Early Trauma Exposure and Marijuana Use as well as Dependence from Adolescence to Emerging Adulthood

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Early Trauma Exposure and Marijuana Use as well as Dependence from Adolescence to Emerging Adulthood

Ian Andru Marsee

A thesis submitted to the faculty of Brigham Young University in partial fulfillment of the requirements for the degree of Master of Science

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ABSTRACT

Early Trauma Exposure and Marijuana Use as well as Dependence from Adolescence to Emerging Adulthood

Ian Andru Marsee
School of Family Life, BYU
Master of Science

This study examines the impact of two types of trauma exposure, mistreatment by an adult as a child and exposure to stressful life events as an adolescent, and their impact on marijuana use as an adolescent and emerging adult and marijuana dependence as an adult. This study also investigates the mediating role of depressive symptoms on the relationship between trauma exposure and marijuana use and dependence. The AddHealth dataset, a nationally representative and longitudinal dataset, was used to assess these relationships. Results show that both types of trauma predict marijuana use and dependence. Results also show that there are indirect effects through depressive symptoms. These findings have implications on children and adolescents who are exposed to trauma, parents, teachers, and those working in the fields of mental health and therapy.

Keywords: trauma, marijuana use, dependence, depression, depressive symptoms
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Early Trauma Exposure and Marijuana Use as well as Dependence from Adolescence to Emerging Adulthood

The public has continued to increase their support of the legalization of marijuana (Geiger, 2017). However, except for medical reasons, there is substantial research showing that (recreational) marijuana use has been linked with lower levels of life satisfaction (Wilkinson, Yarnell, Radhakrishnan, Ball, & D'Souza, 2016), increased reports of depression (Keith, Hart, McNeil, Silver, & Goodwin, 2015), and more risky sexual behaviors (Bryan, Schmiege, & Magnan, 2012). Despite these negative consequences, the prevalence of marijuana use among adolescents has been increasing in the past 16 years (Dubowitz et al., 2016).

Previous studies have shown that adolescents may use substances for many different reasons such as pleasure and creativity (Novacek, Raskin, & Hogan, 1991), experimentation (Lee, Neighbors, & Woods, 2007), and using with their peers (Bahr, Hoffmann, & Yang, 2005). Another reason may be included in the adolescent limited delinquency theory (i.e., the majority of delinquent behavior starts and stops in adolescence). Moffitt (1993) stated that adolescents who are participating in delinquent acts may be doing so to claim adult privileges. Using drugs such as marijuana may be a way for the individuals who demonstrate their maturity to peers and parents alike only in the teenage years. On the other hand, those who continue to use marijuana during and after adolescence may not be doing so to claim adult privileges but to cope from previous trauma, for instance. The self-medication model (Khantzian, 1997) suggests that people may use marijuana to decrease the impact of negative factors (e.g. depressive symptoms). In general, using marijuana as a coping strategy (e.g., to minimize or tolerate stress or pain) has received more attention in recent research (Bujarski et al., 2012, Vilhena-Churchill & Goldstein, 2014).
Research has been conducted on substance use in relation to the stress (or pain) resulted from trauma exposure. For example, recent research has shown that trauma exposure has been linked to early onset smoking (Mills, Alati, Strathearn, & Najman, 2014) and daily adolescent smoking (Roberts, Fuemmeler, McClenon, & Beckham, 2008). Exposure to trauma is also associated with higher levels of adolescent drinking (Cornelius, De Genna, Goldschmidt, Larkby, & Day, 2016), binge drinking (Cisler et al., 2017, Shin, Edwards, & Heeren, 2009), and alcohol disorders (Clark, Lesnick, & Hegedus, 1997). However, despite the link between trauma exposure and cigarette smoking and alcohol use, little is known about the association between earlier trauma exposure and future marijuana use. Among the very few studies looking into the relationship between previous trauma exposure and later marijuana use, research has shown that exposure to community violence (Vermeiren, Segwab-Stone, Leckman, Ruchkin, & Deboutte, 2003) was associated with higher rates of lifetime and past months’ marijuana use compared to their counterparts, while victimization (e.g., attacked or shot at) was associated with a higher likelihood of past year marijuana use among adolescents (Fagan, Wright, & Pinchevsky, 2015).

Across the studies mentioned above, the results regarding earlier trauma exposure and future marijuana use were not easy to be synthesized and concluded. Given the lack of topic exposure, there is a need to evaluate the relationship between earlier trauma exposure and future marijuana use in a large, longitudinal, and nationally representative sample. Accordingly, this study will identify and investigate the risk of two types of trauma exposure, mistreatment by an adult (as a child) and exposure to one or more violent life events (as an adolescent), and their impact on adolescent and emerging adult marijuana use and marijuana dependence.
Literature Review

Marijuana Use and Dependence

Marijuana is one of the most used illicit drugs in the world (Degenhardt & Hall, 2012; Ramaekers et al., 2011) and has been rising since the early 2000’s among adolescents (Dubowitz et al., 2016). As previously mentioned, there is substantial literature showing that marijuana use may lead to several negative outcomes such as a decrease in brain function (Jacobus, Bava, Cohen-Zion, Mahmood, & Tapert, 2009; Volkow, Baler, Compton, & Weiss, 2014) and an being related to depressive symptoms (Hooshmand, Willoughby, & Good, 2012; Medina, Nagel, Park, McQueeny, & Tapert, 2007; Wilkinson et al., 2016). Experimenting with substance use most often begins in adolescence (Clark, Doyle, & Cincy, 2013). According to the adolescence-limited delinquency theory (Moffitt, 1993), this type of experimental behavior usually begins in adolescence and desists in emerging adulthood. Similarly, Tucker and colleagues (2005) indicated that individuals are most susceptible to substance use during adolescence and before adulthood. However, previous research has demonstrated that early adolescent drinkers (Dawson, Goldstein, Chou, Ruan, & Driscoll, 2008; Grant & Dawson, 1997;) or smokers (Lando et al., 1999) are more likely to experience negative consequences, such as dependence symptoms, than adult users and therefore are may be more likely to continue using substances into adulthood. Despite the controversial arguments previously stated, there is a lack of longitudinal studies looking into the trend of marijuana use from adolescence into adulthood (Derefinko et al., 2016).

Marijuana dependence is also of concern when inspecting the relationship between trauma and marijuana use. Miller and Gold (1989), define marijuana dependence “preoccupation with the acquisition of marijuana, compulsive use of marijuana, relapse to or recurrent use of the
marijuana” (p. 183). Hasin and colleagues (2015) have found that marijuana disorders (abuse or dependence) have almost doubled from 2002 to 2013. Yet, there is limited research being done with the prevalence as well as the etiology of marijuana dependence. Of the little research being done, Richter and colleagues (2017), found that adolescents, even when they use less marijuana, are at higher levels of risk for their use to be labeled a disorder. Shi (2014) found that individuals with depression were more likely than those without to become dependent or abuse marijuana. Marijuana dependence has been associated with psychotic symptoms (Fergusson, Horwood, & Swain-Campbell, 2003) and a higher rate of mental disorders (Agosti, Nunes, & Levin, 2002). As has been shown, marijuana dependence may have an impact on adults’ mental and emotional health. For these reasons, marijuana dependence will be investigated along with marijuana use because it reflects the severity of marijuana use and becoming dependent on it. Thus, determining the trend and prevalence of these two marijuana outcomes would be helpful in identifying the vulnerable population and targeting specific prevention strategies.

**Trauma Exposure and Substance Use**

According to the American Psychological Association (2008), trauma is defined as “an event is one that threatens injury, death, or the physical integrity of self or others and … include sexual abuse, physical abuse, domestic violence, community and school violence, … suicides, and other traumatic losses” (p. 2). Although there are different forms of trauma an individual may experience, for the purposes of this study, mistreatment by an adult (as a child) and violent life events (as an adolescent) will be the focus.

A considerable amount of children in the United States have been victims of trauma. According to the U.S. Department of Health and Human Services (2014), over 700,000 children were abused in one calendar year. While some children might be able to cope with their
experiences of abuse and neglect with professional help, some have to deal with the stressful experiences themselves. Based on the life course theory, certain historical or dramatic events (e.g., great depression) may lead children on a different trajectory than others, suggesting that individual adverse experiences during early development may have a long-term impact on their future outcomes (Elder, 1998). For example, studies have shown that being exposed to violence is associated with antisocial behavior (Bacchini, Affuso, & Aquilar, 2015), more depressive and/or anxiety symptoms (Chapman et al., 2004; Eisman, Stoddard, Heinze, Caldwell, & Zimmerman, 2015; Mohammad, Shapiro, Wainwright, & Carter, 2015), and substance use (Vermeiren, et al., 2003).

Furthermore, research has shown that being abused as a child is a strong predictor of Post-Traumatic Stress Disorder (PTSD) symptoms later in life (Catani & Sossalla, 2015) and has specifically been linked to certain substance use outcomes including smoking as young adults (Roberts et al., 2008), and adolescent binge drinking (Shin et al., 2009). However, it is worth noting that individuals who experience a traumatic event but were not diagnosed with PTSD still had higher rates of smoking (Hapke et al., 2005) and substance use (Waldrop & Cohen, 2014). Taken together, these studies suggest that there is a link between trauma exposure and negative outcomes such as substance use regardless of having PTSD or not. Few have specifically examined the association between early trauma exposure and marijuana use over time as well as marijuana dependence.

**Depressive Symptoms**

Depressive symptoms is one of the frequently mentioned individual mental health problems in previous studies that relates to substance use during adolescence and emerging adulthood. Individuals with depressive symptoms have been shown to use more alcohol
Moreover, a previous study also suggested that being exposed to trauma could lead to changes in the brain, which have been associated with features of major depression (Heim, Newport, Mletzko, Miller, & Nemeroff, 2008). Similarly, Dunn and colleagues (2017) found a link between trauma exposure and depressive symptoms and noted that trauma exposure may increase psychopathology such as depression throughout life. Accordingly, depressive symptoms have been seen as an important covariate in studying substance use as well as in studying the relationship between trauma exposure and substance use. Nevertheless, in this study, depressive symptoms are not just seen as a covariate but a potential mediator between childhood trauma and substance use. That is, adolescents and emerging adults who have experienced trauma earlier in development may use marijuana to help alleviate depressive symptoms such as loneliness, sadness, and lack of sleep related to their trauma exposure (see Khantzian, 1997).

Taken together, the bivariate relationships among trauma exposure, depressive symptoms, marijuana use have been documented. Studies to date examining the association between trauma exposure, depressive symptoms, and substance use have focused on treating depressive symptoms as a covariate. However, the potential mediating effect of depressive symptoms on trauma exposure and marijuana use has not yet been fully examined. Accordingly, the current study will examine depressive symptoms as a mediator to explain the relationship between trauma exposure and marijuana use as well as dependence.

**Control Variables**

A number of demographic characteristics have been examined in the context of marijuana use such as age of participants, gender, race, and parental education. Research shows that males
are more likely to use marijuana and the past year and that marijuana use is increasing among males at a faster rate than females (Carliner et al., 2017). With respect to ethnicity in terms of substance use, marijuana use was most prevalent among African Americans in comparison to other races (Pacek, Malcolm, & Martins, 2012; Warner, 2016). In addition, research generally states that there was a negative relationship between parental education and child’s marijuana use (Bachman, O'Malley, Johnston, Schulenberg, & Wallace, 2011). However, there is also a study suggesting that higher levels of parental education are associated with more cannabis and illicit drug use (Charitonidi et al., 2016). Family structure, such as single parent household, has also been linked with more substance use (Barrett & Turner, 2006). Taken together, past research has shown that gender, race, parental education, and family structure may have an impact on both adolescents and emerging adult’s substance use in general. Accordingly, these variables will be included in the study as control variables.

**The Current Study**

The present study aims to 1) determine the prevalence of marijuana use from adolescence into emerging adulthood as well as marijuana dependence in adulthood; 2) to examine the relationship between trauma exposure and marijuana use over time as well as dependence; 3) to assess whether depressive symptoms serve as a mediator in between the relationship between trauma exposure and marijuana use over time and dependence. Data will be drawn from The National Longitudinal Study of Adolescent to Adult Health (Add Health), a large, nationally representative study, to accomplish these aims.
Methods

Participants and Procedures

The study population was drawn from 20,745 individuals from the Add Health dataset. Participants in Add Health completed in-home surveys in 1995 and up to three additional times (1996, 2001-2002, 2008-2009). The mean ages of the participants at each waves of data collection were 16.10 ($SD = 1.73$), 16.78 ($SD = 1.61$), 22.35 ($SD = 1.81$), and 29.09 ($SD = 1.74$), respectively. The Add Health survey was stratified by geographic region, residence, ethnicity, school type and school size to ensure the data was nationally representative. Detailed study design and data collection have been described elsewhere (Harris et al., 2009; Resnick & Bearman, 1997).

For this present study, the number of participants from the Add Health study who met the minimum criteria (participants were interviewed at least at Wave I, Wave III, and Wave IV with available sampling weights) for inclusion was limited to 12,288. Due to missing data in studied variables particularly in parental education (missing $n = 1,661$) and family structure (missing $n = 216$), with the rest of the variables including a small number of missing participants, the analytical sample was further reduced to 10,286. The participants of the analytical sample were 53.7% White, 21.2% Black, 15.6% Hispanic, and 9.4% other. The sample consisted of a majority of females (54.4%). On average, more participants lived in two family homes than single parent homes and had a parent(s) who had been to some college but had not finished a four-year degree. Full results can be seen in Table 1.

Measures

Trauma exposure. Two types of trauma were assessed in this study. One is mistreatment by adults during childhood and the other is exposure to violent life events in adolescence. The
information of *mistreatment by an adult* (before 6th grade) was collected in Wave III using four items and these items have been validated in assessing mistreatment (Roberts et al., 2008). These items asked participants to report any incidences that happened before 6th grade including questions like “By the time you started 6th grade, how often had your parents or other adult care-givers left you home alone when an adult should have been with you?”, “How often had your parents or other adult care-givers not taken care of your basic needs, such as keeping you clean or providing food or clothing”, “How often had your parents or other adult care-givers slapped, hit, or kicked you?”, and “How often had one of your parents or other adult care-givers touched you in a sexual way, forced you to touch him or her in a sexual way, or forced you to have sexual relations?”. These four items were dichotomized into 0 (Did not happen) and 1 (Did happen). Even though these items are not used as a latent variable a CFA was run to show statistical fit. Confirmatory factor analysis showed that these four indicators had acceptable factor loadings (.503, .826, .755, and .699) as well as adequate model fit ($\chi^2 = 296.40, df = 2, p < .001$, $CFI=.998$, $RMSEA = .084$, $SRMR = .003$), demonstrating that they are good indicator for measuring mistreatment by adults. These four items were then summed as a count variable in the analysis (ranged from 0 to 4). *Exposure to violent life events* was assessed at Wave I. Participants were asked to indicate whether they experienced these four items in the past year, including “Saw someone shoot or stab another person”, “Someone pulled a knife or gun on you”, “Someone cut or stabbed you”, and “You were jumped”. A CFA was run on the four items to show statistical fit and showed acceptable factor loadings (.54, .68, .52, and .54) with acceptable model fit ($\chi^2 = 17.101, df = 2, p = .0002$, $CFI = .999$, $RMSEA = .019$, $SRMR = .006$). Responses of each category or type were dichotomously coded as 0 (Did not happen) and 1 (Did happen).
The responses of each category or type were then summed (ranged from 0 to 4) to indicate types of violent life events.

**Marijuana use.** From Wave I to Wave III, participants reported the number of times they used marijuana in the past 30 days using a single item. A very small number of participants (<1%) had reported an excessive number of marijuana use, such as reporting number of times marijuana use exceeding 100. Accordingly, values exceeding 60 times in the past month, were recoded as 60, representing twice per day use. Participants who had no lifetime use or who did not use in the past month were scored as having zero use and were included in the analyses.

**Marijuana dependence.** At Wave IV, Add Health used eight items to measure marijuana dependence based on the Diagnostic and Statistical Manual (DSM-IV). The items include “Used marijuana more than you intended”, “Spent a lot of time using marijuana or recovering from its effects”, “Tried to quit using marijuana but could not”, “Experienced withdrawal symptoms”, “Needed to use marijuana more than you used to”, “Gave up on activities because you couldn’t use marijuana”, and “Continued to use marijuana after it caused emotional or health problems”, and “Wanted to quit using marijuana but did not try.” The response options for each item are 0 (No) and 1 (Yes). Participants who marked three or more items were then categorized as having a “1 = emerging dependence” whereas those had less than three items were categorized as “0 = non-dependence.”

**Depressive symptoms.** A modified version of the Center for Epidemiologic Studies-Depression scale (CES-D; Crockett, Randall, Shen, Russell, & Driscoll, 2005) was utilized in the Add Health survey to assess depressive symptoms among the participants at Wave I. The participants indicated how often they had experienced or encountered one or more of 20 depressive symptoms in the past week. Of the 20 items, 18 were on a scale from 0 (never or
rarely) to 3 (most or all of the time). The remaining two items ranged from 0 (never) to 4 (every day). Following the recommended procedure in previous research (Crockett et al., 2005), the items ranging from 0 to 4 were changed so a value of 4 was changed to 3 with the other values being kept the same. A mean score was then created from the twenty items. Cronbach’s alpha of depressive symptoms shows adequate internal reliability ($\alpha = .862$).

**Control variables.** Control variables will include age, gender (male vs. female [0/1]), race/ethnicity (White [0/1], Hispanic [0/1], Black [0/1], and Other [0/1]), parental educational level (less than high school, high school or equivalent, some college, and college degree or beyond [0/3]), and family structure (one vs. two parental household [0/1]).

**Analytical Procedure**

Data management and descriptive analyses were conducted using SPSS version 23. Inferential analyses were further conducted using *Mplus* version 7.3 (Muthén and Muthén, 1998–2015). Survey weights were included to account for attrition and selection probabilities in the sample. With respect to handing the missing data of this study, a full information maximum likelihood (FIML) method was used in *Mplus*. Dealing with missing data using FIML is favorable in the literature, in comparison to listwise and pairwise deletion, because it provides more efficient and robust estimations (Enders & Bandalos, 2001).

A negative binomial latent growth model was used to model the pattern of developmental changes in marijuana use from Wave I to Wave III. This modeling approach allows for estimating the intercept and the slope (increase or decrease) of marijuana use. A latent growth model using a negative binomial distribution was chosen because it is the most appropriate for treating count outcomes with larger variances than means in the outcome variable. A cohort-sequential design was employed, in which age, rather than wave of assessment, was the unit of
time (Bollen and Curran, 2006; Duncan, Duncan, & Strycker 2006; Duncan, Duncan, & Strycker, 2007). Individual Add Health respondents contributed up to three repeated observations of marijuana use and to age overlap, an adequate number of participants at 11 discrete ages were available, and thus, it was possible to model the smoking trajectory from age 15 to 25. Next, both intercept and slope were regressed on the studied variables as well as control variables. The mediation effect of depressive symptoms was further examined via the “Model Indirect” command. Finally, a path analysis was applied to assess the mediating role of depressive symptoms in the relationship between trauma exposure and marijuana dependence (See Figure 2). Gender, ethnicity, family structure, and parental educational levels were included in the analysis to account for preexisting differences in marijuana dependence.

Results

Descriptive Statistics

Table 2 shows the bivariate correlations between the main independent variables and marijuana use from all four waves. Exposure to violent live events ($r = .18, .18, .11, p < .001$, respectively) and mistreatment by an adult ($r = .06, .05, .10, p < .001$, respectively) were significantly related to marijuana use for the first three waves, while depressive symptoms only significant predicted marijuana use at waves 1, 2, and 4 ($r = .10, .09, .02, p < .001$, respectively). Marijuana dependence was significantly related to both exposure to violent life events ($r = .10, p < .001$) and mistreatment by an adult ($r = .07, p < .001$). Full results can be found in Table 2.

Marijuana Use over Time

An unconditional negative binomial growth model was firstly assessed to estimate the trajectory of marijuana use. This initial model (AIC = 65654.34, BIC = 65772.96, and Log-likelihood = -32811.17) had significant means of the intercept ($b = -2.97, SE = .25, p < .001$) and
slope \( (b = 3.17, SE = .44, p < .001) \). In other words, the intercept of the frequency of marijuana use at Wave I (age 15) was approximately less than 1 time in the past month \( (e^{-2.54} = 0.776) \). The significant positive slope \( (e^{-2.54} = 23.81) \) suggests that the frequency of marijuana use increased with age. Variance of the intercept \( (b = 11.26, SE = 1.05, p < .001) \) was significant while it was not for the slope \( (b = 1.94, SE = 1.79, p = .28) \). The estimated amount of marijuana use over time derived from the growth curve is found in Figure 1. Because the variance of slope did not reach statistical significance suggesting it was not differ from zero, it was fixed at zero for the conditional negative binomial growth model.

A conditional negative binomial growth model was then run with demographic variables, mistreatment by an adult, exposure to violent life events, and depressive symptoms predicting marijuana use over time with depressive symptoms being used as a mediator \( (\text{AIC} = 63291.42, \text{BIC} = 63595.38, \text{Log-likelihood} = -31603.71) \). For full results, see Table 3. Both the mean of the intercept \( (\beta = -1.26, SE = .08, p < .001) \) and slope \( (\beta = 2.35, SE = .35, p < .001) \) of were significant at Wave I. When transformed, the intercept at age 15 came out to smoking marijuana less than once in the past month (.28). Many of the variables significantly predicted marijuana use at the beginning of the assessment (age 15)- the mean of the intercept. Being exposed to violent life events \( (\beta = .25, SE = .02, p < .001) \), mistreated by an adult \( (\beta = .08, SE = .02, p < .001) \), and having depressive symptoms \( (\beta = .22, SE = .02, p < .001) \) were related to more marijuana use at age 15 than those who had had not experienced or experienced fewer of these events. With respect to the associations between demographic (control) variable and marijuana use at age 15, the results showed that Black \( (\beta = -.11, SE = .02, p < .001) \) and Hispanic \( (\beta = -.05, SE = .02, p = .02) \) participants reported less marijuana use at age 15 than White participants. Also, participants from two parents household reported less marijuana use than their counterparts.
(β = -.14, SE = .02, p < .001). Gender, being another racial group compared to white, and parents’ education level did not significantly predict marijuana use at age 15. For predicting depressive symptoms, both exposure to violent life events and mistreatment by an adult reached statistical significance (β = .18, SE = .01, p < .001, and β = .13, SE = .01, p < .001, respectively).

In terms of predicting change of marijuana use over time (slope), the results indicate that exposure to violent life events was related to higher use initially, but with a slower increase (β = -.43, SE = .06, p < .001) over time when compared to those who were not exposed. Being mistreated by an adult was associated with higher use at age 15 and a faster increase (β = .21, SE = .07, p = .002) than those who were not mistreated. Depressive symptoms were related to a higher starting point but a slower increase over time (β = -.49, SE = .07, p < .001) than those with lower or no depressive symptoms. In addition, females use increased at a slower rate over time when compared to males (β = -.55, SE = .07, p < .001). While Black and Hispanic participants started at a lower level of marijuana use than Whites did, there was no difference in change over time between Black and White participants (β = -.001, SE = .07, p = .90) or between Hispanic and White participants (β = -.09, SE = .08, p = .26). Higher parents education was related to a faster increase in marijuana use over time (β = .22, SE = .07, p = .003). Participants who were living with two parents had a lower level of marijuana use at Wave I but with a faster increase of use over time (β = .20, SE = .07, p = .005).

With regard to the proposed mediation effect of depressive symptoms, the results of the intercepts showed that there were indirect effects between exposure to violent life events (β = .039, SE = .004, 95% CI = .032, .048, p < .001) and to marijuana use at age 15 as well as mistreatment by an adult and to marijuana use at age 15 (β = .029, SE = .003, 95% CI = .024, .036, p < .001) via individual depressive symptoms. There was also an indirect effect on the path
between violent life events ($\beta = -.09, SE = .01, 95\% CI = -.114, -.064, p < .001$) and mistreatment by an adult ($\beta = -.07, SE = .01, 95\% CI = -.086, -.048, p < .001$) through depressive symptoms for the slope. There continued to be a direct effect from exposure to violence ($\beta = .25, SE = .02, 95\% CI = .274, .350, p < .001, \beta = -.43, SE = .06, 95\% CI = -.114, -.064, p < .001$, respectively) and mistreatment by an adult ($\beta = .08, SE = .02, 95\% CI = .042, .116, p < .001, \beta = .21, SE = .07, 95\% CI = .077, .350, p < .001$, respectively) to marijuana use after mediation at age 15 (intercept) and over time (slope). Taken together, these results suggested that a) there is an indirect effect between depressive symptoms and both exposure to violent life events and mistreatment by an adult at age 15, and b) individuals with depressive symptoms had a greater usage of marijuana at 15 but there may be a ceiling effect of marijuana increase for those starting at such a high rate.

**Marijuana Dependence**

Table 4 shows the path analysis results of marijuana dependence regressed on mistreatment by adults and violent life events with depressive symptoms set as a potential mediator. The model showed adequate model fit ($\chi^2 = 14.76, df = 4, p = .005, CFI=.982, RMSEA=.016$). Exposure to violent life events ($B = .08, SE = .02, OR = 1.08, p < .001$), mistreatment by an adult ($B = .05, SE = .02, OR = 1.05, p = .02$), and depressive symptoms ($B = .04, SE = .02, OR = 1.04, p = .03$) also significantly predicted marijuana dependence. Gender ($B = -.17, SE = .02, OR = .84, p < .001$), parent education ($B = .06, SE = .02, OR = 1.07, p = .004$), and family structure ($B = -.09, SE = .02, OR = .92, p < .001$) all significantly predicted marijuana dependence.

With reference to the proposed mediation results showed that there was an indirect effect from being exposed to violent life events ($B = .01, SE = .004, 95\% CI = .001, .015, p = .03$) and
from being mistreated by an adult ($B = .01, SE = .003, 95\% CI = .000, .011, p = .03$) to marijuana dependence through depressive symptoms. The direct pathways from exposure to violent life events ($B = .08, SE = .02, 95\% CI = .043, .114, p < .001$) and mistreatment by an adult ($B = .05, SE = .02, 95\% CI = .007, .099, p = .02$) to marijuana dependence were still significant after mediation. Meaning, this is a partial and there may be more factors that play a part in this relationship. For full results see Table 4.

**Discussion**

Utilizing a nationally representative longitudinal sample, this study examined the trajectory of marijuana use and the impact of two types of trauma exposure (i.e., exposure to violent life events and mistreatment by an adult) on both marijuana use and marijuana dependence. This study also evaluated the proposed mediating role of depressive symptoms in relation to trauma exposure and marijuana use as well as dependence. Three major findings emerged: First, there was a consistent increase in marijuana use for adolescents and emerging adults with a group of adults categorized as marijuana dependent. Second, both types of trauma exposure and individual depressive symptoms were significantly related to future marijuana use and dependence. Third, there was a significant indirect effect of individual depressive symptoms between trauma exposure and marijuana use as well as dependence. Overall, this study highlights the importance of a) studying marijuana use from adolescence into emerging adulthood, b) considering the long-term impact of trauma exposure, and c) examining the mediating role of depressive symptoms.

**Marijuana Use**

Results from the negative binomial growth model revealed that the prevalence of marijuana use is relatively low by age 15, but increased throughout emerging adulthood. In line with a substantial literature regarding the trend of substance use (Hasin et al., 2015; Dubowitz et
al., 2016) this finding showed a similar pattern in terms of marijuana use, indicating a predicted increase of marijuana use from adolescence until the end of emerging adulthood. The findings of the current study also show that there were a small amount of individuals (6.1%) who have continued using marijuana to the point of becoming marijuana dependent. This finding suggests that it is possible that the risk of marijuana dependence in addition to marijuana use is manifested by individuals who have experienced trauma and later depressive symptoms.

**Trauma Exposure**

This study is consistent with earlier research (Carliner et al., 2016; Werner et al., 2016) and extends it by providing information about different forms of trauma exposure and their associations with the increased risk of future marijuana use (from adolescence into emerging adulthood) as well as marijuana dependence (in adulthood). Specifically, the finding of this present study adds important information to the literature in following ways. The association between trauma exposure and marijuana use at the beginning of the assessment (intercept) and change over time (slope) were revealed. Both mistreatment by an adult during childhood and exposure to violent life events in adolescence were associated with a greater amount of marijuana use at the intercept. Nevertheless, those who were exposed to violent life events than their counterparts had started with a greater amount of marijuana use, while those who were mistreated had started a lower amount of marijuana use. One reason this may be is because exposure to violent life events was measured during adolescence and therefore had a stronger proximal influence at age 15 compared to a distal effect from childhood. There may also be a ceiling effect for those who have been exposed to violent life events.

Furthermore, the result of this work revealed that both mistreatment by an adult during childhood and exposure to violent life events early in adolescence had long-term impacts in
predicting marijuana dependence in adulthood. Those who are exposed to violent life events are 1.08 times more likely to predict marijuana dependence, while those who were mistreated by an adult are 1.05 more likely to predict marijuana dependence. This finding once again confirms and suggests that the recent exposure of a traumatic event had a greater impact on marijuana use outcomes.

**Depressive Symptoms**

Individual depressive symptoms have been proposed to be a potential mediator between trauma exposure and marijuana use and dependence in this present study. The findings showed that there was an indirect effect between trauma exposure and marijuana use outcomes. One reason may be because of self-medication (Khantzian, 1997). Adolescents who have experienced trauma may be dealing with a multitude of depressive symptoms. One way of alleviating these symptoms may be to use marijuana. Even though the results showed that there were indirect effects, it was still a partial mediation. This suggests that depressive symptoms may not be not the only mediator of this relationship. One explanation of this is that there may be more than one mental health problems/disorder, such as anxiety or PTSD, playing a part in trauma exposure and marijuana use outcomes (Cloutier, Blumenthal, & Mischel, 2016). Future research should investigate not only depression but the combination of depression and other mental health problems and their impact on marijuana use and the development of a marijuana disorder.

**Limitations and Conclusions**

There are limitations in this study that should be acknowledged. First, the variable, mistreatment by an adult, was asked at Wave III and is retrospective and may lead to inaccuracies in the data. An ideal dataset would include data from childhood until adulthood that measured mistreatment by an adult when the participant were children. Second, marijuana use
and dependence were self-report. While this may be a limitation, self-report of drug use has been shown to be fairly reliable (Ali et al., 2002; Napper, Fisher, Johnson, & Wood, 2010). Future researchers may include reports from more than one source, which may improve the research by negating the discrepancy between true and reported marijuana use. Third, trauma exposure was not measured using a standardized measure that included a diagnostic status. Future research should investigate the relationship between those who are diagnosed with PTSD and their relationship with marijuana use and dependence to expand the findings. Lastly, some significant results have relative effect size (Odds ratio closes to one)- representing small effects of the given predictors. However, this finding does contribute to the literature, in that it showed that there is still a possible long-term impact of trauma exposure on marijuana dependence in adulthood even though the impact seems to decrease over time.

Notwithstanding the limitations of the paper, there are many strengths. First the dataset is longitudinal and nationally representative. Second, the study covers adolescents and emerging adults’ marijuana use and adults’ marijuana dependence. Third, the results of this paper have implications on children, parents, educators, and researchers alike. Children and adolescents who are exposed to trauma are more likely to experience depressive symptoms and use marijuana in adolescence and emerging adulthood. Those who are exposed to trauma are also more likely to develop a marijuana disorder. Children and adolescents who have experienced traumatic events may be struggling with depressive symptoms and will need a stronger support system. Parents and educators should watch for signs of trauma in order to implement treatment as soon as possible to reduce the impact. Future research should focus on improved methods of therapy to help those who have been impacted by trauma to recover and avoid both depression and future marijuana use and the development of a marijuana use disorder.
References


Table 1. 
*Descriptive statistics of variables*

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<thead>
<tr>
<th>Variables</th>
<th>Range</th>
<th>Mean (SD) or Proportion</th>
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<tr>
<td>Female</td>
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<tr>
<td>Race</td>
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<tr>
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<tr>
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<tr>
<td>Marijuana W1</td>
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<tr>
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<tr>
<td>Marijuana W3</td>
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Table 2.
Correlations among studied variables

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<td>.18**</td>
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<td>.10**</td>
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<td>.07**</td>
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<td>--</td>
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<td>.02**</td>
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<td>.16**</td>
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<td>5. Marijuana W2</td>
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<td>.41**</td>
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<td>7. Marijuana Dependence</td>
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<td>.20**</td>
<td>.41**</td>
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Note: * p<.05, ** p<.01
### Table 3.

*Results of negative binomial growth curve on level of marijuana use with mediation*

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<th>Slope</th>
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<td>Exp (β)</td>
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<td>0.95</td>
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<tr>
<td>Black</td>
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<tr>
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<td>Parent Education</td>
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<td>1.25</td>
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</tr>
<tr>
<td>Mistreatment</td>
<td>.03**</td>
<td>1.03</td>
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*Note:* Results are standardized. *p*<.05, **p**<.01
### Table 4.
*Results of path analysis with mediation*

<table>
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<tr>
<th></th>
<th>B</th>
<th>SE</th>
<th>Odds Ratios (95% CI)</th>
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<td>.05</td>
<td>4.46 (4.07, 4.98)</td>
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<tr>
<td>Gender</td>
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<td>.02</td>
<td>0.84 (.80, .87)</td>
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<td>-.04</td>
<td>.02</td>
<td>0.96 (.91, 1.00)</td>
<td>.081</td>
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<tr>
<td>Black</td>
<td>-.04</td>
<td>.03</td>
<td>0.96 (.91, 1.01)</td>
<td>.117</td>
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<tr>
<td>Other</td>
<td>-.04*</td>
<td>.02</td>
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<tr>
<td>Parent Education</td>
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<td>.02</td>
<td>1.07 (1.02, 1.11)</td>
<td>.004</td>
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<tr>
<td>Family Structure</td>
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<td>.02</td>
<td>0.92 (.88, .96)</td>
<td>.000</td>
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<tr>
<td>Exposure to Violence</td>
<td>.08**</td>
<td>.02</td>
<td>1.08 (1.04, 1.12)</td>
<td>.000</td>
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<tr>
<td>Mistreatment</td>
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<td>.02</td>
<td>1.05 (1.01, 1.10)</td>
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<tr>
<td>Depressive Symptoms</td>
<td>.04*</td>
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<td>1.04 (1.00, 1.09)</td>
<td>.027</td>
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<td>.036</td>
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</table>

*Note: Results are standardized.  *p*.05, **p*.01*
Figure 1

Estimated marijuana use by age
Figure 2
*Depressive symptoms as a mediator in a growth curve and logistic regression*