

INCREMENTAL EFFECTS OF CHRONIC HEALTH CONDITIONS AND ADVERSE
CHILDHOOD EXPERIENCES ON CURRENT DEPRESSION

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ADVERSE CHILDHOOD EXPERIENCES AND DEPRESSION

Abstract

Previous research examining the prevalence of adverse childhood experiences (ACEs) has demonstrated that such occurrences can lead to negative physical and behavioral health outcomes later in life. Most commonly, ACEs have been examined and discussed as a comprehensive experience in which a Total ACE score is composited representing the total number of ACEs experienced: the higher the Total score, the more abuse/ neglect a person has suffered. The proposed study breaks down ACEs into 3 separate subscales (household dysfunction, emotional/physical abuse, and sexual abuse) and is designed to investigate the independent effects of the subscales on current depression in adulthood. Chronic health conditions were included as a model covariate along with age, sex, educational level, and employment status. Hierarchical regression models were used to determine the relative contribution of ACE subscales to current depression and these models were compared to a model that replaced ACE subscales with the Total ACE Score. Results indicated that each ACE subscale contributed to a statistically significant increase in relation to current depression and that there were no significant advantages to using ACE subscales to predict current depression among adults over the Total ACE Score. Further, Total ACE Score in addition to number chronic health conditions is the best predictor in determining a person's current depression status.

ADVERSE CHILDHOOD EXPERIENCES AND DEPRESSION

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ADVERSE CHILDHOOD EXPERIENCES AND DEPRESSION

List of Abbreviations

ACE	Adverse Childhood Experience
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers of Disease Control
DSM-IV	<i>Diagnostic and statistical manual of mental disorders (4th edition)</i>
PHQ-8	Patient Health Questionnaire-8 Depression Scale
PHQ-9	Patient Health Questionnaire-9 Depression Scale
MDD	Major Depressive Disorder
EFA	Exploratory Factor Analysis
CFA	Confirmatory Factor Analysis

Incremental Effects of Chronic Health Conditions and Adverse Childhood Experiences on Current Depression

For many years, the focus of long-term effects of childhood neglect and maltreatment primarily concentrated on only a few types— typically sexual and physical abuse. As abuse became more prevalent, researchers continued to explore the area and an increasing number of studies have examined the impact of more than just one type of childhood abuse (Briere & Runtz, 1990; Brown, Cohen, Johnson, & Smailes, 2000; Liebschutz et al., 2002; Mullen, Martin, Anderson, Romans, & Herbison, 1996). These multiform abuse and neglect findings have provided evidence that long-term effects of childhood maltreatment are not the result of a single form of abuse, but instead include other forms of maltreatment such as emotional/psychological abuse, unstable and disordered family, or household environments. Adverse childhood experiences (ACEs) are defined as occurrences of childhood maltreatment such as physical, emotional, or sexual abuse, as well as family or household dysfunction that take place before the age of 18 years. ACEs in the form of physical abuse include being hit, beaten, or kicked. ACEs in the form of emotional or psychological abuse include being sworn at, insulted, or put down. ACEs in the form of sexual abuse include being inappropriately touched. ACEs in the form of household dysfunction include living with a family or household member who was mentally ill or suicidal, abusing substances, ever incarcerated, living in a household with domestic violence, or with parents who got divorced or separated after the child was born (Font & Maguire-Jack, 2016). Consequences of these childhood experiences often endure throughout life's course, which subsequently result in a variety of negative health outcomes as an adult (Chapman et al., 2004; Campbell, Walker, & Egede, 2016).

It is widely recognized that ACEs are continually associated with poorer mental, behavioral, and physical health in adulthood (Anda et al., 1999, 2006; Dietz et al., 1999; Dong, Anda, Dube, Giles, & Felitti, 2003; Chapman et al., 2004; Dube, Anda, Felitti, Chapman, et al., 2001; Felitti et al., 1998; Font & Maguire-Jack, 2016; Campbell, Walker, & Egede, 2016). ACEs have been linked to a range of adverse physical health outcomes such as obesity (Felitti et al., 1998; Anda et al., 2006; Font & Maguire-Jack, 2016; Campbell, Walker, & Egede, 2016), heart disease (Campbell, Walker, & Egede, 2016), cancer and lung disease (Felitti et al., 1998), diabetes and myocardial infarction (Campbell, Walker, & Egede, 2016), and even early death (Brown et al., 2009). ACEs have also been linked to negative behavioral health outcomes such as smoking and substance and alcohol abuse (Felitti et al., 1998; Anda et al., 2006; Font & Maguire-Jack, 2016; Campbell, Walker, & Egede, 2016), suicide and high-risk sexual behavior (Felitti et al., 1998; Campbell, Walker, & Egede, 2016), anxiety, hallucinations, and sleep disturbances (Anda et al., 2006). Additionally, those who had experienced child maltreatment were more likely to engage in risky health-related behaviors during childhood and adolescence: early initiation of smoking, sexual activity, illicit drug use, adolescent pregnancies, and suicide attempts (Felitti & Anda, 1997), which may likely contribute to the relative physical health issues.

The associations between ACEs and adult mental and physical health are well accepted in the literature. Exposure to these types of events during childhood can have a negative impact on adult mental health as that has been established repeatedly. More specifically, these ACEs can increase the likelihood of becoming depressed as an adult. Depression is currently one of the most common types of mental illness today making it

the largest contributor to mortality rates. In 2007 it was documented that 8 of 10 ACEs were significantly related to higher reports of depressive symptoms during the transition to adulthood (Schilling, Aseltine, & Gore, 2007). In a study that examined childhood adversities among a population of women provided further evidence that household dysfunction, physical abuse, verbal abuse, and sexual abuse were all positively associated with current depressive symptoms (Remigio-Baker, Hayes, & Reyes-Salvail, 2014). More recent research by Merrick and colleagues (2017) conducted a study to assess ACE exposure and self-reported mental health outcomes. A dose-response relationship indicated that in addition to having increased suicide attempts, as a person's ACE score increased the odds of experiencing depressed affect in adulthood also increased (Merrick et al., 2017). The clear link between these ACEs and depression is an area that needs attention for preventive purposes.

Childhood maltreatment and other adverse childhood experiences have largely been studied together as one comprehensive experience, defined by a Total ACE Score composed of the number of adversities experienced before the age of 18 years measured by the ACE Module (Dong et al., 2004; Felitti et al., 1998; Felitti, 2002; Dube et al., 2006; Hughes, Lowey, Quigg, & Bellis, 2016). Furthermore, Total ACE Score was derived from the retrospective self-reported summed number of categories to which a person was exposed during childhood. The higher the ACE Score, the greater likelihood of persistent physical and behavioral health risks outcomes. This Total Score is then used as a single index to estimate the overall impact on subsequent physical or mental health (Ford et al., 2014).

Historically, the effects of ACEs have been studied in co-occurrence with one another (Turner, Finkelhor, & Ormrod, 2006; Dong et al., 2004), and therefore have been measured and assessed as one comprehensive experience in relation to negative health outcomes as a whole. This particular method of measuring adverse childhood experiences has generated a significant amount of research that documents a persistent graded or dose-response relationship between Total ACE Score and negative health and well-being outcomes (Dube et al., 2006; Felitti et al., 1998; Hughes, Lowey, Quigg, & Bellis, 2016). Using logistic regression models, Felitti and colleagues (1998) found a strong, dose-response relationship between the number of ACEs and 10 maladaptive behaviors, health practices, and behavior patterns (smoking, severe obesity, physical inactivity, depressed mood, suicide attempts, alcoholism, substance abuse, parenteral drug abuse, a high number of sexual partners, and a history of STD). Moreover, there is evidence of a strong graded relationship between adverse childhood experiences and adult onset of chronic illness—those with ACE scores of 4 or more had significantly higher rates of heart disease and diabetes than those with ACE scores of zero (Felitti & Anda, 1997). This response effect demonstrates a dose-response relationship between the extent of ACEs and adult health risk behaviors and outcomes, in that as the number of reported ACEs increase, so do the negative health risks and outcomes in adulthood (Dube et al., 2006; Felitti, 2002; Felitti et al., 1998).

Ford and colleagues (2014) have provided the foundation to further investigate the association between single ACE subtypes and the subsequent impact they have on behavioral and physical health outcomes. Ford et al. (2014) assessed whether the factor structure of the BRFSS ACE Module is valid. They first analyzed data from the 2009

BRFSS Module using exploratory factor analysis (EFA) to estimate factorial structure. Then, the exploratory solution was validated using confirmatory factor analysis (CFA) with the 2010 BRFSS ACE Module (Ford et al., 2014). The CFA results suggested that a 3-factor solution adequately fit the data and represent the following construct areas: (1) Household Dysfunction, (2) Emotional/ Physical Abuse, and (3) Sexual Abuse.

Relatively little is known about the distinct contribution of separate ACE subtypes (household dysfunction vs. physical/emotional abuse vs. sexual abuse) and specific behavioral and physical health outcomes. Moreover, there is no current research to our knowledge that has examined the association between ACE subtypes and the role of current depression and chronic health conditions in adulthood. As it is likely that many ACEs do indeed co-occur with each other, it is also possible that ACEs may occur independently and therefore, have particular effects on behavior and health outcomes later in life.

The purpose of this study is to examine the association between the characteristic effects of each ACE subtype, current depressive symptoms, and chronic health conditions. Specifically, the goal is to answer the following question: which of ACE subtype(s) are most related to current depression? We hypothesize that the more severe the abuse endured, the more associated it will be with current depression. We predict that Household Dysfunction will be the least related, Emotional/Physical Abuse will be moderately related, and Sexual Abuse will be the most related to current depression as an adult.

Method

In 2008, the CDC's National Center for Chronic Disease Prevention and Health Promotion developed questions similar to those used in the ACE Study for incorporation into the Behavioral Risk Factor Surveillance System (BRFSS) survey. The BRFSS is the largest ongoing health study in the world and has been useful in the surveillance of health behaviors and practices among U.S. adults (Anda, Butchart, Felitti, & Brown, 2010). In 2009, the CDC began annually administering 11 items adapted from the ACE Study questionnaire to samples of adults participating in the BRFSS survey (Ford et al., 2014).

Participants

We used data from the Adverse Childhood Experiences module administered to participants on the 2010 Behavioral Risk Factor Surveillance System annual survey (CDC, 2010a).

The sample for Total ACE consisted of $N = 20,509$ and was used for the data analysis. The sample had a mean age of 56 years ($SD = 16.1$ years). Sociodemographic characteristics (sex, marital status, employment status, education level) for each sample are summarized in Table 1. Chi-square analyses indicated no differences among the three subsamples on the variables of sex, marital status, employment status, and education. Because the samples were similar on relevant variables, and the actual data loss was small, we did not replace missing values.

Criterion variable

The Patient Health Questionnaire-8 (PHQ-8, Kroenke et al., 2009) depression scale consists of 8 items (cronbach's $\alpha = .86$) from the Patient Health Questionnaire-9 (PHQ-9, Kroenke & Spitzer, 2002) depression scale. The PHQ-8 questions are based on

the diagnostic criteria from the DSM-IV for Major Depression Disorder (MDD). The scale items asked respondents the number of days in the past 2 weeks he or she had experienced a particular depressive symptom (Kroenke, Spitzer, & Williams, 2001). Individual item scores range from 0 – 14, which are summed to produce the PHQ-8 total score. PHQ-8 total scores range from 0-112. PHQ-8 total scores in this form are known as the PHQ-8 days scores. PHQ-8 days scores of 55 or higher are consistent with Major Depression as defined in DSM-5 (American Psychiatric Association, 2013) and has a sensitivity of 0.91 and a specificity of 0.99 (Dhingra, Kroenke, Zack, Strine, & Balluz, 2011).

Predictor Variables

Adverse Childhood Experiences

The ACE module (CDC, 2010b) consists of 11 items that measure self reported exposure to the following 9 types of childhood adversities: emotional abuse, physical abuse, sexual abuse, household member mental illness, household member substance abuse, witnessing domestic violence, parental separation or divorce, and incarcerated family members (See Table 2, 2010 BRFSS ACE Module).

The Household Dysfunction subscale consists of 5 items (cronbach's $\alpha = .60$) from the ACE Module, which includes questions to which participants responded yes (1) or no (0) if they lived with anyone who is mentally ill, used alcohol or drugs, or has spent time in a correctional facility. Response options for the question about parents' marital status were scored for married (0) or divorced, separated, or never married (1).

The Emotional/ Physical abuse subscale consists of 3 items (cronbach's $\alpha = .70$) from the ACE Module, which includes questions that participants responded never (1),

once (2), or more than once (3) to if they had been physically or verbally abused by a parent or witnessed abuse between parents.

The Sexual Abuse subscale consists of 3 items ($\alpha = .84$) from the ACE Module, which includes questions that participants responded never (1), once (2), or more than once (3) to if they had been touched sexually, forced to touch another sexually, or forced to have sex.

Covariates

Various sociodemographic details were obtained and included as covariates in the regression models. Covariates were selected and included in the models in order to control for the effects of their known associations with depression. Model covariates were age, sex, employment status (8 categories), and educational level (6 categories). Each of these variables was measured based on participants' responses to questions on the BRFSS survey.

Chronic health conditions

Chronic health conditions were measured by totaling the number of chronic illnesses reported by survey respondents including diabetes, asthma, heart attack, heart disease, and/ or stroke. The chronic health conditions variable was the total number of health conditions reported. Health conditions ranged from 0 (no chronic health conditions) to 3 (3 or more health conditions).

Research indicates that the first incidence of MDD tends to appear in emerging adulthood. This suggests that the likelihood of experiencing depression increases as one ages (Rohde, Lewinsohn, Klein, Seeley, & Gau, 2013). Women are more likely to be depressed than men (Parker & Brotchie, 2010). Employment status was included because

people who are unemployed are more likely to experience depressive symptoms (Dooley, Prause, & Ham-Rowbottom, 2000, Kessler & Bromet, 2013). Educational level was included because lower levels of education are associated with depression (Wang, Schmitz, & Dewa, 2010).

Procedure

ACE data were collected as part of the annually administered BRFSS questionnaire. The aim of the BRFSS is to track the state-specific prevalence of behavioral health risks in all 50 states and US territories. BRFSS interviewers ask respondents a series of questions regarding their physical, mental, and behavioral health. All data for the BRFSS ACE module were collected via random digit dialing telephone survey and was based off self-report.

Design and Analysis

A hierarchical regression design was used to analyze the data to assess the incremental increase in R^2 when a new variable was added into the model. The first stage in the model entered the covariates into a model as a block. Stage two included covariates and chronic health conditions. Stage three was the covariates, chronic health conditions, and the Household Dysfunction subscale. Stage four added the Emotional/ Physical Abuse subscale to the previous stage. Stage five included the variables from stage four with the addition of the Sexual Abuse subscale. The hypothesis in each stage was that the incremental change in R^2 attributable to ACE subscales in their respective stage will be significantly related to depression.

Statistical analysis was performed using SAS PROC SURVEYREG, which is designed to analyze data from complex survey designs. Statistical analysis was

constructed to account for sample stratification and clustering, and was weighted to better approximate population values.

Results

The regression model analysis is summarized and provided in Table 3. The hierarchical regression revealed that at stage one the covariate block yielded an R^2 of .119 and accounted for 11.9 % of the variation in current depression. At this stage, each covariate was also significantly related to current depression. Introducing Chronic Health Conditions into the model at stage two accounted for a modest but statistically significant increase in R^2 of .02 and the associated R^2 of .139 accounted for 13.9% of the variation in current depression.

At stage 3, the Household Dysfunction subscale was added to the regression model, which accounted for a statistically significant .04 increase in R^2 . The addition of this subscale caused the model R^2 to increase to .181, accounting for 18.1% of the variation in current depression. At stage 4, the Emotional/ Physical Abuse subscale was added to the model and increased R^2 by .025, which was statistically significant. The overall model R^2 was .206, accounting for 20.6% of the variation in current depression. At stage 5, adding Sexual Abuse to the regression model accounted for a small, but statistically significant increase of .009 in R^2 and yielded a model R^2 of .215. This model R^2 value accounts for 21.5% of the variation in current depression. Results indicated that the three ACE subscales accounted for an increase in R^2 of .08 above the R^2 value at stage 2 which included the covariates and chronic health conditions. Each of the ACE subscales was significantly related to current depression as indicated by the incremental increase at each stage of the model.

Discussion

The purpose of this study was to investigate the independent effects on current depression of 3 construct areas of Adverse Childhood Experiences: Household Dysfunction, Emotional/ Physical Abuse, and Sexual Abuse. We hypothesized that the severity level of the abuse would determine the strength of association between ACE subscale and current depression. We hypothesized that Household Dysfunction would be least related, Emotional/ Physical Abuse would be moderately related, and Sexual Abuse would be the most related to current depression.

The hierarchical regression was used to enter the subscales in a sequential order based on subjective ranking of severity, which reflected our hypotheses of the subscales being differentially related to current depression. The hierarchical regression model displayed the effect of the independent subscale while controlling for the effects of the previously entered subscale. At each stage of the model the independent effects of the ACEs contributed a statistically significant incremental increase in the R^2 value while controlling for covariates, chronic health conditions, and each subscale. While each of the ACE subscales were significantly related to current depression, the order in which we predicted them to be was partially supported. Contrary to our hypothesis, findings indicated that household dysfunction was the most related to current depression by having the largest increase in R^2 when introduced into the model. Sexual abuse was found to be the least related, which was indicated by having the smallest increase in R^2 . Our results found that emotional/ physical abuse was moderately related to current depression, which supported a portion of our hypothesis.

As a possible explanation for these findings, it is important to have knowledge on the differences in frequencies among these types of abuse. For example, our data indicated that 45.2% of participants reported household dysfunction in childhood, 46.5% reported emotional/ physical abuse, and 11.9% reported sexual abuse. It may be that household dysfunction is a more chronic event that a person is exposed to more often compared to sexual abuse that may be a more episodic type event. Following these premise, it is likely that abuse that happens more frequently can have longer lasting effects than infrequent occurrences. Because of the individual differences in occurrences of experiences and severity of the ACE type, current depression is best predicted when a person has been exposed to a combination of adverse childhood experiences.

Further, our findings indicated that no single ACE subscale showed greater association with current depression than stage 5 of the model, which included all three ACE subscales. The inclusion of all three ACE subscales in the regression model yielded similar results as a model we ran separately containing a Total ACE Score (see step 6 of table 3). These finding suggest that the final model that included all three ACE subtypes is the best predictor of current depression among adults. There is no advantage to using the individual ACE subscales to predict current depression, but rather a combination of different types of adverse childhood experiences is most related to current depression.

Limitations

It is important to distinguish current depression and lifetime history of depression. A person with a history of depression and adverse childhood experiences may not have been depressed at the time of the survey. The effects of Adverse Childhood Experiences on depression may be seen more clearly in relation to lifetime experience of

depression compared to current depression. Because of this, it is important for future research to investigate how the relationship between Adverse Childhood Experiences and lifetime history of depression.

The PHQ-8 scale is widely used because of its reliability and validity in assessing depression. However, the PHQ-8 scale does not allow us to distinguish between the many features of depression, such as type of depression, duration of symptoms, and severity of symptoms. The PHQ-8 scale in this present study was used more as a screening tool to determine a person's current level of depression. This does not provide information on the type of depression (e.g., dysthymia, bipolar disorder, major depressive episode) being experienced or episode duration. Because of this, the results bear on the experience of current depressive symptomatology but not on any particular diagnostic category.

Future Directions

This study examined the influence of ACEs and current depression. These findings provided evidence that people who have experienced a combination of ACEs are more likely to have current depression, but have left another important question unanswered: what about the people who are not currently depressed, but have a history of depression? It is possible for some to have a history of depression, but not currently be depressed? People who have a history of depression, but are not currently depressed would weaken an association between ACEs and current depression. Future research should examine the relationship of ACEs to lifetime history of depression as well as other experiences that contribute to well-being in adulthood. This would address whether or not a person who has experienced a negative traumatic events as a child can grow into adulthood and live a fulfilling life, even if the event had once caused emotional distress

and depression. Shedding light on this will allow researchers to determine how these events impact adults, how we can grow from them, and even possibly aide in treating individuals who have suffered from these events and depression.

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Table 1 Participant demographic characteristics

Variable	ACE Total N=20,509	
	n	Weighted %
Sex		
Male	8347	49.8
Female	12314	50.2
Marital Status		
Married	11540	60.8
Divorced	2962	8.5
Widowed	2552	5.8
Separated	304	1.0
Never Married	2685	19.4
Unmarried couple	544	4.4
Refused/Don't know	74	.3
Employment Status		
Employed	10822	60.4
Unemployed	1199	8.0
Homemaker	1195	6.5
Student	354	4.5
Retired	5910	16.8
Unable to work	1064	3.6
Refused/Don't know	57	.4
Education		
None or kindergarten	29	.1
Grades 1-8	15	.1
Grades 9-11	366	1.1
Grade 12/ GED	846	4.0
College 1-3 years	6094	30.9
College 4 years or more	5702	29.5
Refused/Don't know	7609	34.3
Chronic Health Conditions		
0 health conditions	14595	75.5
1 health condition	4486	19.5
2 health conditions	1123	3.5
3 or more health conditions	457	1.5

Table 2 BRFSS 2010 ACE Module Questions**BRFSS Adverse Childhood Experience (ACE) Module**

All questions refer to the time period before you were 18 years of age. Now, looking back before you were 18 years of age---

- 1) Did you live with anyone who was depressed, mentally ill, or suicidal?
- 2) Did you live with anyone who was a problem drinker or alcoholic?
- 3) Did you live with anyone who used illegal street drugs or who abused prescription medications?
- 4) Did you live with anyone who served time or was sentenced to serve time in a prison, jail, or other correctional facility?
- 5) Were your parents separated or divorced?
- 6) How often did your parents or adults in your home ever slap, hit, kick, punch or beat each other up?
- 7) Before age 18, how often did a parent or adult in your home ever hit, beat, kick, or physically hurt you in any way? Do not include spanking.
- 8) How often did a parent or adult in your home ever swear at you, insult you, or put you down?
- 9) How often did anyone at least 5 years older than you or an adult, ever touch you sexually?
- 10) How often did anyone at least 5 years older than you or an adult, try to make you touch sexually?
- 11) How often did anyone at least 5 years older than you or an adult, force you to have sex?

Response Options**Questions 1-4**

- 1=Yes
- 2=No
- 7=DK/NS
- 9=Refused

Question 5

- 1=Yes
- 2=No
- 7=DK/NS
- 8=Parents not married
- 9=Refused

Questions 6-11

- 1=Never
- 2=Once
- 3=More than once
- 7=DK/NS
- 9=Refused

Table 3 Summary of Hierarchical Regression Models

	F	df	R ²	ΔR ²
Step 1 Covariates Only (n=20,509)				
Model	30.1***	14	.119	---
Age	12.9**	1		
Sex	24.9***	1		
Employment	43.0***	6		
Education	8.1***	6		
Step 2 Covariates + Chronic Health Conditions (n=20,509)				
Model	32.3***	17	.139	.02
Age	22.6***	1		
Sex	27.4***	1		
Employment	39.6***	6		
Education	7.2***	6		
Chronic Illness	32.2***	3		
Step 3 Covariates + Chronic Health Conditions + Household Dysfunction (n=20,506)				
Model	40.2***	18	.181	.04
Age	2.9	1		
Sex	18.7***	1		
Employment	35.8***	6		
Education	3.8**	6		
Chronic Illness	28.6***	3		
Household Dysfunction	158.0***	1		
Step 4 Covariates + Chronic Health Conditions + Household Dysfunction + Emotional/Physical Abuse (n=20,445)				
Model	42.7***	19	.206	.025
Age	3.4	1		
Sex	22.3***	1		
Employment	33.7***	6		
Education	3.4*	6		
Chronic Illness	27.0**	3		
Household Dysfunction	48.0***	1		
Emotional/Physical Abuse	117.3***	1		

Table 3 continued Summary of Hierarchical Regression Models

	F	df	R ²	ΔR ²
Step 5 Covariates + Chronic Health Conditions + Household Dysfunction + Emotional/Physical Abuse + Sexual Abuse (n= 20,354)				
Model	40.2***	20	.215	0.009
Age	3.8	1		
Sex	14.0**	1		
Employment	31.9**	6		
Education	3.2*	6		
Chronic Illness	26.2***	3		
Household Dysfunction	35.5***	1		
Emotional/Physical Abuse	89.1***	1		
Sexual Abuse	25.3***	1		

Note: * $p < .05$, ** $p < .001$, *** $p < .0001$