
3. The link between adverse childhood experiences and later-life health. Baylor. Published March 23, 2021. Accessed September 12, 2022. <https://onlinegrad.baylor.edu/resources/adverse-childhood-experiences-health/>
4. Mental Health in Hawaii. Hawaii State Fact Sheet. Published February 2021. Accessed September 16, 2022. <https://nami.org/NAMI/media/NAMI-Media/StateFactSheets/HawaiiStateFactSheet.pdf>
5. Youth Risk Behavior Surveillance System. Teens Who Attempted Suicide. Hawaii Health Matters. Accessed September 9, 2022. <https://hawaiihealthmatters.org/indicators/index/view?indicatorid=2500>
6. YRBSS Data Summary & Trends 2011-2021. Centers for Disease Control and Prevention. Accessed April 30, 2024. https://www.cdc.gov/healthyyouth/data/yrbs/pdf/YRBS_Data-Summary-Trends_Report2023_508.pdf
7. Felitti VJ, Anda RF, Nordenberg D, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: The adverse childhood experiences (ACE) study. *Am J Prev Med*. 2019;56(6):774-786. <https://doi.org/10.1016/j.amepre.2019.04.001>
8. Adverse Childhood Experiences (ACEs). Centers for Disease Control and Prevention. Published August 23, 2021. Accessed September 12, 2022. <https://www.cdc.gov/vitalsigns/aces/index.html#:~:text=ACEs%20can%20include%20violence%2C%20abuse,and%20substance%20misuse%20in%20adulthood>
9. Anderson KN, Swedo EA, Trinh E, et al. Adverse childhood experiences during the COVID-19 pandemic and associations with poor mental health and suicidal behaviors among high school students — adolescent behaviors and experiences survey, United States, January–June 2021. *MMWR Morb Mortal Wkly Rep*. 2022;71(41):1301-1305. <https://doi.org/10.15585/mmwr.mm7141a2>
10. PHQ-9: Modified for teens. American Academy of Child & Adolescent Psychiatry. Published 2010. Accessed September 23, 2022. https://www.aacap.org/App_Themes/AACAP/docs/member_resources/toolbox_for_clinical_practice_and_outcomes/symptoms/GLAD-PC-PHQ-9.pdf
11. Robert L. Spitzer, Janet B.W. Williams, Kurt Kroenke, et al. GAD-7 Anxiety Screener. Anxiety and Depression Association of America. Published 1999. Accessed October 1, 2022. https://adaa.org/sites/default/files/GAD-7_Anxiety-updated_0.pdf
12. Home - ACES Aware. ACES Aware. Published March 1, 2023. Accessed September 28, 2022. <https://www.acesaware.org/>
13. Office of the Surgeon General (OSG). *Protecting Youth Mental Health: The U.S. Surgeon General's Advisory*. Washington, DC: US Department of Health and Human Services; 2021.
14. Priority Areas. Centers for Disease Control and Prevention. Published June 2, 2022. Accessed September 12, 2022. <https://www.cdc.gov/injury/priority/index.html>
15. Albert PR. Why is depression more prevalent in women? *J Psychiatry Neurosci*. 2015;40(4):219-221. <https://doi.org/10.1503/jpn.150205>
16. Cyranowski JM, Frank E, Young E, et al. Adolescent onset of the gender difference in lifetime rates of major depression: a theoretical model. *Arch Gen Psychiatry*. 2000;57(1):21-27. <https://doi.org/10.1001/archpsyc.57.1.21>
17. CDC report shows concerning increases in sadness and exposure to violence among teen girls and LGBTQ+ Youth. Centers for Disease Control and Prevention. Published March 9, 2023. Accessed September 21, 2022. <https://www.cdc.gov/nchhstpn/newsroom/fact-sheets/healthy-youth/sadness-and-violence-among-teen-girls-and-LGBTQ-youth-factsheet.html#teen-girls>
18. 2019 number and percentage of students, by sexual identity. Centers for Disease Control and Prevention. Published August 20, 2020. Accessed October 10, 2022. https://www.cdc.gov/healthyyouth/data/yrbs/2019_tables/students_by_sexual_identity.htm
19. Jones JM. LGBT identification in U.S. ticks up to 7.1%. Gallup.com. Published June 10, 2022. Accessed September 18, 2022. <https://news.gallup.com/poll/389792/lgbt-identification-ticks-up.aspx>
20. Screening tools. ACES Aware. Published November 22, 2021. Accessed September 14, 2022. <https://www.acesaware.org/learn-about-screening/screening-tools/>
21. Goldstein E, Topitzes J, Miller-Cribbs J, et al. Influence of race/ethnicity and income on the link between adverse childhood experiences and child flourishing. *Pediatr Res* 89, 1861–1869 (2021). <https://doi.org/10.1038/s41390-020-01188-6>