Associations between adverse childhood experiences and adverse health outcomes among adolescents in Bangkok, Thailand

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Abstract: The association of adverse childhood experiences (ACEs) on health outcomes has garnered attention as a public health concern. The present study aimed to examine the prevalence and associations between ACEs and adverse health outcomes among adolescents. In 2017, a cross-sectional study was conducted to identify the retrospective prevalence of ACEs and their association with adverse health conditions. A total of 2,058 adolescents completed the on-line questionnaire. Exposures included psychological, physical, and sexual forms of abuse, neglect and violence as well as household dysfunction. Main outcome measures included sexual behavior, drinking, illegal drug use, smoking, depression, and anxiety. Multiple logistic regression assessed the independent relationship between individual ACEs, ACE score categories, and adverse health conditions in adolescents, while controlling for covariates. A total of 51.4% of respondents reported at least one ACE and 12.2% reported three or more ACEs. A score of >3 ACEs was associated with increased odds of experiencing high anxiety (AOR = 3.91, 95%CI = 2.92,5.25), high depression (AOR = 4.02, 95%CI = 3.00,5.38), sexual experience (AOR = 3.12, 95% CI = 2.23,4.37), binge drinking (AOR = 3.32, 95%CI = 1.74,3.08), smoking (AOR = 3.14, 95%CI = 2.31,4.28), and illegal drug use (AOR = 2.59, 95%CI = 1.80,3.67). The study

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PUBLIC INTEREST STATEMENT
Childhood adversity has significant long term on physical, mental health and behavior outcome. Research indicates that ACEs can threaten an adolescent development and well being, and contribute to issues including addiction and delinquency. In addition to other negative mental and physical health problem that occurs later in life. ACEs are traumatic events that include abuse, neglect, household dysfunction, and exposure violence. It is an important time for laying the foundations for good health in adolescents. In a previous study, several Thai adolescents reported mental health problems and risky behavior related to anxiety and depression sex experience and substance use. Therefore, this article explores the roles of ACEs related to six types of adverse health outcome (anxiety, depression, sex experience, drinking, smoking, illicit drug use) among adolescents in vocational school, Bangkok Thailand. Understanding ACEs contribute to poor outcome, screening, and assessment on ACEs are needed.
found a link between exposure to multiple ACEs and anxiety, depression, alcohol use, tobacco use, and illicit drug use. In addition, the individual ACEs had different effects on adverse health conditions. Finally, the individual ACEs had different effects on adverse health outcome. In addition to having a cumulative effect, individual ACE components have differential effects on adverse health outcome, after controlling for important confounders.

**Subjects:** Social Sciences; Behavioral Sciences; Health Psychology; Social Psychology; Social Sciences; Sociology & Social Policy

**Keywords:** adverse childhood experience; anxiety; depression; sexual experience; substance use; vocational student

### 1. Introduction

Research increasingly shows that adverse childhood experiences (ACEs) are linked to poor health across the life cycle. Specifically, having a greater number of ACEs has been associated with increased risk of many physical, mental, sexual, and behavioral health problems. Previous research studies have found that, if a person begins regular alcohol consumption below the age of 18 years, there is a significantly greater risk of brain degradation from the effects of alcohol than if drinking started at a later age (Waller et al., 2019). That is only one example of how adolescent behavior can have life-long health consequences. The prior study found that ACEs are associated with higher odds of risky behavior, morbidity, and disability in adulthood. As exposure to ACEs increases, the odds of current smoking, HIV risk behavior, depression, and disability caused by poor health increase significantly. In addition to having a cumulative effect, individual ACE components have a differential relationship with risky behaviors and comorbid conditions in adulthood (Brown et al., 2009). Moreover, associations have also been found between the number of ACEs and increased risk for disease conditions in adulthood, such as cancer, heart disease, stroke, obesity, diabetes, and chronic obstructive pulmonary disease (Campbell et al., 2016).

The ACEs model has more recently been applied to the general adolescent population. Studies on ACEs include stressful and potentially traumatic events associated with a higher risk of long-term behavioral problems and chronic illnesses among adolescents. A sample of adolescents age 10 to 14 years from low-income communities in 14 cities of the world from the Global Early Adolescence Study, found high rates of ACEs exposure experienced by young adolescents in resource-poor neighborhoods in low- and middle-income countries and a disproportionate exposure of boys and strong associations between ACEs and both depressive symptoms and violence perpetration (Blum et al., 2019). A study from the Fragile Families and Child WellBeing Study, a national urban birth cohort found that exposure to ACEs is strongly associated with externalizing and internalizing behaviors and likelihood of ADHD diagnosis in middle childhood (Hunt et al., 2017). Tsehay's study among secondary school students of Ethiopia provides evidence of the association between ACEs and adolescent prevalence and severity of depression (Tsehay et al., 2020). A study of Vietnamese adolescents in secondary school and high school students found that ACEs are common in Vietnamese adolescents; the nature of ACEs and the overlap among them vary widely across the population, and ACEs are strongly associated with depression, psychological distress, and suicidal thoughts (Thai et al., 2020). ACEs are strongly related to ever drinking alcohol and to alcohol initiation in US early- and mid-adolescence, and the ACEs score had a graded or “dose-response” relationship to these alcohol use behaviors (Dube et al., 2006). More than 90% of the youth had experienced an ACE by age 14 years. There was a graded relationship between ACEs and any health problem, while 2 and 3 or more ACEs were associated with somatic concerns. Recent adversity appeared to uniquely predict poor health, somatic concerns, and any health problem. Flaherty et al. (2013) in adolescents of a Brazilian birth cohort; the most common ACE was parental separation (42%), followed by emotional neglect (19.7%) and domestic violence (10.3%). Approximately 85% of the adolescents experienced at least one ACE, and females reported a higher number of ACEs. Several socioeconomic,
demographic, and family-related characteristics were associated with the occurrence of ACEs, e.g., non-white skin color, low family income, low maternal schooling, absence of mother’s partner, maternal smoking, and poor maternal mental health (Soares et al., 2016). The chronic ACEs group had increased self-reported health concerns and use of medical care at age 18, but not poorer self-rated health status. The early ACEs-only group did not significantly differ from those with limited ACEs on outcomes. In addition to other negative outcomes, chronic ACEs appear to affect physical health in emerging adulthood (Thompson et al., 2015).

School dropout and health-risk behavior such as substance use and mental problem represent major problems among students attending upper secondary vocational education. In Thailand, Students leaving school without a basic qualification has been a problem over the past few decades. early school leaving occurs in all types of education, but most frequently in vocational education, especially in the secondary years and during school transitions. School drop-out rate is 10 times higher in vocational training education compared to basic education system (UNICEF, 2017, 2019). Health-risk behavior in vocational students is frequent and dropping out of school due to abuse and other factors is a serious concern. Research shows that adverse childhood experience is one of the root cause of health-risk behavior among adolescent (Carlson et al., 2019) for Thai students also. Unfortunately, little is known about whether the patterns of risk behaviors vary by ACEs factors because previous studies in Thailand tended to concentrate on one risk behavior or pairwise associations between behaviors such as smoking, drinking, and drug use. From an epidemiological perspective, knowledge about patterns of health-risk behavior among vocational student may further our understanding of the risk factors leading to adverse health outcomes and also provide effective information for developing more comprehensive intervention programs.

Recently, a study among juvenile offenders from the Florida Department of Juvenile Justice (FDJJ), found an overwhelming majority (96–97%) had experienced at least one ACE, and 40% had experienced four or more ACEs. ACEs were also found to be highly interrelated, with 67% of those youth exposed to one ACE also being exposed to four or more ACEs (Baglivio, et al., 2015). Among a high-risk sample of early adolescents in foster care due to maltreatment, ACEs scores were predictive of risk behaviors after controlling for age, sex, and minority status. Although males and older youth were more likely to engage in risk behaviors, none of the demographic characteristics moderated the ACE-risk behavior association, thus demonstrating an association between ACEs and risk behaviors in extremely vulnerable early adolescents (Garrido et al., 2018). A study examined the relationship between ACEs and substance use in a sample of minority Chicago youth, and found that higher ACEs scores were associated with increased substance use (tobacco, alcohol, and marijuana use), worse mental health, and overall health in adulthood (Mersky et al., 2013). A study on children and adolescents living in Chicago from age cohorts (i.e., 0, 3, 6, 9, 12, 15, and 18), found ACEs may be uniquely associated with delinquency for boys and substance use for girls. Gender differences in criminological risk factors reveal potential intervening mechanisms in these relationships (Leban & Gibson, 2020). The Longitudinal Studies on Child Abuse and Neglect (LONGSCAN), using a sample of high-risk youth, to examine race differences in the relationship between ACEs and delinquent outcomes found that Black youth reporting more ACEs were at higher risk for arrest and for using alcohol and marijuana (Fagan & Novak, 2018).

A substantial body of research shows the relationships between ACEs and long-term health consequences, mostly conducted in the U.S. and Europe, and demonstrates substantial associations between ACEs and poor health and life outcomes. Several studies have also found a dose-response relationship between ACEs and increased risk of negative physical and behavioral health outcomes among adults in high-income countries, including an increased risk of tobacco, alcohol, and drug abuse. Fewer studies have examined the health impacts of ACEs in LMICs. However, the prevalence of ACEs has been found to be higher in certain global contexts, such as 75% of respondents reporting at least one ACE in a study in a developing country setting (Ramiro et al., 2010) compared with about 64% of respondents in the United States. Nonetheless, studies in LMICs in Africa, Asia, and Latin America have generally found similar relationships between ACEs and poor health outcomes. Studies
have examined the prevalence and implications of ACEs in low- and middle-income countries. Malawi adolescents who had >4 ACEs were more likely to report depression, post-traumatic stress disorder, worse self-rated health, and a higher expected likelihood of dying in the next 5 years compared with those with lower scores. However, the number of ACEs did not demonstrate a graded relationship with obesity, stunting, or grip strength (Kidman et al., 2020). It is essential to examine the patterns of ACEs in different countries as well as cultures, as the occurrence and co-occurrence of ACEs varies widely (Bellis et al., 2014), which in turn may influence the type of adverse outcomes. Studies suggest that physical abuse may be higher in Asian populations due to strict parenting styles where disciplinary action involving the use of physical punishment remains common for educational purposes, despite some moderation over time (Ji et al., 2013). ACEs are not uncommon and there is a need for further research in this area to examine the trends in ACEs in the younger adult segment as well as the impact of cultural and generational influence on ACEs in the local context given their significant association with mental (Subramaniam et al., 2020) and physical conditions. Thus, there is a general consensus in the international literature and development programs that ACEs are a major threat to a country’s development, and require accurate data on the patterns and levels of ACEs in the population and contexts.

The association between ACEs and increased adverse health outcomes across life course is increasingly becoming recognized as a public health concern (Biglan et al., 2017; Dube, 2018). Despite the extensive evidence linking ACEs to adverse health outcomes, there are still gaps in the literature. For example, there is a lack of research on ACEs in vocational student populations in Thailand; studies have been limited to mostly descriptive design with small convenience samples. Most ACEs studies were done in high-income countries, and the majority of published studies regarding the association between ACEs and adverse health outcomes are in adults. The few studies examining gender differences suggest that males and female are differentially exposed to ACEs (Bellis et al., 2014) and the consequences of exposure to ACEs vary by gender (Duke et al., 2010). Studies suggest that ACEs may operate through different pathways for boys and girls; boys and men are more likely to respond to adverse, stressful, or traumatic experiences with externalizing behaviors, such as anger or aggression, while girls and women are more likely to respond to strain in an internalizing manner, such as feelings of depression (Leban & Gibson, 2020). Thus, this study was conceived to add to the body of knowledge on the effect of ACEs on adolescents by using a proxy population of Year 2 vocational school students in Bangkok, which looked at adverse manifestations such as abnormal anxiety, depression, early age of sexual debut, and alcohol/tobacco/drug consumption.

This study examined the prevalence of ACE exposure among adolescents using the BBSS 2017 data, and analyzed proximal associations between cumulative ACEs score, mental health, and risky behavior among adolescents. First, we hypothesized that individual ACE components, mental health, and risky behavior vary by sex. Second, compared to adolescents without a history of ACEs, we hypothesized that adolescents exposed to ACEs are at increased risk of adverse health outcomes. Third, we hypothesized that there is a relationship between ACEs and adolescent adverse health outcome.

2. Methodology

2.1. Sample design and procedures
The current study represents secondary data analysis of the Bangkok Behavioral Surveillance Survey (BBSS). The BBSS is a very large, representative database collected by Mahidal University in collaboration with the AIDS, TB and STIs Control Division of the Bangkok Metropolitan Administration (BMA). The BBSS included a sample of adolescents to assess physical and mental health, sexual behavior, healthcare access, and substance use. A school-based, cross-sectional, web-based self-administered study design was used to identify the associations of adverse health outcomes (AHOs) and ACEs among 2,058 Year 2 students, age 15–18 years, from 12 vocational schools using a stratified, random school selection procedure. On average, the students needed 40 minutes to complete the whole survey. Students were assured of the confidentiality and anonymity of their answers.
2.2. Measures of variables

2.2.1. Adverse childhood experiences (ACEs)
The ACE module is an 11-item survey where respondents are asked if they experienced a variety of adverse events during their childhood. ACEs were dichotomized and categorized to closely match previous ACE studies (e.g., Felitti et al., 1998). Specifically, abuse includes (1) emotional abuse, (2) physical abuse, and (3) sexual abuse; neglect includes (4) emotional neglect and (5) physical neglect; household dysfunction includes (6) parental separation or divorce, (7) living with a household member with alcohol abuse and/or illicit drug use, (8) household member incarceration (9) household member with depression, mental illness, and/or suicidality; Violence includes (10) witnessing family violence and (11) a previous history of bullying/victim.

For the analysis of ACE scores, counts were created for each question to which respondents answered that they had experienced the event. A score was generated for the occurrence of ACEs where each affirmative answer was worth one point, yielding a total range of summed response from zero to eleven. ACE scores were then categorized as 0, 1–3, and 4 or more ACEs. For the analysis investigating the influence of specific types of adverse events, questions were categorized by physical abuse, sexual abuse, verbal abuse, mental illness in the home, substance abuse in the home, separation/divorce in the home, violence among adults in the home, and history of incarceration of member(s) in the home.

2.2.2. Anxiety and depression
The Hopkins Symptom Checklist-25 (HSCL-25) is a symptom inventory that measures symptoms of anxiety and depression. It consists of 25 items: Part I of the HSCL-25 has 10 items for anxiety symptoms; Part II has 15 items for depression symptoms (Glaesmer et al., 2014). The scale for each question includes four categories of response (“Not at all,” “A little,” “Quite a bit,” “Extremely,” rated 1 to 4, respectively). Two scores are calculated: the total score is the average of all 25 items, while the depression score is the average of the 15 depression items. (Cronbach’s $\alpha = .92$, Anxiety; Mean = 1.73, SD = 0.65, range = 1–4; Depression Mean = 1.69, SD = 0.65, range = 1–4). Validity coefficients of the HSCL-25 were calculated for two different thresholds: $\geq 1.55$ and $\geq 1.75$, respectively. When $\geq 1.75$ was chosen as a cutoff point, the validity coefficients obtained by the HSCL-25 in this study were comparable to those obtained in other studies.

2.2.3. Sexual experience
A dichotomous sexual intercourse experience variable was created where 1 indicates that the adolescent had ever had sex, and 0 indicates no history of sex.

2.2.4. Illicit drug use
Information pertaining to the age of drug initiation, severity of drug use, and type of drug used was collected. Specifically, illicit drugs include cannabis, heroin, methamphetamine, Ecstasy, ketamine, and crystal methamphetamine. Drug use severity was measured based on use in the past 12 months: 0 = no illicit drug use, 1 = used illicit drugs.

2.2.5 Alcohol and tobacco use
The use of alcohol and tobacco was assessed by the following questions: “Did you smoke cigarettes in the last 3 months? (yes/no)” and “Did you drink alcohol in the last 3 months? (yes/no)”. If the adolescents had smoked or had drunk alcohol at least once within the prior 3 months, they were considered as a user of tobacco or alcohol, respectively.

2.2.6. Adverse health outcome (AHOs)
Cumulative exposure to an AHO was measured using the AHO score which counts each exposure (anxiety, depression, sex, consuming alcohol/cigarettes/illegal drugs) as one point without taking into account the frequency or severity of any given AHO during a person’s lifetime. A cumulative
AHO score was summed from the six categories of AHOs (1 = yes, 0 = no) to derive a score from 0 to 6. Scores were grouped into 0, 1–2, and >2.

2.2.7. Socio-demographics
Socio-demographic variables were also measured. A checklist was used to measure relationships within the home. Respondents were coded as living with parents, step-family, single parent, or other. Gender, parent education, and household income were collected from all surveyed individuals. Sex was dichotomized. Gender was categorized as male-female and other, a person’s gender does not always align with what has been assigned at birth. Education was categorized as primary school, secondary school, vocational school, and college graduate. Family income per month (baht) was categorized as <20,000; 20,000–35,000; 35,001–50,000, and >50,000. Socio-economic status (SES) was measured using the combined family income and father’s and mother's educational attainment. Responses were summed to form an SES score. The scale can be used as an indicator of absolute and relative socioeconomic position in society. For the purposes of this study, the relative SES scores range from 3 to 12. Scores were grouped into 3–5 (low SES), 6–9 (medium SES) and >9 (high SES).

2.3. Analysis strategy
Comparisons were carried out using the Chi-square test as appropriate. P-values of less than 0.05 were considered statistically significant. Descriptive analyses were conducted to examine the prevalence of ACE exposure, anxiety, and depression among Year 2 vocational students by gender. To examine broad categories of exposure, ACEs were combined into abuse (yes/no), neglect (yes/no), household violence (yes/no), and household dysfunction (yes/no). To examine exposure to multiple ACEs, a cumulative ACE score was summed from the 11 categories of ACEs (1 = yes, 0 = no) to derive a score from 0 to 11. Scores were grouped into 0, 1–3 and >3. Logistic regression models were employed to assess the relationship between ACE scores, the other covariates, and six outcomes reflecting substance use, mental health, or sexual behaviors. The six outcomes required respondents to have received a self-report in order to be considered present, including lifetime sexual experience, alcohol and tobacco use the past 3 months, illicit drug use in the past 12 months, depression, and anxiety. Adjusted odds ratios (AOR) and 95% confidence intervals (CI) were obtained from the multivariate models using SPSS version 22.

2.4. Ethics
The study protocol was approved by the Mahidol University Review Board. Informed consent was obtained from all participants. (Certificate of approval No: 2016/436.2311).

3. Results
Table 1 presents the percent distribution and statistical associations between the demographic variables and SES by sex. This study found that, overall, about two-thirds of the sample lived in a dwelling with one or both parents, siblings, or other relatives, while one-third lived in a dormitory. For most (72%) the family income was less than 35,000 baht per month. About one-fourth of both the father and mother of the respondent had completed bachelor’s degree education. There were statistically different gender differences for the socio-demographic variables, with the exception of the experience of having a boy/girlfriend.

Table 2 presents experience of 11 ACEs by sex. Nearly all the ACE factors were significantly different by sex (with the exception of emotional neglect). In general, the male vocational students suffered more physical, emotional, and sexual abuse. There was also more violence in the male student’s household, including having a household member who was an ex-convict or mentally ill. By contrast, female vocational students had more experience with parents’ marital dissolution and living in a household with alcoholism or other drug addiction.

Table 3 presents the report of AHO by sex. Overall, male vocational students had more AHO and risk behaviors than their female counterparts, and these differences were statistically significant. Accordingly, the overall AHO score was significantly higher for males than females.
Table 1. General characteristics by sex

| Socio demographic factors | Total (n = 2,058) | Male (n = 1,013) | Female (n = 1,045) | p-value* |
|---------------------------|------------------|------------------|--------------------|----------|
|                           | n                | (%)              | n                  | (%)      | n                  | (%)      |       |
| Gender                    |                  |                  |                    |          |                    |          |       |
| Male                      | 952 (94.0)       | 8 (0.8)          | <0.01              |          |                    |          |       |
| Female                    | 24 (2.4)         | 957 (91.6)       |                    |          |                    |          |       |
| Other                     | 37 (3.7)         | 80 (7.7)         |                    |          |                    |          |       |
| Current Resident          |                  |                  |                    |          |                    |          |       |
| Family house (with parents or relative) | 1,364 (66.3) | 707 (69.8) | 657 (62.9) | <0.01 |
| Rent/Dormitory            | 694 (33.7)       | 306 (30.2)       | 388 (37.1)         |          |                    |          |       |
| Have a boy/girl friend    |                  |                  |                    |          |                    |          |       |
| No                        | 928 (45.1)       | 447 (47.1)       | 451 (43.2)         | 0.076    |
| Yes                       | 1,130 (54.9)     | 536 (52.9)       | 594 (56.8)         |          |                    |          |       |
| Family income per month (Thai baht) |          |                  |                    |          |                    |          |       |
| < 20,000                  | 851 (41.4)       | 417 (41.2)       | 434 (41.5)         | <0.01    |
| 20,000–35,000             | 636 (30.9)       | 253 (25.0)       | 383 (36.7)         |          |                    |          |       |
| 35,001–50,000             | 263 (12.8)       | 119 (11.7)       | 144 (13.8)         |          |                    |          |       |
| >50,000                   | 308 (15.0)       | 224 (22.1)       | 84 (8.0)           |          |                    |          |       |
| Father’s education        |                  |                  |                    |          |                    |          |       |
| Primary school            | 535 (26.0)       | 214 (21.1)       | 321 (30.7)         | <0.01    |
| Secondary school          | 588 (28.6)       | 241 (23.8)       | 347 (33.2)         |          |                    |          |       |
| Vocational school         | 465 (22.6)       | 242 (23.9)       | 223 (21.3)         |          |                    |          |       |
| Bachelor’s degree         | 470 (22.8)       | 316 (31.2)       | 154 (14.7)         |          |                    |          |       |
| Mother’s education        |                  |                  |                    |          |                    |          |       |
| Primary school            | 518 (25.2)       | 218 (21.5)       | 300 (28.7)         | <0.01    |
| Secondary school          | 630 (30.6)       | 247 (24.4)       | 383 (36.7)         |          |                    |          |       |

(Continued)
Table 1. (Continued)

| Socio demographic factors | Total (n = 2,058) | Male (n = 1,013) | Female (n = 1,045) | p-value* |
|---------------------------|------------------|------------------|-------------------|----------|
|                           | n    | (%)  | n    | (%)  | n    | (%)  |       |
| Vocational school         | 470  | (22.8) | 261  | (25.8) | 209  | (20.0) |       |
| Bachelor's degree         | 440  | (21.4) | 287  | (28.3) | 153  | (14.6) |       |
| Socio-economic status     |      |       |      |       |      |       |       |
| High                      | 274  | (13.3) | 194  | (19.2) | 80   | (7.7)  | <0.01 |
| Moderate                  | 452  | (22.0) | 228  | (22.5) | 224  | (22.0) |       |
| Low                       | 1,332| (64.7) | 591  | (58.3) | 741  | (70.9) |       |
| Current GPA               |      |       |      |       |      |       |       |
| ≤ 2.50                    | 575  | (38.3) | 358  | (46.1) | 217  | (29.9) | <0.01 |
| 2.51–3.00                 | 512  | (34.1) | 274  | (35.3) | 238  | (32.8) |       |
| > 3.00                    | 415  | (27.6) | 144  | (18.6) | 271  | (37.3) |       |

*Chi-squared heterogeneity test.
| Adverse Childhood Experience factors | Total (n = 2,058) | Male (n = 1,013) | Female (n = 1,045) | p-value* |
|--------------------------------------|------------------|------------------|--------------------|----------|
|                                      | n | (%) | n | (%) | n | (%) |
| Emotional Abuse                      |   |      |   |      |   |      |
| Yes                                  | 380 | (18.5) | 206 | (20.3) | 174 | (16.7) | 0.035 |
| No                                   | 1,678 | (81.5) | 807 | (79.7) | 871 | (83.3) |
| Physical Abuse                       |   |      |   |      |   |      |
| Yes                                  | 197 | (9.6) | 122 | (12.0) | 75 | (7.2) | <0.01 |
| No                                   | 1,861 | (90.4) | 891 | (88.0) | 970 | (92.8) |
| Sexual Abuse                         |   |      |   |      |   |      |
| Yes                                  | 255 | (12.4) | 159 | (15.7) | 96 | (9.2) | <0.01 |
| No                                   | 1,803 | (87.6) | 854 | (84.3) | 949 | (90.8) |
| Emotional Neglect                    |   |      |   |      |   |      |
| Yes                                  | 319 | (15.5) | 150 | (14.8) | 169 | (16.2) | 0.395 |
| No                                   | 1,739 | (84.5) | 863 | (85.2) | 876 | (83.8) |
| Physical Neglect                     |   |      |   |      |   |      |
| Yes                                  | 195 | (9.5) | 127 | (12.5) | 68 | (6.5) | <0.01 |
| No                                   | 1,863 | (90.5) | 886 | (87.5) | 977 | (93.5) |
| Parental Separation/ Divorce         |   |      |   |      |   |      |
| Yes                                  | 534 | (25.9) | 237 | (23.4) | 297 | (28.4) | <0.01 |
| No                                   | 1,524 | (74.1) | 776 | (76.6) | 748 | (71.6) |
| Bully/Victim                         |   |      |   |      |   |      |
| Yes                                  | 197 | (9.6) | 126 | (12.3) | 72 | (6.9) | <0.01 |
| No                                   | 1,861 | (90.4) | 888 | (87.7) | 973 | (93.1) |

(Continued)
| Adverse Childhood Experience factors | Total (n = 2,058) | Male (n = 1,013) | Female (n = 1,045) | p-value* |
|-------------------------------------|------------------|------------------|-------------------|---------|
|                                     | n    | (%)   | n    | (%)   | n    | (%)   |       |
| Yes                                 | 354  | (17.2)| 194  | (19.2)| 160  | (15.3)| 0.023 |
| No                                  | 1,704| (82.8)| 819  | (80.8)| 885  | (84.7)|       |
| Household Alcohol/Drug abuse        |      |       |      |       |      |       |       |
| Yes                                 | 470  | (22.8)| 258  | (5.0) | 212  | (20.3)| <0.01 |
| No                                  | 1,588| (77.2)| 755  | (74.5)| 833  | (79.7)|       |
| Household Mental Illness            |      |       |      |       |      |       |       |
| Yes                                 | 211  | (10.3)| 128  | (12.7)| 83   | (7.9) | <0.01 |
| No                                  | 1,847| (89.7)| 885  | (87.4)| 962  | (92.1)|       |
| Household member in prison          |      |       |      |       |      |       |       |
| Yes                                 | 319  | (15.5)| 171  | (16.9)| 148  | (14.2)| 0.100 |
| No                                  | 1,739| (84.5)| 842  | (83.1)| 897  | (85.8)|       |
| Cumulative ACEs                     |      |       |      |       |      |       |       |
| No ACEs                             | 1,001| (48.6)| 508  | (50.1)| 493  | (47.2)| <0.01 |
| 1–3                                 | 707  | (34.4)| 301  | (29.7)| 406  | (38.9)|       |
| 4–11                                | 350  | (17.0)| 204  | (20.1)| 146  | (14.0)|       |

*pChi-squared heterogeneity test.*
Table 3. Adverse health outcome by sex

| Adverse Health Outcome | Total | Male | p-value | Female | p-value |
|------------------------|-------|------|---------|--------|---------|
|                        | n     | (%)  | n       | (%)    | (%)     | n       | (%)    |
| Depression             |       |      |         |        |         |
| Low (≤1.75)            | 1,273 | (61.9)| 625     | (61.7) | 648     | (62.0) |
| High (>1.75)           | 785   | (38.1)| 388     | (38.3) | 397     | (38.0) |
| Anxiety                |       |      |         |        |         |
| Low (≤1.75)            | 1,217 | (59.1)| 606     | (59.8) | 611     | (58.5) |
| High (>1.75)           | 841   | (40.9)| 407     | (40.2) | 434     | (41.5) |
| Sexual experience in lifetime | |    |         |        |         |
| Yes                    | 830   | (40.3)| 472     | (46.6) | 358     | (34.3) |
| No                     | 1,228 | (59.7)| 541     | (53.4) | 687     | (65.7) |
| Alcohol use (past 3 months) | |    |         |        |         |
| Yes                    | 637   | (31.0)| 391     | (38.6) | 246     | (23.5) |
| No                     | 1,421 | (69.0)| 622     | (61.4) | 799     | (76.5) |
| Tobacco use (past 3 months) | |    |         |        |         |
| Yes                    | 414   | (20.1)| 327     | (32.3) | 87      | (8.3)  |
| No                     | 1,644 | (79.9)| 686     | (67.7) | 958     | (91.7) |
| Illicit drug consumption (past 12 months) | |    |         |        |         |
| Yes                    | 296   | (14.6)| 231     | (22.8) | 65      | (6.2)  |
| No                     | 1,762 | (85.4)| 782     | (77.2) | 980     | (93.8) |
| Overall Adverse Health Outcome | |    |         |        |         |
| 0-2 scores             | 1,289 | (62.6)| 541     | (53.4) | 748     | (71.6) |
| 3-6 scores             | 769   | (37.4)| 472     | (46.6) | 297     | (28.4) |

*Chi-squared heterogeneity test.

Remark: Adverse Health Outcome score = 0–6 (high depression = 1, high anxiety = 1, have had sex = 1, drink alcohol = 1, smoking = 1 and use illicit drug = 1).
Table 4 presents the adjusted odds ratios (AOR) for the relationships between ACE components and adverse outcome (mental health, and risky behavior) of the sample. In general, the individual ACEs had differential relationships with mental health, and risky behavior outcomes. Specifically, increased odds for experiencing anxiety was associated with the emotional, physical, and/or sexual abuse (AOR = 1.47, 95% CI = 1.13, 1.91), emotional and/or physical neglect (AOR = 1.39, 95% CI = 1.04, 1.86), experience of violence (AOR = 1.43, 95% CI = 1.16, 1.76) and household dysfunction (AOR = 1.56, 95% CI = 1.19, 2.05). Increased odds for experiencing depression was associated with emotional, physical, and/or sexual abuse (AOR = 1.80, 95% CI = 1.39, 2.34), emotional and/or physical neglect (AOR = 1.67, 95% CI = 1.25, 2.23), experience of violence (AOR = 1.37, 95% CI = 1.11, 1.69) and household dysfunction (AOR = 1.33, 95% CI = 1.01, 1.74). Increased odds for sex experiencing was associated with emotional, physical, and/or sexual abuse (AOR = 1.50, 95% CI = 1.15, 1.94), and experience of violence (AOR = 1.31, 95% CI = 1.01, 1.72). Increased odds for drinking was associated with emotional, physical, and/or sexual abuse (AOR = 1.60, 95% CI = 1.23, 2.09). Increased odds for smoking was associated with the emotional, physical, and/or sexual abuse (AOR = 1.54, 95% CI = 1.15, 2.06). Increased odds for illicit drug use was associated with experience of violence (AOR = 1.58, 95% CI = 1.12, 2.34).

A score of >3 ACEs was associated with increased odds of experiencing high anxiety (AOR = 3.91, 95%CI = 2.92,5.25), high depression (AOR = 4.02, 95%CI = 3.00,5.38), sexual experience (AOR = 3.12, 95%CI = 2.23,4.37), drinking (AOR = 3.32, 95%CI = 1.74,3.08), smoking (AOR = 3.14, 95%CI = 2.31,4.28) and illegal drug use (AOR = 2.59, 95%CI = 1.80,3.67).

A score of 1–3 ACEs was associated with increased odds of experiencing anxiety (AOR = 1.97, 95%CI = 1.62,2.40), depression (AOR = 2.32, 95%CI = 1.83,2.73), drinking (AOR = 1.56, 95%CI = 1.27,1.91), smoking (AOR = 1.38, 95%CI = 1.08,1.75) and illegal drug use (AOR = 1.42, 95%CI = 1.06,1.87).

4. Discussion
This study found that most (85.7%) of the vocational students had adverse health outcomes or risk behavior. Males had more adverse health outcomes and risky behavior than their female counterparts. Individual ACEs were significantly different by sex. Having had one or more ACEs is a reliable predictor of AHOs later on. The present findings further showed that prevalence rates for most health-risk behaviors among vocational high school students were higher than among general high school students. Previous studies in Bangkok, Thailand consistently revealed higher smoking rates for vocational school students. It is possible to speculate that school characteristics may affect not only the prevalence of smoking but other health-risk behaviors.

4.1. Gender differences in exposure to ACEs and AHOs
Our first aim was to examine gender differences in the number and types of exposures to ACEs for vocational students, given the results from studies that have reported more female experience of ACEs than males (Baglivo et al., 2015; Felitti et al., 1998). Our study found that significantly more males experienced abuse than females, which is consistent with other studies (Leban & Gibson, 2020; Teague et al., 2008). This study also found a significant gender difference in the cumulative number of ACEs experienced. This is in contrast to some studies that have reported more male experience of ACEs than females (Leban & Gibson, 2020). Perhaps these divergent findings are, in part, due to how ACEs are operationalized across studies, as well as the number and types of ACEs measured. These are important differences between our study and others, especially since childhood sexual abuse tends to be more common among females than males, a finding that has been found in previous studies (Bellis et al., 2014). This is due to reluctance in males to report abuse, especially since males tend to be the aggressor. Hence, when the perpetrator is male, the same-sex element of the abuse carries significant meaning for males. It is possible that women are sexually abused more often than males, as perpetrators are more likely to be males. Research demonstrated that sexual abusers are overwhelmingly male, and the majority of victims are female. Our study also found that experiencing ACEs increased the likelihood of frequent
marijuana, tobacco, and alcohol use among males and female adolescents, with the odds of using each substance slightly higher among males (Mersky et al., 2013).

4.2. Relationship between ACEs and AHOs
The research presents evidence for the cross-sectional association and subsequent effects of childhood adversity on negative outcomes among adolescents. The results show that ACEs are associated with higher odds of anxiety, depression, sex experience, and substance use in adolescents after controlling for important demographic and socioeconomic factors. The results support the hypothesis of a dose–response effect of increased history of ACEs on the presence of AHOs in adolescents. As observed in studies elsewhere in the world, most respondents reported experiencing at least one ACE and, as ACEs increase, the odds of risky behavior, morbidity, and disability increase. In the United States, approximately 15.5 million children are exposed to domestic violence annually; over 3 million allegations of abuse or neglect are reported to child protective services each year, and more than 1 in 5 children live in poverty (Carlson et al., 2019). It is well established that adolescents who have a history of exposure to adverse experiences tend to engage in higher rates of problem behaviors—including smoking, delinquent behavior, perpetration of interpersonal and violence—relative to their unexposed and less-exposed peers. Individuals who have ACEs tend to have more physical and mental health problems as adults than do those who do not have ACEs and, ultimately, greater premature mortality (Anda et al., 2010; Ford et al., 2011). Physiological and bimolecular studies are increasingly establishing how childhood exposure to chronic stress leads to changes in development of nervous, endocrine, and immune system deficiencies, resulting in impaired cognitive, social, and emotional functioning, and increased allostatic load (i.e., chronic physiological damage) Thus, individuals who have ACEs can be more susceptible to disease development through both differences in physiological development and adoption and persistence of health-damaging behaviors. However, mechanisms that underlie this pathway are not well understood (Clarkson Freeman, 2014).

4.3. ACEs prevalence among adolescents
Our study found extremely high rates of ACE exposure in this sample of adolescents. More than half the sample reported exposure to at least one ACE (51.4%), and 17.0% reported at least four. This adjusted prevalence of ACE exposure is similar to findings from more developed countries such as the US adult population (52%–68%) and a US pediatric sample (67.2%), but lower compared to less developed countries such as the Philippines (75.0%). There are detrimental health outcomes and risk behaviors associated with ACEs (Hughes et al., 2017). A meta-analysis found that the proportion of participants having at least one ACE is within the range reported in the literature (i.e., 46.4% to 79.5%) (Hughes et al., 2017). The World Mental Health Surveys across 21 countries found little variation in ACE prevalence between country income groups, with 38–39% of participants reporting at least one ACE, and the prevalence of at least four ACEs being 2–3% (Kessler et al., 2010). These levels are similar to those measured by studies in that meta-analysis, with 34.4% of participants across all studies reporting 1–3 ACEs, and 17.0% reporting at least four. A systematic review and meta-analysis conducted by Jewkes et al found that 57% of participants across all studies reported at least one ACE, and 13% reported at least four (Jewkes et al., 2010).

4.4. ACEs and the impact on adolescent substance use
History of ACEs was found to be associated with increased risk of substance use disorder in adolescents. More importantly, this study shows that, in addition to having a cumulative effect, broad categories of ACEs have a differential relationship with risky substance use in adolescent after controlling for important confounders. For example, history of emotional, physical, and/or sexual abuse showed a significant independent effect on drinking and smoking in adolescence. Only experience of violence had an independent effect on illicit drug use. This was partly consistent with other studies which showed that exposure to abuse and household dysfunction were associated with increased risks of drug initiation in adolescence, lifetime illicit drug use, and intravenous drug use (Dube et al., 2003; Felitti et al., 1998; Gomez et al., 2018; Ramiro et al., 2010; Tonmyr et al., 2010). Notably, our findings are consistent with a study which found that
### Table 4. Associations between adverse childhood experiences and adverse health outcome

| Determinates | Anxiety | Depression | Sexual experience | Alcohol use | Tobacco use | Illicit drug use |
|--------------|---------|------------|-------------------|-------------|-------------|-----------------|
|              | AOR     | 95% CI     | AOR               | 95% CI      | AOR         | 95% CI          | AOR       | 95% CI     | AOR         | 95% CI     | AOR         | 95% CI     |
| Broad categories of adverse childhood experiences |         |            |                   |             |             |                 |           |            |             |             |             |             |
| 1. Emotional, physical, and/or sexual abuse (Ref: No) | 1.47    | (1.13, 1.91)| 1.80 (1.39, 2.34)| 1.50 (1.15, 1.94)| 1.60 (1.23, 2.09)| 1.54 (1.15, 2.06)| 1.08 | (0.76, 1.54) |
| 2. Emotional and/or physical neglect (Ref: No) | 1.39    | (1.04, 1.86)| 1.67 (1.25, 2.23)| 1.25 (0.94, 1.66)| 1.03 (0.76, 1.37)| 1.21 (0.88, 1.66)| 1.10 | (0.76, 1.61) |
| 3. Violence (Ref: No) | 1.57    | (1.19, 2.05)| 1.33 (1.04, 1.70)| 1.31 (1.01, 1.72)| 1.24 (0.94, 1.63)| 1.32 (0.98, 1.77)| 1.58 | (1.12, 2.24) |
| 4. Household dysfunction (Ref: No) | 1.43    | (1.16, 1.76)| 1.37 (1.12, 1.69)| 1.03 (0.84, 1.27)| 1.28 (0.98, 1.51)| 1.24 (0.97, 1.58)| 1.30 | (0.98, 1.74) |
| Cumulative exposure to multiple forms of adverse childhood experiences |         |             |                   |             |             |                 |           |            |             |             |             |             |
| ACE Score (Ref: No ACE) |         |             |                   |             |             |                 |           |            |             |             |             |             |
| 1–3 | 1.97 | (1.62, 2.40)| 2.32 | (1.83, 2.73)| 1.17 | (0.94, 1.46)| 1.56 | (1.27, 1.91)| 1.38 | (1.08, 1.75)| 1.42 | (1.06, 1.87) |
| 4–11 | 3.91 | (2.92, 5.25)| 4.02 | (3.00, 5.38)| 3.12 | (2.23, 4.37)| 2.32 | (1.74, 3.08)| 3.14 | (2.31, 4.28)| 2.59 | (1.80, 3.67) |

Odds ratios (ORs) were adjusted for Sex, GPA, and Socio-economic status covariates. p < .05.
childhood exposure to more ACEs was found to be associated with increased risk of substance use in adolescents. Compared to adolescents without a history of ACE exposure, adolescents with exposure to one to three or more ACEs had a greater risk of substance use. In addition, the risk observed in adolescents with four or more forms of exposure was higher than adolescents with one to two forms of exposure (Dube et al., 2006; Moran et al., 2004). This relationship is consistent with several studies showing that exposure to multiple forms of ACEs was associated with incremental risks of illicit drug use, including self-reported drug problems and addiction. Moreover, exposure to ACEs has also been associated with earlier drug use initiation in adolescence.

4.5. ACEs and the impact on mental health of adolescents

History of severe and chronic ACEs can lead to toxic stress response, and the adverse physical and emotional effects of that can persist into adulthood. This study of a sample of Bangkok vocational school students found that those who had a history of ACEs were prone to anxiety and depression more than those who had no ACEs. That finding is consistent with many similar studies which also found an association between ACEs and learning disability, poor memory, and deficient academic performance (Kessler et al., 2010). In addition, those reporting emotional, physical, and/or sexual abuse, emotional and/or physical neglect, and experienced violence and household dysfunction had greater odds of reporting anxiety and depression. This suggests that individual ACE components may concentrate their effects on mental health through different mechanisms.

4.6. ACEs and the impact on sexual behavior among adolescents

Sexual health issues have received public attention in Bangkok over recent decades because initiation of sexual activity among adolescents is occurring at a younger age. The prevalence of sexual intercourse among in-school adolescents in Bangkok increased from 12.6% in 2002 to 28.6% in 2017. Fully 46.6% of male and 34.3% of female vocational school students (average age of 16) reported that they had ever had sex (Htike et al., 2017). This study found that exposure to four or more ACEs had over three-fold higher odds of ever having had sex, compared to those reporting no ACEs. In addition, history of emotional, physical, and/or sexual abuse and experience of violence showed a significant independent effect on sex experience. This finding is different with previous studies which have provided extensive evidence regarding the impact of family instability and living in a single-parent household on a child’s sexual debut (Hillis et al., 2001; Tsuyuki et al., 2019). Most studies have focused on family structural changes due to divorce and/or separation. Divorce/separation is not only a one-off event, but a consequence of long-term poor relationships between spouses, and this can impact on sexual debut of their child(ren) (Felitti & Anda, 2010). In our sample, parental separation/divorce did not show higher strength of association with sex experience of the adolescent respondents.

5. Conclusions

The results support the hypothesis that individual ACE components, mental health, and risky behavior vary by sex. First, we hypothesized that there is a dose–response effect of increasing exposure to ACE on the presence of AHOs among adolescents. Second, compared to adolescents without a history of ACEs, adolescents exposed to ACEs are at increased AHOs. Third, we hypothesized that there is a dose–response relationship between ACEs and adolescent AHOs. Like studies conducted elsewhere in the world, this research indicated that, as ACEs increase, so do the adjusted odds of poor physical, mental, and behavioral health outcomes. This study helps to clarify that exposure to ACEs was associated with increased AHOs, alcohol and tobacco use, and illicit drug use in adolescents. Findings from this analysis underscore the potential benefit of providing focused preventative approaches to mitigate both the specific and cumulative burden of AHOs in adolescents. In addition, having had multiple ACEs is a major risk factor for many health conditions. The outcomes most strongly associated with multiple ACEs represent ACE risks for the next generation (e.g., violence, mental illness, and substance use). Sustaining improvements in public health requires a shift in focus to include prevention of ACEs, resilience building, and ACE-informed service provision. Findings from the current study also highlight the need to consider the possibility of gender-specific responses to ACEs, and to consider gender-specific intervention strategies.
6. Limitations

This study has several limitations. The data collection focused on a specific group (adolescents in vocational schools) and, therefore, the findings do not necessarily represent all adolescents in Bangkok and should not be generalized to the general Thai adolescent population. The cross-sectional design of the study precludes analysis of causality. Additionally, there are limitations related to self-report of ACEs reflects the “true” situation. Finally, though this study used variables based on the literature, not all potential confounders were available in the data set.

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