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Isak Kim

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# Independent and cumulative impacts of adverse childhood experiences on adolescent subgroups of anxiety and depression

Isak Kim <sup>a</sup>, Angélica Galván <sup>b</sup>, Nayoung Kim <sup>c</sup>

<sup>a</sup> *The Pennsylvania State University, CEDAR Building, University Park, PA 16802, United States*

<sup>b</sup> *Tennessee Technological University, 1 William L Jones Dr, Cookeville, TN 38505, United States*

<sup>c</sup> *New York Institute of Technology, 16 W 61st Street, Room 711, New York, NY 10023, United States*

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Anxiety Depression Comorbidity Adverse childhood experiences  
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## **A B S T R A C T**

The purpose of this study is to investigate the independent and cumulative impacts of Adverse Childhood Experiences (ACEs) on the subgroups of anxiety and depression among 12–17 aged adolescents in the U.S. A sample of 21,496 cases was derived from the 2017–2018 National Survey of Children’s Health (NSCH). Four adolescent subgroups were identified depending on their mental health condition: Anxiety-only (7.2%), Depression-only (1.5%), Anxiety-Depression (6.3%), and None (85.0%). All sociodemographic characteristics such as sex, age, race/ethnicity, and family structure had significant associations with the subgroups. Two multinomial logistic regression analyses were conducted to examine the independent and cumulative effects of ACEs on the sub- groups. The findings suggested having a family member with severe mental illness showed the strongest relationship with the development of anxiety, depression, and both. A dose–response relationship was found between cumulative ACEs and the subgroups, with Anxiety-Depression as the most prevalent group when adolescents had multiple ACEs. Implications for

service providers and future research are discussed.

## **Introduction**

Recent national, population-based data show the high prevalence of Adverse Childhood Experiences (ACEs) among youth, with almost one-half of them in the United States having ACEs, such as maltreatment and household dysfunction (e.g., Bethell et al., 2017). ACEs have critical impacts on the development of anxiety and depression among adolescents; that is, youth with ACEs are at greater risk of developing those mental health concerns (Bethell et al., 2014; Elmore & Crouch, 2020; Moore & Ramirez, 2016). The pervasiveness of the ACEs indicates that it is critical to consider them as significant contributors of various developmental consequences in adolescence. Despite a few previous studies that found the association between ACEs and adolescent anxiety and depression, it is still necessary to comprehensively investigate the relationship. The present study aims to examine both the independent and cumulative effects of ACEs on anxiety, depression, and comorbid condition among adolescents ages 12–17.

## **Adolescents' anxiety, depression, and comorbid condition**

Anxiety and depression have been frequently reported as significant mental health concerns that often emerge for the first time during adolescence. Literature suggests that up to 20% of young people experience anxiety or depression by age 18 (e.g., Costello et al., 2003). Particularly, anxiety disorders are known as some of the most commonly reported mental health issues that affect adolescents (Costello et al., 2005). While anxiety has a high prevalence identified during adolescence (Merikangas et al., 2010), it also frequently co-exists with other psychological disorders, with the comorbidity of 51% (Essau, 2003). The prevalence of depression increases as adolescents make a transition out of childhood and the risk of it becoming a lifelong affliction rises (Mojtabai et al., 2016; Saluja et al., 2004). Anxiety and depression among adolescents have been reported to significantly influence their cognition, interpersonal and social functioning, and psychological and physical health (Essau et al., 2014; Teubert & Piquart, 2011).

Anxiety and depression can even occur at the same time, negatively affecting minors to a significant extent. A recent review on comorbid anxiety and depressive symptoms reported that comorbid anxiety and depression are common among adolescents, while the comorbid conditions are likely underestimated among the population (Melton et al., 2016). Adolescents with comorbid anxiety and depression have unique challenges with higher symptom severity. Complications from the comorbid condition of anxiety and depression among youth involve greater impairment and symptom severity of negative self-evaluation and discouragement, and more severe depressed mood (e.g., Fichter et al., 2010; Franco et al., 2007; O'Neil et al., 2010). For example, O'Neil et al. (2010) reported that comorbidity of anxiety and depression was associated with lower global functioning, more severe social anxiety, poorer family functioning, and greater severity of specific depressive symptoms among youth with a principal anxiety diagnosis. The anxious depressive symptomatology also engages other health-related outcomes, such as somatic concerns, insomnia, poor concentration, depersonalization, subjective anger, obsessive thoughts and compulsive behaviors, and distrustfulness (Clayton et al., 1991; Unick et al., 2009). Given the consequential difficulties of anxiety, depression, and comorbidity among adolescents, there is a critical need to understand risk factors associated with the development of these mental health problems.

### **Adverse childhood experiences**

*Adverse Childhood Experiences* (ACEs) refer to potentially traumatic events that occur during childhood, before age 18. ACEs initially included psychological, physical, sexual forms of abuse and neglect and household dysfunction by a monumental study by Felitti et al. (1998). Later, the concept of ACEs has been expanded to additional types of childhood adversity, including community violence, victimization, racial discrimination, and poverty; and a variety of ACE measures has been developed with modifications and adaptations from the original ACE inventory to assess the new overall ACEs (e.g., Cronholm et al., 2015; Finkelhor et al., 2013; Wade et al., 2014). Felitti et

al. (1998), in their pivotal ACE study, discovered a dose–response relationship of ACEs, which means the more ACEs, the greater likelihood of suboptimal health outcomes.

Since the ACE study in 1998, an extensive body of research has established the impacts of ACEs on developmental outcomes across the lifespan. Researchers reported that ACEs have significant associations with physical health, such as early mortality (e.g., Bellis et al., 2015) and cancer (e.g., Brown et al., 2013), and high-risk health behaviors, including smoking (e.g., Edwards et al., 2007), alcohol abuse (e.g., Campbell et al., 2016), and risky sexual behaviors (e.g., Ramiro et al., 2010). In addition, ACEs have been found to affect both externalizing and internalizing behaviors. Research suggests ACEs have been found to be associated with violence, such as violence perpetration (e.g., Duke et al., 2010), sex offense (e.g., Levenson et al., 2016), and externalized adjustment problems (e.g., Hazen et al., 2009). Prior research has discovered internalized distress among adolescents as consequences of ACEs, such as depression (e.g., Brockie et al., 2015), anxiety (e.g., Spence et al., 2002), comorbid anxiety and depression (e.g., Hovens et al., 2010) and suicidal risk (e.g., Perez et al., 2016). A recent study conducted by Muniz and colleagues (2019) also showed that specific ACEs may predict certain externalizing or internalizing behaviors among juveniles. Moreover, a large body of work has found significant associations between ACEs and a number of challenges within the context of K-12 settings among adolescents. Such challenges include chronic school absenteeism (e.g., Stempel et al., 2017) and a lower degree of academic performance in school (e.g., Bethell et al., 2014). Because of these extensive, adverse consequences of ACEs on health and behavior outcomes, ACEs have received a considerable amount of attention for the last two decades.

### **ACEs, anxiety/depression, and research gaps**

Research has shown critical impacts of ACEs on developing anxiety and depression across different developmental stages from childhood to late

adulthood (Karatekin, 2018; Merrick et al., 2017; Schilling et al., 2007; Spinhoven et al., 2010). Particularly, ACEs have received growing attention in explaining adolescents' anxiety and depression from scholars (Balistreri & Alvira-Hammond, 2016; Bethell et al., 2014; Elmore & Crouch, 2020; Lee et al., 2020; Moore & Ramirez, 2016). Despite the studies noted above, research gaps exist in the approaches to examining the impacts of ACEs on adolescents' anxiety and depression. It is still less known about the independent and cumulative impacts of ACEs on adolescents' subgroups of anxiety and depression. Most of the prior work paid less attention to an incorporated perspective of both independent and cumulative effects despite the significance of recognizing the effects of ACEs with specificity and cumulateness. Many previous studies relied on using only a cumulative index of ACEs by summing up the scores of a series of childhood adversities, which supports a dose-response relationship from the seminal work on ACEs by Felitti et al. (1998). This approach has advantages, such as convenience and simplicity of the interpretation, but fails to provide a relative specificity of different types of adversities to anxiety, depression, or comorbidity of both. It is critical to consider the relative specificity of different ACEs regarding their impacts because cumulative number of ACEs do not fully explain which types of ACEs are sensitively associated with the condition of anxiety and depression. Specifically, some types of ACEs may demonstrate their associations with both anxiety and depression, whereas others may have relations to only either anxiety or depression or even none of those mental health conditions. Therefore, it is important to consider both specificity and cumulateness when examining the impacts of ACEs to provide a broader understanding of the relationship between ACEs and adolescent anxiety and depression. Much uncertainty also exists in the relationship between ACEs and the comorbid condition of anxiety and depression among adolescents. Some previous studies, which investigated anxiety and depression associated with childhood adversity, treated anxiety and depression separately (e.g., Karatekin, 2018; Mersky et al., 2013). In other cases, researchers combined anxiety and depression as a single

construct, such as emotional well-being (e.g., Balistreri & Alvira-Hammond, 2016). Only a few previous studies focused on the association between childhood adversity and depressive, anxiety, and comorbid concerns, based on subgroups, including: (a) none of the conditions, (b) depression only, (c) anxiety only, and (d) comorbid condition of anxiety and depression (e.g., Hovens et al., 2010; Levitan et al., 2003). Nevertheless, those studies targeted adult populations, not adolescents, leaving room for further investigation with a focus on an adolescent population.

### **Purpose of the study**

The overarching goal of this study is to build upon and extend existing literature by investigating the relationship between ACEs and anxiety, depression, and comorbidity among 12–17 aged adolescents in the U.S. The current investigation specifically aimed to (a) identify prevalence of the subgroups of anxiety and depression (i.e., Anxiety- only, Depression-only, Anxiety-Depression, and None) associated with demographic variables, (b) examine independent effects of each ACE on their subgroup membership, and (c) examine cumulative effects of ACEs. The present study used a population-based investigation by using nationally representative data.

### **Method**

#### ***Data and sample***

The current study used the 2017–2018 National Survey of Children's Health (NSCH), a large cross-sectional, nationally representative survey designed and sponsored by the U.S Maternal and Child Health Bureau in partnership with the National Center for Health Statistics, Child and Adolescent Health Measurement Initiative, and a National Technical Expert Panel. The 2017–2018 NSCH was administered by both online and mail based on randomly selected addresses from households across the 50 states and the District of Columbia. The respondents of the NSCH data for the present investigation were parents or caregivers of youth who are 0–17 years old. Questionnaires

rendered children and youths' demographics, physical/mental/developmental health issues, parental health, school-related factors, and neighborhood-related factors. The total number of the 2017–2018 surveys was 52,129 participants. Out of the dataset completed by the total respondents, our sample was limited to caregivers of 12–17 aged adolescents, resulting in 21,496 respondents included as the final analytic sample.

**Table 1**  
Descriptive Statistics (n = 21,496).

Category	Total <i>n</i>	Unweighted <i>n</i>	Weighted %
<b>Sex</b>			
Male	21,496	11,193	52.1
Female		10,303	47.9
<b>Age</b>			
12–14 years old	21,496	9,600	44.7
15–17 years old		11,896	55.3
<b>Race/ethnicity</b>			
White	21,496	15,064	70.1
Black		1,465	6.8
Hispanic		2,391	11.1
Asian		1,095	5.1
Other/Multi-racial		1,481	6.9
<b>Family structure</b>			
Two-parents, currently married	21,145	14,851	70.2
Two-parents, not currently married		1,189	5.6
Single parent (mother or father)		4,217	19.9
Grandparent household		638	3.0
Other family type		250	1.2
<b>Independent ACEs</b>			
Income hardship (Yes)	21,119	3,353	15.9
Divorce (Yes)	20,923	6,366	30.4
Death (Yes)	20,896	1,014	4.9
Jail (Yes)	20,857	1,669	8.0
Domestic violence (Yes)	20,845	1,359	6.5
Neighborhood violence (Yes)	20,843	1,137	5.5
Mental health (Yes)	20,796	2,363	11.4
Drug (Yes)	20,849	2,696	12.9
Discrimination (Yes)	20,897	1,037	5.0
<b>Cumulative ACEs</b>			
No ACE	20,174	10,490	52.0
1 ACE		4,854	24.1
2 ACEs		2,172	10.8
3 ACEs		1,184	5.9
4 or more ACEs		1,474	7.2
<b>Subgroups</b>			
Anxiety-only	20,486	1,470	7.2
Depression-only		311	1.5
Anxiety-Depression		1,289	6.3
None		1,7416	85.0

*Note:* Total *n* of each variable differs due to cases with missing values.

## **Measures**

### ***Adverse Childhood Experiences (ACEs)***

ACEs comprised nine types of childhood adversity in the NSCH data. The items about ACEs are as follows: (a) income hardship: hard to get by on family's income (hard to cover basics such as food or housing), (b) divorce: parent or guardian divorced or separated, (c) death: parent or guardian died, (d) jail: parent or guardian served time in jail, (e) domestic violence: saw or heard parent or adults slap, hit, kick, punch one another in the home, (f) neighborhood violence: victim/witness of neighborhood violence, (g) mental health: lived with anyone who was mentally ill, suicidal, or severely depressed, (h) drug: lived with anyone who had a problem with alcohol or drug, and (i) discrimination: treated or judged unfairly because of their race or ethnic group. All items, except for income hardship, were dichotomous questions (i.e., Yes/No experience). Income hardship, which originally had four response options (i.e., never, rarely, somewhat often, and very often), was transmuted into a dichotomous question; 'somewhat often' and 'very often' were recoded as 'Yes', and 'rarely' and 'never' were recoded as 'No'.

The ACE inventory served as an independent variable in two separate multinomial logistic regression models. For the independent impacts of ACEs, the nine types of ACEs were separately included in the multinomial logistic model. The ACE scores were summed up for the second multinomial logistic model to investigate the cumulative impacts of ACEs. The sum scores were mean centered to reduce potential multi-collinearity and to enhance convenience in interpretation of the results.

### ***Subgroups of anxiety and depression***

The NSCH survey contains multiple questions assessing mental health conditions of adolescents (e.g., anxiety, depression). Items examining the current mental health conditions regarding anxiety and depression were transformed for analysis. Initially, respondents (i.e., parent or guardian) were asked to report if their children ever had anxiety and depression as binary items (i.e., Yes = 1, No = 2). Subsequently, if yes to those items, respondents

were asked to answer if their children currently have the mental health conditions as binary items again (i.e., Yes = 1, No = 2). In this study, the two items asking the current status of anxiety and depression were combined to create four mutually exclusive subgroups: Anxiety-only, Depression-only, Anxiety- Depression, and None. This categorical variable representing the four subgroups served as an outcome variable for the multinomial logistic regression models.

### **Covariates**

Adolescents' sex, age, race/ethnicity, and family structure were included as covariates in this study. *Sex* was a binary variable that consisted of male and female. *Age* was also treated as a binary item that consisted either 12–14 years or 15–17 years, out of adolescents ages 12 to 17 years old. *Race/ethnicity* was categorized as (a) White, non-Hispanic, (b) Black, non-Hispanic, (c) Hispanic, (d) Asian, non-Hispanic, and (e) other/multiracial, non-Hispanic. In association with *family structure*, respondents were asked to identify the relationships of parents (e.g., biological/adoptive parents, step-parents) in the household and their marital status. Five response options were described: (a) two parents, currently married, (b) two parents, not currently married, (c) single parent (mother or father), (d) grandparent household, and (e) other family type.

### **Data analysis**

The analyses proceeded in multiple steps. Four mutually exclusive groups of anxiety and depression were created: Anxiety-only, Depression-only, Anxiety-Depression, and None. Descriptive analyses were performed to present sample characteristics, the prevalence of ACEs, and composition of the subgroups representing the anxiety-depression subgroups. For a preliminary analysis, a series of Chi-square tests were implemented to compare the anxiety-depression subgroups with socio-demographic characteristics (i.e., sex, age, race/ethnicity, and family structure). Subsequently, two multinomial logistic regression

analyses were performed to address the research questions, independent and cumulative impacts of ACEs on the current conditions of anxiety, depression, and both. Multinomial logistic regression model is useful when examining the effects of independent variables on a nominal dependent variable, here, the four subgroups of anxiety and depression. Given that multinomial logistic regression requires a minimum of 10 cases per independent variable (Schwab, 2002), the sample size of the present study was large enough to conduct multinomial logistic regression. The subgroup of 'None' that represents those who have neither anxiety nor depression served as a reference group for two times of the regression models.

There are many ways to obtain  $R^2$  in multinomial logistic regression, while there is no agreement on which one is the best. The Cox-Snell  $R^2$  (Cox & Snell, 1989) may be an option because it contains the ordinary least square  $R^2$  as a special case. However, use of Cox-Snell  $R^2$  involves a limitation in its interpretability because the upper bound of Cox-Snell  $R^2$  (i.e.,  $1 - L_0^{2/n}$ ) can be significantly  $< 1$ . Thus, we determined to use Nagelkerke  $R^2$  (Nagelkerke, 1991), which adjust Cox-Snell  $R^2$  by dividing Cox-Snell  $R^2$  by its upper bound, for more intuitive interpretation of  $R^2$ , such as  $R^2$  in the linear regression model.

The first multinomial logistic regression model included individual ACE items as independent variables, and the second regression model had a cumulative index of ACEs (i.e., sum score of nine ACEs) instead of individual ACE items. Sociodemographic variables, which were identified to have associations with the outcome variable (i.e., four subgroups of anxiety and depression) in the preliminary analysis, were entered as covariates in both multinomial logistic regression models. The probabilities to belong to each subgroup of anxiety and depression were plotted depending on the number of ACEs to visualize the association between cumulative ACEs and anxiety, depression, and the comorbid condition.

**Table 2**

Chi-Square Analyses between group membership and demographic variables  
(n = 20,486).

Category		Anxiety-only	Depression-only	Anxiety- Depression	None	$\chi^2$
<b>Sex</b>	Male	656 (6.1%)	154 (1.4%)	500 (4.7%)	9,392 (87.8%)	148.42***
	Female	814 (8.3%)	157 (1.6%)	789 (8.1%)	8,024 (82.0%)	
<b>Age</b>	12–14	680 (7.4%)	92 (1.0%)	413 (4.5%)	8,044 (87.2%)	128.16***
	15–17	790 (7.0%)	219 (1.9%)	876 (7.8%)	9,372 (83.3%)	
<b>Race</b>	White, non-Hispanic	1,157 (8.1%)	189 (1.3%)	988 (6.9%)	11,986 (83.7%)	159.194***
	Black, non-Hispanic	51 (3.6%)	32 (2.3%)	54 (3.8%)	1,270 (90.3%)	
	Hispanic	141 (6.2%)	48 (2.1%)	123 (5.4%)	1,961 (86.3%)	
	Asian, non-Hispanic	22 (2.1%)	18 (1.7%)	31 (2.9%)	1,000 (93.4%)	
	Other, multi-racial, non-Hispanic	99 (7.7%)	24 (1.7%)	93 (6.6%)	1,199 (84.7%)	
<b>Family Structure</b>	Two parents currently married	1,006 (7.1%)	160 (1.1%)	742 (5.2%)	12,312 (86.6%)	209.158***
	Others/no parent	73 (6.5%)	27 (2.4%)	80 (7.1%)	948 (84.0%)	
	Single parent	314 (7.9%)	84 (2.1%)	353 (8.9%)	3,227 (81.1%)	
	Grandparent household	38 (6.4%)	32 (5.4%)	63 (10.6%)	462 (77.6%)	
	Other family type	17 (7.4%)	6 (2.6%)	28 (12.2%)	179 (77.8%)	
<b>Total</b>		1,470 (7.2%)	311 (1.5%)	1,289 (6.3%)	17,416 (85.0%)	

Note: Percentage denotes to the % of the respondents from each row. \*\*\* $p < .001$ .

## Results

### *Descriptive statistics of the study sample*

Four subgroups of anxiety and depression were identified: Anxiety- only ( $n = 1,470$ ; 7.2%), Depression-only ( $n = 311$ ; 1.5%), Anxiety- Depression ( $n = 1,289$ ; 6.3%), and None ( $n = 17,416$ ; 85.0%). Male adolescents were 11,193 cases consisting of 52.1% of the total sample, and White, non-Hispanic were the

majority comprising more than seventy percent of the sample ( $n = 15,064$ , 70.1%). In terms of types of ACEs, the most prevalent ACE was parental separation/divorce ( $n = 6,366$ ; 30.4%), followed by income hardship ( $n = 3,353$ ; 15.9%), alcohol or drug abuse of a household member ( $n = 2,696$ ; 12.9%), and mental health problem of a household member ( $n = 2,363$ ; 11.4%). The least prevalent ACE was experience of parental death ( $n = 1,014$ ; 4.9%), followed by racial discrimination ( $n = 1,037$ ; 5.0%), experience of neighborhood violence ( $n = 1,137$ ; 5.5%), and witnessing domestic violence ( $n = 1,359$ ; 6.5%). For the cumulative index, those who experienced at least one ACE appeared 48% ( $n = 9,684$ ) of a total sample, indicating experience of one ACE as 24.1% ( $n = 4,854$ ), two ACEs as 10.8% ( $n = 2,172$ ), three ACEs as 5.9% ( $n = 1,184$ ), and four or more ACEs as 7.2% ( $n = 1,474$ ). Table 1 summarizes descriptive statistics about the sample characteristics.

### ***Composition of the subgroups by sociodemographic characteristics***

A series of Chi-square analyses were conducted to demonstrate the associations between group memberships of the Anxiety-Depression dyad and sociodemographic characteristics, such as sex, age, race/ethnicity, and family structure. All sociodemographic variables showed significant Chi-square statistics with the subgroups of anxiety and depression. In other words, the proportions of the subgroups differed by sex, age group, race/ethnicity, and family structure. Female adolescents ( $n = 789$ ; 8.1%) were more likely than male adolescents ( $n = 500$ ; 4.7%) to belong to the Anxiety-Depression group, and older adolescents ( $n = 876$ ; 7.8%) were more likely than younger ones ( $n = 413$ ; 4.5%). White, non-Hispanic ethnic group was more likely to belong to the Anxiety-only ( $n = 1,157$ ; 8.1%) and Anxiety-Depression groups ( $n = 988$ ; 6.9%), while Asians, non-Hispanic were less likely to belong to those groups (i.e., 93.4% belonged to the None group;  $n = 1,000$ ). Regarding the family structure, two-parents groups showed relatively lower risks (i.e., 86.6% belonged to the None group;  $n = 12,312$ ), but grandparent household or other family type appeared at greater risks (i.e., 77.6% [ $n = 462$ ] and 77.8% [ $n = 179$ ] of them belonged to the

None group respectively in the order of presentation) than those of other family structure. In particular, the 'grandparent household' showed the highest rate of the Depression-only group ( $n = 32$ ; 5.4%), which is three times more than the average rate of group membership to this subgroup out of the total sample (1.5%). Also, the 'other family type' presented the highest rate of the Anxiety-Depression group ( $n = 28$ ; 12.2%), which is approximately double the average (6.3%). Table 2 indicates the results of the Chi-square analyses.

### ***Independent effects of ACEs on the anxiety-depression subgroups***

The first multinomial logistic regression model was implemented to examine the relationship between independent ACEs and subgroups of anxiety and depression. The group which has neither anxiety nor depression was entered as a reference group. All sociodemographic characteristics were set as covariates based on the results of the Chi-square tests that found significant test statistics. The full model significantly improved the model compared to the one with the only intercept as a result of likelihood ratio tests, with  $\chi^2(57) = 1625.549$ ,  $p < 0.001$ . Findings indicated that some sociodemographic characteristics, such as age, gender, and race/ethnicity, were significantly associated with group membership, except family structure.

The subgroups of anxiety and depression were found to have heterogeneous associations with independent childhood adversity. The Anxiety-only group was found to have associations with four types of ACEs, including: (a) income hardship, (b) neighborhood violence, (c) living with a mentally ill family member, and (d) racial discrimination. The Depression-only group had associations with six childhood adversities; the largest number of early adversities among the three groups: (a) income hardship, (b) parental divorce/separation, (c) parental death, (d) domestic violence, and (e) living with a mentally ill family member, and (f) alcohol/ drug abuse. The Anxiety-Depression group was found to be associated with five adversities during childhood, including: (a) income hardship, (b) parental divorce/separation, (c) neighborhood violence, (d) living with a mentally ill family member, and (e) alcohol/drug abuse.

In terms of the independent ACEs, only income hardship and living with a mentally ill family member were found to increase the risk of belonging to all three subgroups. In particular, income hardship increased probability to the Anxiety-only group by 73%, to the Depression-only group by 43%, and to the Anxiety-Depression group by 91%, compared with the condition of not experiencing it. Living with the mentally ill household member was found to be the strongest predictor across three subgroups, increasing the probability of 92% for the Anxiety-only, 176% for the Depression-only, and 322% for the Anxiety-Depression group. Parental divorce/separation and alcohol/drug abuse of a household member were associated with depression-related groups (i.e., Depression-only and Anxiety-Depression) exclusively, while neighborhood violence was related to anxiety-related groups (i.e., Anxiety-only and Anxiety-Depression) only. Parental death and domestic violence were associated with the Depression-only group, while racial discrimination had an association with only the Anxiety-only group. Interestingly, incarceration of a family member had no relationship with any of the three subgroups of anxiety and depression. Table 3 shows the results of the multinomial logistic regression analysis for covariates and independent ACEs.

### ***Cumulative effects of ACEs on the anxiety-depression subgroups***

We used a sum score of ACEs (ranging from 0 to 9) as an outcome variable to investigate cumulative effects of ACEs on the subgroups of anxiety and depression. Again, all sociodemographic characteristics, including sex, age, race/ethnicity, and family structure, were included as covariates. The sum score of ACEs was treated as a continuous variable in the model.

The full model was found statistically significant,  $\chi^2(57) = 1367.092, p < 0.001$ . A unit increase in the ACE sum score indicated an approximately 1.25 increase in the odds of having a membership of the Anxiety-only group, 1.62 increase for the Depression-only group, and 1.60 increase for the Anxiety-Depression group. The result showed that a one-unit increase in the ACE sum score increased the odds of belonging to all subgroups (i.e., Anxiety-only, Depression-

only, and Anxiety- Depression), but had stronger relationships with the Depression-only and the Anxiety-Depression than the Anxiety-only group. More specifically, a one-unit increase of the ACE sum score had a stronger relationship with the Depression-only group by approximately 30% and with the Anxiety-Depression group by 28% than the Anxiety-only group. Table 4 summarizes the result of the multinomial logistic regression model. Fig. 1 represents the likelihood of subgroup membership (i.e., Anxiety-only, Depression-only, and Anxiety-Depression) based on the number of cumulative ACEs, which indicates adolescents are more likely to develop both conditions instead of one of them, when having experienced multiple ACEs.

## **Discussion**

The goal of the current study was to compare the relative and accumulative effects of ACEs on the development of adolescent anxiety, depression, or comorbid anxiety and depression. In addition to using a population-based sample, we considered sociodemographic variables as covariates in running multinomial logistic regression analyses for independent and cumulative effects of ACEs. Results of the current study suggest recent estimates of the subgroups of anxiety and depression among adolescents ages 12 to 17 by sociodemographic characteristics, such as sex, age, race/ethnicity, and family structure. Adolescents who were reported to have anxiety were 13.5% out of a total sample, and those who reported to have depression were 7.8%, which resulted in 6.3% of those having both conditions. This finding suggests approximately 15.0% of adolescents in the U.S. struggle with either anxiety or depression, or both, at the point of the survey. The prevalence of anxiety and depression was found higher than a previous study using the 2016 NSCH data among the same age group (12 to 17), which found 6.1% had depression and 10.5% had anxiety (Ghandour et al., 2019).

**Table 3**

Results of the Multinomial Logistic Regression: Independent ACEs.

Variable	Anxiety-only (n = 1,470)		Depression-only (n = 311)		Anxiety-Depression (n = 1,289)	
	Odds ratio	CI interval	Odds ratio	CI interval	Odds ratio	CI interval
<b>Sex</b> (female)	0.67***	[0.60, 0.74]	0.82	[0.65, 1.04]	0.52***	[0.46, 0.59]
<b>Age</b> (15–17 years)	1.00	[0.90, 1.12]	0.52***	[0.40, 0.67]	0.54***	[0.47, 0.61]
<b>Ethnicity</b> (Other/Multi-racial)						
White	1.27*	[1.02, 1.59]	1.00	[0.62, 1.59]	1.43**	[1.11, 1.84]
Hispanic	0.89	[0.68, 1.18]	1.55	[0.92, 2.63]	1.04	[0.76, 1.41]
Black	0.42***	[0.29, 0.61]	1.44	[0.82, 2.56]	0.57**	[0.39, 0.83]
Asian	0.33***	[0.21, 0.53]	1.62	[0.83, 3.16]	0.55*	[0.34, 0.90]
<b>Family structure</b> (Others type)						
Grandparent	0.88	[0.46, 1.68]	2.70	[0.89, 8.17]	1.11	[0.62, 1.99]
Single mother	1.00	[0.57, 1.77]	1.83	[0.64, 5.22]	1.03	[0.61, 1.72]
Two parents, not married	0.87	[0.47, 1.60]	2.45	[0.81, 7.41]	0.94	[0.53, 1.66]
Two parents currently married	0.89	[0.50, 1.58]	1.94	[0.67, 5.60]	0.96	[0.57, 1.62]
<b>Childhood adversity</b> (no)						
Income hardship	1.73***	[1.50, 2.00]	1.43*	[1.08, 1.90]	1.91***	[1.65, 2.21]
Divorce	0.93	[0.80, 1.09]	1.76***	[1.30, 2.38]	1.30**	[1.10, 1.53]
Death	1.08	[0.83, 1.41]	1.97**	[1.34, 2.90]	1.26	[0.98, 1.62]
Jail	0.98	[0.77, 1.24]	1.09	[0.76, 1.57]	1.08	[0.87, 1.34]
Domestic violence	0.96	[0.75, 1.24]	1.55*	[1.07, 2.25]	1.08	[0.86, 1.36]
Neighborhood violence	1.46**	[1.15, 1.86]	1.19	[0.79, 1.77]	1.78***	[1.43, 2.21]
Mental health	1.92***	[1.62, 2.27]	2.76***	[2.04, 3.73]	4.22***	[3.62, 4.91]
Drug	1.06	[0.88, 1.28]	1.83***	[1.32, 2.53]	1.21*	[1.01, 1.44]
Discrimination	1.41**	[1.09, 1.83]	1.18	[0.76, 1.82]	1.28	[0.99, 1.68]

Notes: Reference group = None,  $n = 19,179$ . Nagelkerke  $R^2 = 0.13$ .\*  $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .**Table 4**

Results of the Multinomial Logistic Regression: Cumulative ACEs.

Variable	Anxiety-only (n = 1,470)		Depression-only (n = 311)		Anxiety-Depression (n = 1,289)	
	Odds ratio	CI interval	Odds ratio	CI interval	Odds ratio	CI interval
<b>Sex</b> (female)	0.66***	[0.60,0.74]	0.82	[0.65, 1.04]	0.52***	[0.46,0.58]
<b>Age</b> (15–17 years)	1.00	[0.90, 1.12]	0.52***	[0.40, 0.67]	0.53***	[0.47,0.61]
<b>Ethnicity</b> (Other/Multi-racial)	1.23	[0.99, 1.54]	1.12	[0.71, 1.78]	1.54**	[1.20, 1.97]
White						
Hispanic.	0.88	[0.67, 1.16]	1.56	[0.92, 2.65]	1.05	[0.77, 1.43]
Black	0.44***	[0.30, 0.64]	1.35	[0.76, 2.38]	0.58**	[0.40, 0.85]
Asian	0.33***	[0.20,0.53]	1.64	[0.84, 3.21]	0.56*	[0.35, 0.91]
<b>Family structure</b> (Others type)						
Grandparent	0.842	[0.44, 1.61]	2.58	[0.85, 7.76]	1.05	[0.59, 1.86]
Single mother	1.12	[0.64, 1.96]	1.90	[0.67, 5.37]	1.26	[0.76, 2.09]
Two parents, not married	0.951	[0.52, 1.73]	2.45	[0.82, 7.32]	1.11	[0.64, 1.93]
Two parents currently married	1.17	[0.67, 2.05]	1.95	[0.68, 5.57]	1.35	[0.81, 2.25]
<b>ACEs sum</b>	1.25***	[1.20, 1.30]	1.62***	[1.52, 1.73]	1.60***	[1.54, 1.66]

Notes: Reference group = None, n = 19,179. Nagelkerke R<sup>2</sup> = 0.10.

\* p < .05, \*\*p < .01, \*\*\*p < .001.

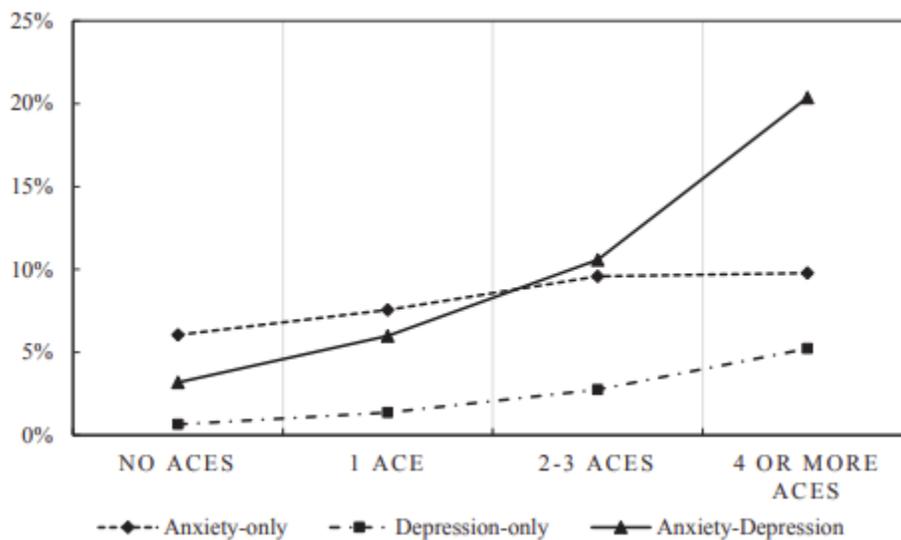


Fig. 1. Subgroups of Anxiety and Depression based on the Number of Cumulative ACEs.

With respect to sociodemographic variables, adolescents who are female and older (ages 15 to 17 compared with 12 to 14) appeared to be more vulnerable to developing anxiety and depression, which also lends support to prior work that found the same result (e.g., Elmore & Crouch, 2020). In terms of race/ethnicity, the Anxiety-only and Anxiety-Depression groups were more

contingent on race/ethnicity. Specifically, Whites, non-Hispanic were found to be at the greatest risk to those two groups, while Asians and African Americans were at relatively low risks. For the family structure, growing up in a single parent or grand- parent household had associations with higher probabilities to belong to the risk groups (i.e., Anxiety-only, Depression-only, and Anxiety- Depression) compared with adolescents with two parents married. In particular, adolescents from a grandparent household showed a prominent feature that they showed the highest rate to belong to the Depression-only (5.4%) compared to the average rate (1.5%). This result should be carefully interpreted because the analysis did not fully consider potential confounding factors, for example, cause of being in a single parent or grandparent household.

The findings of the associations between sociodemographic characteristics and development of anxiety and depression are partially supported by Bronfenbrenner's social-ecological theory (1979) of human development and the Social Determinants of Mental Health model (World Health Organization and Calouste Gulbenkian Foundation, 2014). Specifically, the social-ecological theory seeks to explain human development by the interactions between varying systems and the direct and indirect relationships an individual has within these systems. The Social Determinants of Mental Health model describes the impacts of accumulative positive or negative factors from genetic factors and social contexts on developing mental health outcomes over the life-course stages. These theoretical frameworks suggest that certain social groups are at higher risk of mental health concerns because of greater exposure and vulnerability to unfavorable social circumstances. This implication indicates that systemic inequalities seem to be generated on mental health outcomes across different social groups by age, ethnicity, income, education, family structure, or geographic area of residence, which are all interrelated. The disadvantaged social groups may suffer disproportionately from common mental health problems, such as anxiety and depression here, and their adverse consequences subsequently.

We also found the relative specificity of particular ACEs to anxiety,

depression, or both. Only two types of ACEs, such as income hardship and severe mental illness of a household member, were found as general predictive factors across the Anxiety-Depression subgroups. Mental illness of a family member was found the strongest variable, particularly in the Anxiety-Depression group, suggesting that adolescents with an individual suffering from mental disorders in their family may be vulnerable to comorbidity of anxiety and depression. This finding is consistent with a qualitative study from Liegghio (2017), revealing that youths with a family member who has a severe mental illness are at risk in developing mental health concerns due to a great deal of family stress and stigma. Also, the finding may imply a role of biological and genetic factors for an adolescent developing anxiety, depression, or both.

We further suggested a dose–response relationship between the summed ACEs score and the Anxiety-Depression subgroups, after holding sociodemographic characteristics. The findings indicate that the more ACEs experienced, the more elevated risks of anxiety, depression, or both. The cumulative effects of ACEs appeared stronger in predicting Anxiety-Depression and Depression-only groups than Anxiety-only, as shown in Table 4 and Fig. 1. Interestingly, the Anxiety-Depression group was found the most common type of subgroup when adolescents experienced multiple childhood adversities. Given that most of the prior work endeavored to examine a possible link between ACEs and “pure” anxiety or depression, these findings highlight again the importance of considering comorbid condition when exploring possible associations between ACEs and later mental health concerns (Levitan et al., 2003).

### *Implications for helping professionals*

This study provides substantial practical implications for service providers working with adolescents. With the increase of mental health concerns for adolescents 12–17 years of age represented in the NSCH surveys between 2017 and 2018, it is evident that addressing this age group will be a significant task moving forward in both reactive and preventative measures at different

social levels. Early intervention will be an essential approach for this age group, one that is dedicated to adolescents in particular since treatment aimed for adults or children may not be appropriate or suitable due to their distinct developmental needs (Brown et al., 2019). Schools are particularly well suited to recognize adolescents in need and address some of these concerns by providing social support and interventions, such as school-based skills and social skills training aimed at reducing symptoms (Van Loon et al., 2019). Evidence-based group work with adolescents targeting depression symptoms has shown its effectiveness (Ruffolo & Fischer, 2009). Given the higher risk for adolescent females, a female-only group may be warranted. Specific or common ACEs can also be determinants for group assignment to increase cohesiveness within groups and to address specific needs.

As a result of the higher rate of the comorbid condition of anxiety and depression (6.3%) over depression alone (1.5%), it is vital to address the unique needs of those who have comorbidity. From a social-ecological perspective, family and community-oriented interventions have shown promising results in treating adolescents with comorbidity (Grano et al., 2014). Family interventions can improve family system dynamics and home environments, increasing social support and resiliency for adolescents with comorbid anxiety and depression (Li et al., 2016). Service providers at community centers may encourage families to participate in these interventions to mitigate the effects of ACEs when adolescents appear to experience comorbidity of anxiety and depression. In addition, government or community-based agencies can increase access to high-quality childcare as a safeguard to the effect of negative home environments (Watamura et al., 2011).

Considering that income hardship and severe mental illness of a household member are ACEs that significantly increase the risk of mental health concerns, it is important to consider how disadvantaged groups and systemic barriers have relevance to anxiety, depression, and comorbidity among adolescents. According to the World Health Organization and Calouste Gulbenkian Foundation (2014), resilience to economic hardship and

sociopolitical barriers can be influenced by supports provided by the family system, community, and local and national services, indicating that supportive programs and systemic changes should be encouraged to increase welfare. Furthermore, support for adolescents and their families in the form of trauma-informed practices can be beneficial and restorative (Metzler et al., 2017). One way to build this resilience and support is by implementing interventions based on Advocating Student-within-Environment (ASE) in schools. ASE theory and interventions see students as active agents in their environment, which in turn affects their wellbeing (Lemberger & Hutchison, 2014). Adolescents can increase their involvement, agency, and connectedness to their environment while being an active participant and advocate in their own change. Providers incorporating ASE principles can be agents for change and social justice not only for those they work with in the present but future students as well. From a societal perspective, enacting policies that tackle systemic barriers by reducing poverty and enhancing access to affordable housing, quality childcare, early education, and medical and mental healthcare can increase positive outcomes and target the generational impact of income hardship (Metzler et al., 2017).

Considering the significance of the social-ecological systems affecting adolescent's mental health, service providers are strongly recommended to build resilience for adolescents with ACEs from a collaboration in school, family, and community and from an individual to a societal perspective. Specifically, service providers are encouraged to promote positive family processes, develop collective goals and shared work plans among community partners, and build supportive relationships across the school-family-community system (Ellis & Dietz, 2017; Oshri et al., 2015; Williams & Bryan, 2013). These approaches will help adolescents mitigate the impacts of ACEs and achieve adversarial growth with resilience.

### ***Limitations and Future directions***

Several limitations should be noted despite the significant contributions that the current investigation makes to the literature and clinical settings. Some

methodological features of the NSCH data involve concerns in the reliability and validity of the findings. The cross-sectional nature of the NSCH data collection does not warrant a causal relationship between ACEs and current conditions of anxiety and depression although the independent variables in this study (i.e., 'childhood' adversities) precedes the dependent variable being time-based. Whereas a retrospective study using a cross-sectional design has strengths, such as convenience and cost-efficiency, longitudinal studies investigating the impacts of ACEs will produce more accurate information on linkages between ACEs and outcome variables.

Another limitation is that the respondents of the survey in the current investigation are caregivers, not adolescents. Interpretation of the results should be cautious in consideration of the research design for this study. Furthermore, the use of self-report by parents or guardians of the adolescents may involve response errors. For example, the parents or guardians might have underestimated socially undesirable events of the family (e.g., domestic violence and incarceration) and potentially stigmatizable conditions of their children (e.g., anxiety and depression). Future investigations may use a multi-informant approach from both caregivers and adolescents to enhance the validity of responses and evaluate inter-rater reliability.

The use of the items about mental health conditions and the ACE inventory in this study may involve several cautions in interpretation. The items of anxiety and depression were based on caregivers' perception, instead of clinical diagnoses, which may not capture adolescents' clinical conditions rigorously. It can be resolved by asking whether the adolescent had ever been diagnosed in a professional setting or by using other measures that presented strong validity or reliability, instead of simplified items in the current study. In addition, the survey items of anxiety and depression were not comprehensive enough to incorporate biological and genetic factors. This study also excluded cases that previously ever experienced a condition of anxiety or depression but does not currently have it, when creating the subgroups of anxiety and depression. Future studies should be guided by more fully delineated portrait of

the relationship between ACEs and adolescents' anxiety and depression by considering biological factors, medical history of the mental health conditions, current conditions, and recovery with protective factors of mental health disorders.

Furthermore, the ACE items were all binary with only 'yes' or 'no' response options, which fails to take the duration, intensity, frequency, and individualized significance of each adverse event into account. Future work can be improved by investigating the independent and cumulative effects of ACEs with polytomous items. Moreover, the ACE inventory did not follow the list of ACEs that used in the conventional ACE study by Felitti et al. (1998), for example, omitting emotional abuse/neglect and sexual abuse. The ACEs inventory also did not include adverse events in peer relationships, such as peer victimization. It is recommended that the findings of this study should be carefully interpreted with the limitations above. Lastly, given the results in this study that sociodemographic characteristics were closely related to anxiety and depression among adolescents, more attention is needed about the role of the social determinants and multicultural contexts of an individual in the relationship between ACEs and suboptimal mental health conditions later.

## **Conclusion**

Despite the limitations mentioned above, the current study provides a better understanding of the impacts of ACEs on adolescents' anxiety and depression by examining comorbidity of them with independent and cumulative effects of ACEs alike. This study highlights the significance of addressing the comorbid conditions of anxiety and depression associated with multiple childhood adversities and sociodemographic characteristics among adolescents. Therefore, by recognizing the prevalence and interrelations of ACEs and adolescent anxiety and depression with consideration of sociodemographic features, counselors and helping professionals can develop culturally appropriate interventions that target adolescent anxiety and depression among those who have experienced ACEs.

## Credit authorship contribution statement

**Isak Kim:** Methodology, Software, Formal analysis, Data curation, Writing - original draft, Writing - review & editing. **Ange´lica Galva´n:** Writing - original draft, Writing - review & editing. **Nayoung Kim:** Writing - original draft, Writing - review & editing.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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