LONGITUDINAL ASSOCIATIONS BETWEEN PAIN IN ADOLESCENCE AND SUBSTANCE USE IN EMERGING ADULTHOOD

By

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THESIS ABSTRACT

Longitudinal Associations Between Pain in Adolescence and Substance Use in Emerging Adulthood

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This study tested for a longitudinal association between adolescent chronic pain and higher-risk substance use in emerging adulthood, and investigated potential moderators of the hypothesized relationship. A positive association between frequency of pain and substance use was hypothesized. Archival data were drawn from the long-running Panel Study of Income Dynamics (PSID). At an initial assessment, youth aged 13-18 were surveyed regarding frequency of pain, substance use, sense of belonging, frequency of absence from activities, and demographic factors; a follow-up five years later (in emerging adulthood) assessed several measures of use of a number of substances. Using multiple regression analyses, the hypothesized longitudinal relationship between time-1 pain and time-2 substance use was supported for several measures of time-2 substance use. Analyses incorporating the potential moderators of school absence and sense of belonging were conducted for cigarettes, alcohol, and marijuana, revealing a sole significant moderation of the relationship between time-1 pain and time-2 cigarette use by school absence. This study served as an initial foray into a significant gap in literature, addressing overlooked potential future mental health consequences of adolescent chronic pain. Results prompt a call for further research, to strengthen the knowledge base and to make progress

toward developing long-term strategies promoting healthy transitions into adulthood for children suffering from chronic pain.

Acknowledgements

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Introduction

Adolescent chronic pain presents a significant challenge to healthy psychosocial development during a period of great risk for the development of a variety of mental illnesses (Eccleston, Wastell, Crombez, & Jordan, 2008). There is some evidence, though inconsistent, of a concurrent link between chronic pain and increased substance use in adolescence (Britto et al., 1998; Sawyer, Drew, Yeo, & Britto, 2007). A thorough search of the literature revealed no *longitudinal* investigations of the link between adolescent chronic pain and substance use in emerging adulthood (i.e., 18-25; see Arnett, 2000).

Developing an understanding of this potential longitudinal link is critical to furthering our understanding of the long-term mental health outcomes among children with chronic illness and to the development of preventive interventions among adolescents currently experiencing chronic pain. In addition to the psychological resources they need to cope with the additional burden of illness in adolescence, these youth can benefit both from knowledge of the specific psychosocial risks they face later in development as they transition into adulthood and from targeted assistance building the perspectives and skill sets required to make that transition in as low-risk a fashion as possible.

This study tested for an association between adolescent chronic pain and substance use in early adulthood, and investigated two potential moderators of such an association: sense of belonging and school absence. Previous literature has established the individual links in the proposed models with varying degrees of stability. A review of the literature relevant to each link follows, prior to a detailed hypothesis.

Adolescent Chronic Conditions and Increased Risk Behaviors

Assessing the prevalence of chronic pain in adolescence is difficult. A systematic review by King et al. (2011) reported prevalence estimates of musculoskeletal/limb pain among adolescents ranging between 4%-40%; they found similar ranges in the estimation of the prevalence of pain of other etiology. They attribute the wide variance to challenges in definition, measurement, and sampling, among others (King et al., 2011). Sawyer et al. (2007) found similar difficulties in assessing the behavioral correlates of adolescents with chronic conditions.

The systematic reviews referenced above do lead to two conclusions relevant to this study: adolescent chronic pain is prevalent, and adolescents with chronic conditions are more likely to engage in risky behaviors than their healthier peers (King et al., 2011; Sawyer et al., 2007). In particular, the latter include risky sexual activity, tobacco use, and alcohol use; marijuana use appears lower among adolescents with chronic conditions than in those without (Sawyer et al., 2007). However, Sawyer et al. (2007) also note inconsistency in findings of substance use in youth with chronic conditions.

Note that the terms “chronic conditions” and “chronic pain” are not synonymous. Sawyer et al. (2007), in their review, did not limit their search terms to conditions with pain as a feature; however, many of the conditions they considered did have that feature (eg. Sickle Cell Disease and Cystic Fibrosis). Factors stemming from the presence or absence of pain in a chronic illness may mediate or moderate any associations between that illness and engagement in risk behaviors.

Chronic Pain and Substance Abuse

Substance abuse continues to exact a heavy toll on emerging adults. The prevalence of binge-drinking behaviors among adults aged 19-26 ranges from 28%-38%; these rates peak among 21-22 year-olds (Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2014). Alcohol consumption among college students is significantly associated with academic impairment, unwanted and unprotected sexual activity, and sexual assault and coercion (Perkins, 2002). Annual and past-30 day marijuana use is more prevalent among emerging adults than any other age group (Johnston et al., 2014). The percentage of the nation's drug problem consisting of nonmedical prescription drug use has increased steadily since the 1990s; among college students, this behavior has been associated with lower grades and higher rates of use of other substances, among other negative consequences, such as driving after binge drinking and riding as passenger in the vehicle of a drunk driver (Johnston et al., 2014; McCabe, Teter, Boyd, Knight, & Wechsler, 2004).

Iatrogenic pathways to substance abuse frequently involve the prescription of opiate pain medication for chronic noncancer pain (Portenoy, 1996). The swiftly developing tolerance characteristic of opiate exposure over time often requires increasing doses to maintain analgesic effect (Portenoy, 1996). This may lead to not-as-prescribed use of opiate analgesics and/or use of nonprescription or illicit opiates (Streltzer, 1980). Numerous studies (e.g. Fishbain, Cole, Lewis, Rosomoff, & Rosomoff, 2007; McCabe, West, & Boyd, 2013; Streltzer, 1980; Trentadue, Kachoyeanos, & Lea, 1998; Webster & Webster, 2005) have suggested that chronic pain patients receiving opiate analgesic therapy may exhibit

behaviors indicating substance use disorders with or without actually developing these disorders; these include the desire to increase the regular dose of the drug, fear of cessation of the drug, and symptoms of physical withdrawal. By contrast, Proctor et al. (2013) found very low prevalence of substance use disorder diagnoses among a sample of 216 chronic pain patients receiving treatment at a pain clinic; the authors suggest that the severity of patients' illnesses may mediate against the development of such disorders.

The direct pathway from as-prescribed use to nonmedical abuse of opiate analgesics is not the only iatrogenic concern: there is evidence linking as-prescribed use of opiate analgesics to alcohol abuse (Streltzer, 1980; Sullivan, Edlund, Steffick, & Unützer, 2005). Studies also find considerably risky use behaviors among nonaddicted chronic pain patients, including not-as-prescribed use of pain medication and the addition of illicit substances to prescribed medications (Fishbain et al., 2007; Katz et al., 2003). Manchikanti et al. (2006) noted greater prevalence of use of marijuana, cocaine, methamphetamine, and amphetamine (16%) than of opiate abuse (9%) among a sample of 500 chronic pain patients. In an earlier study, Manchikanti and colleagues (2003) found abuse of the above illicit drugs among patients both with and without evidence of co-occurring abuse of prescription medications; rates of abuse of illicit drugs were considerably higher among the population with indications of abuse of prescription substances.

Chronic Pain and School Absence

School absence is one factor, with potential implications for risk behavior, that differs between illnesses featuring chronic pain and those that do not. There is a firmly established correlation between chronic pain and number of days of school missed; according to Newacheck and Taylor (1992), childhood chronic illnesses involving recurrent or chronic pain cause more frequent school absence than other childhood chronic illnesses with a significant impact on functioning. In their comprehensive review, Sato et al. (2007) observed a complex relationship involving interactions between the children with chronic pain and their significant others, including peers; this model suggests that positive peer-group interactions help to moderate against school absence.

Chronic Pain and Peer-Group Belonging

Peer-relationship outcomes among adolescents with chronic pain have received little focused study (Forgeron et al., 2010). In their systematic review of these outcomes, Forgeron et al. (2010) found 42 articles that met their inclusion criteria, only nine of which had peer relationships as their primary focus. These nine studies were not fully capable of measuring sense of peer-group belonging; they tended more toward measurement of social network structure than quality of friendships or other outcomes that may be more closely related to sense of belonging (Forgeron et al., 2010). However, the review concluded that adolescents with chronic pain were more likely to be victimized by peers, to have fewer friends, to be seen as more isolated and less likeable (Forgeron et al., 2010). These findings raise the question of whether or not low sense of peer-group belonging is a potential outcome of adolescent chronic pain. Additionally,

Riva, Wirth and Williams (2011) found in their experiment that inducing physical pain reduced sense of belonging, and led to feelings of exclusion among participants.

Peer-Group Belonging and Substance Abuse

Sense of belonging is considered an essential need for healthy psychological development (Baumeister & Leary, 1995); in its absence, particularly during the risk-laced period of adolescence, several maladaptive behaviors may arise (Valencia & Cromer, 2000). Newman, Lohman and Newman (2007) examined the relationship between peer-group belonging and adolescent behavior problems; they found that youth who rated peer group belonging high in importance but experienced low peer group belonging were more likely to engage in problem behaviors, including substance use. Resnick et al. (1997) established low connectedness in both the family and school contexts as risk factors for substance use.

In the specific context of substance abuse, Valencia and Cromer's (2000) observation that adolescents with chronic conditions may engage in risky behavior out of a desire to "be like the others" may be salient. Suris, Michaud, Akre and Sawyer (2008) cite this aspect of Valencia and Cromer's study in their discussion of findings related to increased risky behaviors including smoking and cannabis use among a sample of 760 chronically ill adolescents in Switzerland.

Hypothesis and Model

Controlling for age, gender, ethnicity, and adolescent substance use (as substance use varies along each variable; see Centers for Disease Control and Prevention, 2015), I hypothesized a positive correlation between frequency of pain in adolescence and substance use in emerging adulthood. This hypothesized main effect may be moderated by frequency of school absence and/or low sense of belonging.

Figure 1 depicts the proposed model of positive association between pain in adolescence and substance use in emerging adulthood; the purpose of this study was to test that relationship and to investigate whether it was moderated by frequency of absence from school and other regular activities and/or sense of peer-group belonging (displayed in Figures 2 and 3).

Substance abuse in emerging adulthood is associated with, among other outcomes, impaired driving, lowered resistance to physical illness, increased risk of addiction, and suicidal ideation and attempts (Johnston, O'Malley, Bachman, Schulenberg, & Miech, 2014; Perkins, 2002); it is vitally important to determine whether emerging adults who suffered chronic pain as teens face a greater struggle navigating these pitfalls.

Method

This study was undertaken through analysis of archival data from the Panel Study of Income Dynamics (PSID). PSID is a long-running household survey, collecting data relevant to physical and mental health in addition to demographic and socioeconomic data. Designed to track changes in income and poverty, the PSID sample was compiled in 1968 from two independent samples: an over-sample of 1,872 low-income families and a nationally representative sample of 2,930 families (PSID, 2015). This original cohort has been followed since 1968 with little mortality; a new representative sample of immigrant families was added in 1997 to reflect post-1968 immigration unaccounted for by the original sample (PSID, 2015). As the families involved in the original data collection grew, new family members have been added to the study. The dataset is produced, maintained and distributed by the University of Michigan through the Institute for Social Research.

The Child Development Supplement (CDS), a comprehensive effort to collect data specifically on children and adolescents (newborn to 17 years) in PSID families, was added in 1997. CDS has been readministered at 5-year intervals. As the initial CDS cohort aged, the Transition to Adulthood study (TA) was implemented to track the older cohort members as they entered emerging adulthood (beginning age 18). Items used in this study were taken from the 2002 CDS-II in-home interview held with all children aged 8-18, and from the wave of TA data that was collected in 2007. The instruments for these two waves provided the data most relevant to the research question.

Youth included in this study were between the ages of 13 and 18 at the initial assessment (2002) and were followed-up 5 years later (2007). Age range at initial assessment was the only sampling criterion: any individual who responded to the selected items in both the CDS-II (2002) and TA 2007 surveys was necessarily between the ages of 13-18 in 2002. This resulted in the inclusion of 1,251 cases out of the 2,907 completed interviews collected for CDS-II (more descriptive statistics available in Table 1).

Predictor Variable and Measure

Chronic pain during adolescence was the predictor variable. A single item about the frequency of physical pain experienced in the last month, taken originally from the National Longitudinal Study of Adolescent to Adult Health (Add Health) was used to gauge pain at the CDS-II initial assessment: "In the last month, how often did you have aches, pains, or soreness in your muscles or joints?" Closed-ended responses ranged from "Never" to "Every day" along a six-point scale.

Outcome Variable and Measures

Substance use in emerging adulthood was the outcome variable. Items regarding the frequency and volume of substance use were used to gauge level of risk of substance use at the TA 2007 follow-up assessment. The substances included were:

- cigarettes
- alcohol
- marijuana
- the following substances, combined into "other drugs":

- diet pills
- amphetamines
- cocaine
- barbiturates
- tranquilizers
- steroids

The "other drugs" composite included all other drugs surveyed in the CDS-II assessment; the choice to combine responses to these items was based on the low number of affirmative responses.

The absence of TA 2007 measures of narcotic/opiate analgesic use was notably unfortunate.

For each substance, multiple items assessed frequency of use in the lifetime, past-12 months, and past-30 days timeframes; each item provided seven response options ranging in frequency from not at all in the given timeframe to 40 or more occasions. Two additional, open-ended items assessed a) average number of alcoholic drinks per day over the past year and b) number of days in the past year on which respondent engaged in heavy alcohol use, defined in the study as 4 drinks for women and 5 for men. All items except alcohol also had an open-ended Time-2 "age at first use" variable; there were Time-1 "age at first use" variables available for cigarettes, alcohol, and marijuana. Race/ethnicity was also assessed at CDS-II; the age item was taken from the previous Child Development Supplement, measured in 1997; and was appended to PSID's ongoing individual

record of each of its respondents rather than being reassessed by each module comprising the dataset.

Statistical Analysis

Multiple regression analyses were conducted separately for each substance listed above, controlling for age, race (1=male, 2=female), and gender (1=white, 2=African-American or other non-white). Analyses involving frequency of cigarette, alcohol, and marijuana use and quantity of alcohol use included an additional control: frequency of use of the same substance at the initial assessment. As noted above, frequency of use in emerging adulthood was the outcome variable; frequency of pain in adolescence was the predictor variable. Tests of association between time-1 pain and binary time-2 measures of whether or not respondents used alcohol, marijuana, cigarettes, and the composite of other drugs (see above) were performed using logistic regression.

Time-1 frequency of absence and peer-group belonging were the potential moderators investigated as part of this study. Absence was measured by two items at the 2002 assessment: "In the last month, how often did a health or emotional problem cause you to miss a day of school?" and "In the last month, how often did a health or emotional problem cause you to miss a social or recreational activity?" Five response options to each ranged from "Never" to "Every day".

Peer-group belonging was measured with several items at the 2002 assessment:

- "In the last month, how often have kids in your school or neighborhood purposely left you out of your friends' activities?"

    - Six responses to the above items range from not at all to every day
- "How close do you feel towards your friends?"
    - Six response options range from "Do not have this person" to "Extremely close".
- "Select the sentence that best describes your feelings during the last two weeks:"
    - "I have plenty of friends"
    - "I have some friends, but wish I had more"
    - "I do not have any friends"

Cronbach's alpha for the variables "left out of things," "plenty of friends," and "close to friends" was low (α=.41); they lacked the consistency required for a true scale. The two absence variables were also inconsistent in this regard (α = .63). However, logical combinations have been considered: rough composites of "belonging" and "absence" were constructed.

As ad-hoc measures, these were not ideal representations of the constructs in question. However, as detailed above, the constructs of absence and belonging have been linked individually with both chronic pain and substance use; the potential for the moderation should be investigated. These ad-hoc measures – like much of this proposed study – serve most effectively as a call for more stringent research into this neglected potential association.

To investigate the potential moderating effects of absence and belonging, multiple regression analyses were conducted. Again, analyses were conducted separately for cigarettes, alcohol, marijuana, and the "other drugs" construct detailed above. Frequency of pain was the predictor variable, entered into two

models: the first with the belongingness composite and the calculated pain-by-belongingness variable, the second with the absence composite and the pain-by-absence variable. The tests again controlled for age, gender, ethnicity, and frequency of use of the outcome-variable substance at initial assessment. There was no prediction regarding the results of this component of the study.

All analyses were conducted with SPSS statistical analysis software.

Results

Tables 1-3 report descriptive statistics for the sample (N=1251, 51% female); mean age in 2002 (i.e. time 1) was 15.05. 24.3% of the sample reported frequent pain; an additional 11.5% reported experiencing pain almost every day or every day (see Table 4). 24.4% reported infrequent pain, and 21.5% said they never experienced pain.

Table 5 displays frequencies of time-1 pain by time-2 substance use. A greater percentage of respondents in the higher categories of pain frequency reported having used cigarettes, alcohol, marijuana, and other drugs than in the lower categories. Detailed results of the regression analyses testing this pattern follow.

Cigarettes

Results related to cigarette use are reported in Table 6. Time-1 pain significantly predicted time-2 use of cigarettes and lifetime use of cigarettes at time 2. Additionally, among those who had used cigarettes by time 2, those who reported more frequent pain in adolescence were more likely to report an earlier age of first use of cigarettes. Time-1 pain did not significantly predict the number of cigarettes smoked by current smokers at time 2.

Alcohol

Time-1 pain was significantly related to time-2 alcohol use. More frequent pain was associated with whether or not respondents reported drinking at time-2 and with higher rates of past-12-months drinking (see Figure 4). Measures of quantity at time-2 (i.e. number of alcoholic drinks per day and frequency of binge

drinking) were not significantly associated with time-1 pain. Table 7 reports these results in detail.

Marijuana

As detailed in Table 8, time-1 pain significantly predicted time-2 marijuana use. Time-1 pain was also significantly associated with frequency of past-12-months use at time 2 (see Figure 5), but association with frequency of past-30-days use was non-significant. Time-1 pain also failed to significantly predict time-2 measures of age at first use of marijuana.

Other Drugs

All cases in which one or more of the six drugs were used with doctor permission were omitted from the data prior to conducting the analyses. Frequency of time-1 pain is associated with use of other drugs (a composite of diet pills, amphetamines, cocaine, barbiturates, tranquilizers, steroids) in emerging adulthood (see Table 9). Time-1 pain also predicted the number of drugs used at time-2, but did not significantly predict the frequency of past-30-days use at time 2, or the earliest age at which any of the six drugs was used.

Moderation

As reported in Tables 10-21, moderation analyses revealed little of significance. The belonging composite failed to affect any measure of the relationship between time-1 pain and time-2 substance use for which a main effect was uncovered (see Tables 6-9). The absence composite significantly moderated the relationship between adolescent pain and cigarette use in emerging adulthood.

Discussion

As hypothesized, adolescent pain significantly predicted a number of outcomes in emerging adulthood. Those with more frequent pain in adolescence were more likely to smoke cigarettes (both at time 2 and in their lifetimes), to drink alcohol, to use marijuana, and to use other drugs in emerging adulthood. Time-1 pain also predicted frequency of past-12-months use of alcohol and marijuana, and frequency of lifetime use of other drugs: those who reported both frequent pain in adolescence and use of each of the relevant substances in emerging adulthood also reported doing so more often.

Results also suggest a particularly notable relationship between time-1 pain and age of first use of cigarettes; those who reported more frequent pain initiated cigarette use earlier. This relationship was not revealed for marijuana or for the other drugs composite. Note that the Transition to Adulthood supplement of the PSID (i.e. time 2) did not assess age of first use of alcohol; it was not possible within this study to test for an association between time-1 pain and time-2 reporting of age of first use of alcohol.

Study of potential moderators was less fruitful. Time-1 absence moderated the relationship between adolescent pain and cigarette use in emerging adulthood; all other moderations were non-significant. The composite was, as stated previously, a less than ideal representation of the construct in question; however, the above logistic regression model appears sound ($\chi^2(7)=133.29$, $p<.001$, $R^2=.266$).

Numerous potential risk factors may place adolescents with frequent pain at additional risk for initiation of use of alcohol, cigarettes, and marijuana by ages

18-23 (mean age at time 2: 20.05). Given the biopsychosocial nature of substance use disorders, it is appropriate to consider factors which may contribute to these findings along biological, psychological, and social/community lines.

Physiological tolerance offers one potential link between frequent adolescent pain and later substance use. Adolescents prescribed opiates for frequent pain develop a tolerance that predisposes them to abuse of their prescriptions as well as to use of illicit opiates (Portenoy, 1996), but there may be biological factors predisposing them to use of further substances (see Streltzer, 1980; Sullivan, Edlund, Steffick, & Unützer, 2005).

Stress is, perhaps, a psychological factor at play in this relationship. Frequent pain may either contribute to or flow in some way from significant stress, which has in turn been shown to increase vulnerability to substance abuse (Gordon, 2002; Sinha, 2008). Additionally, adolescents with frequent pain, whether treated with opiate medications or other prescription or non-prescription analgesics, may develop learned drug-seeking behaviors (e.g. Dinndorf, McCabe, & Frierdich, 1998). Such behaviors would predispose them psychologically to acting on the perception that use of a non-prescribed psychoactive substance is a healthy or otherwise acceptable measure in the face of physical or emotional pain. This is particularly notable in the case of marijuana, whose uses as a potential analgesic have been under study for some time.

Social or community factors may exist that influence both the likelihood of reporting more frequent pain at time-1 and substance use at time-2. For

example, early environmental stressors may both contribute to an increase in the frequency of pain and socialize adolescents toward risky behavior (Gordon, 2002).

The potential social moderators studied herein yielded little for discussion. This may be, in part, because the belonging variables do not account for the nature of the group to which adolescents report belonging; therefore, these analyses could not account for the potential influence of participants who felt belonging to groups with norms that either included substance use or placed members at risk for substance use.

Although those with adolescent pain were more likely to drink alcohol in emerging adulthood, they were not necessarily more likely to drink in higher quantities. Pain in adolescence could not predict either number of drinks per day or number of days participants had 4-5 drinks. It may be that, in order to uncover associations between adolescent pain and patterns of alcohol use in emerging adulthood that involve the dimension of quantity, it is necessary to include other factors in the model that cannot be assessed at present. For example, while adolescent pain alone may predict whether or not people drink in emerging adulthood and how often they may drink in a given year, it may be necessary to add the factor of whether or not they were prescribed opiates (and if so, how often/in what doses) to predict their typical quantity of alcohol use or how often they engage in heavy drinking (Streltzer, 1980; Sullivan, Edlund, Steffick, & Unützer, 2005).

Limitations

A notable limitation of this study was the inability to assess the etiology of self-reported pain; it is possible that some responses to the item refer to pains generated by injury rather than physiopathology or other chronic illness. However, particularly at the higher ends of frequency, this potential difference in etiology may not foul the findings or purpose of this study: if the pain is frequent enough to predict the hypothesized outcome, the pain is of concern. If the hypothesized relationship is revealed in this study, future research efforts should attempt to parse potential differences in outcome dependent on the etiology of the pain predictor.

Another limitation is the inability to assess severity of pain via this survey item. As with etiology, it is possible that severity of pain plays an important role in the proposed model; this study was incapable of determining whether or not this is the case, and so is limited in scope.

There is some peculiarity in the measures used to assess substance use at time-2. Among these, there are items assessing age at first use for every substance except alcohol, and past-30-days use was not assessed for alcohol or for cigarettes. This limited the ability to perform more in-depth analyses in these areas.

Finally, the composites for absence and belonging are each logically reasonable, but statistically questionable. The combination reflected the best possible attempt to measure the constructs in question, given the items available. The lack of significant findings, despite the low validity of the composites, may still usefully rule out potential avenues of future research.

Future Directions

The longitudinal association between pain in adolescence and substance use in early adulthood raises a number of further research questions, geared toward both further elucidation of the association and addressing the limitations of this study. Potential mediators, and moderators other than those proposed herein, would merit consideration. Demographic differences in the association represent another avenue of study. This thesis is capable of discerning some by-drug variations in the proposed association; any such discoveries would also raise further questions for study.

Prospective study of adolescents with chronic pain is the best path forward for such research. Such a design should include the ability to assess etiology of pain, as well as its severity at various time points and its frequency of recurrence. Assessment of a large battery of biological, psychological, and social factors, in addition to risky behaviors including but not limited to substance use, would help uncover modifiers of the relationships revealed in this study.

There are also questions to be asked concerning the role of perceived social support in emerging adulthood. Do teens with frequent pain, whether or not they report a healthy sense of belonging, perceive and/or receive adequate social support from their peer groups? Whether they do or not, how does this social support contribute to or detract from a healthy transition to adulthood? Are teens who either receive inadequate social support, or perceive a lack of same, more likely to engage in risky behavior?

In sum, frequent pain in adolescence predicts patterns of use of a variety of substances in emerging adulthood, including past-year frequency of use of

alcohol and marijuana, early onset of cigarette use, and use of several other drugs. This study was unable to explain the etiology behind this pattern of results; among several other potential directions of future study suggested by the results, other potential pathways of association should be explored.

Figures

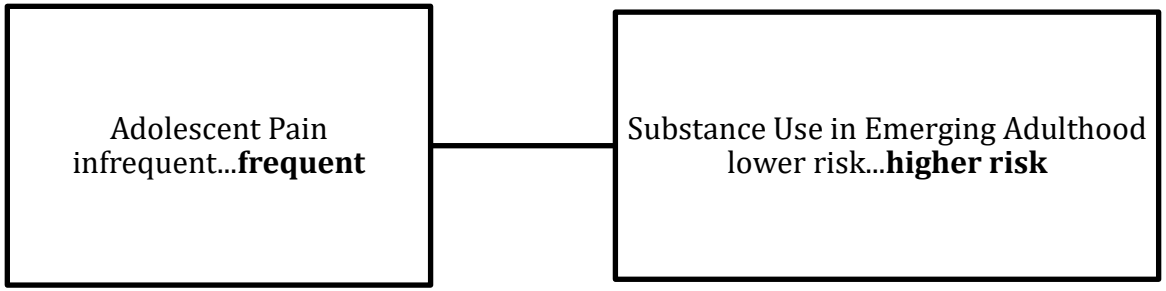

Figure 1. Hypothesized association between time-1 pain and time-2 substance use.

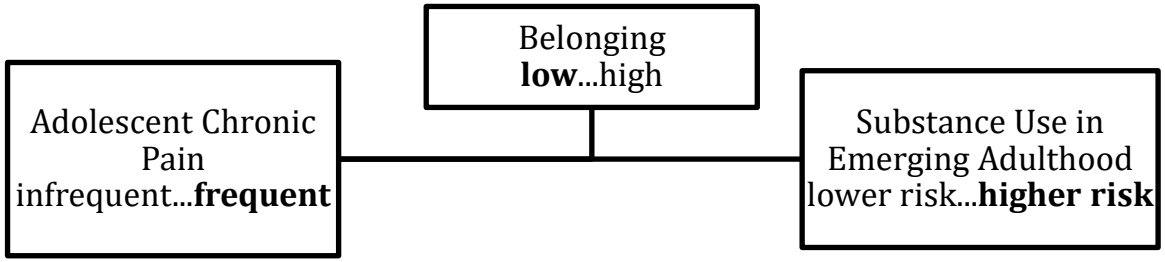

Figure 2. potential model of association between time-1 pain and time-2 substance use moderated by sense of belonging.

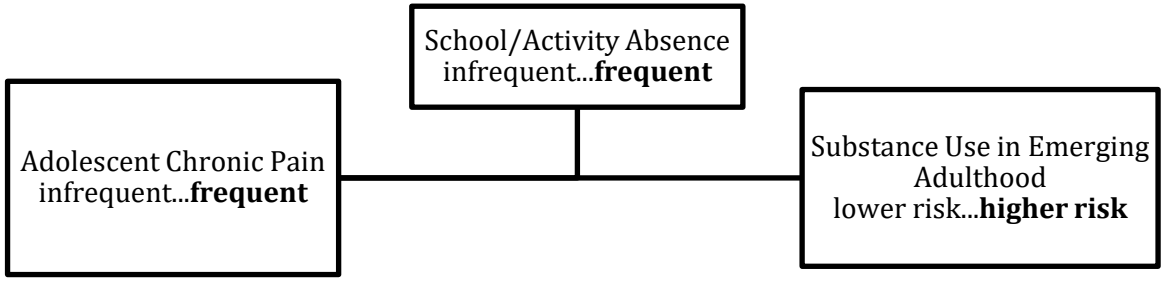

Figure 3. Potential model of association between time-1 pain and time-2 substance use, moderated by absence.

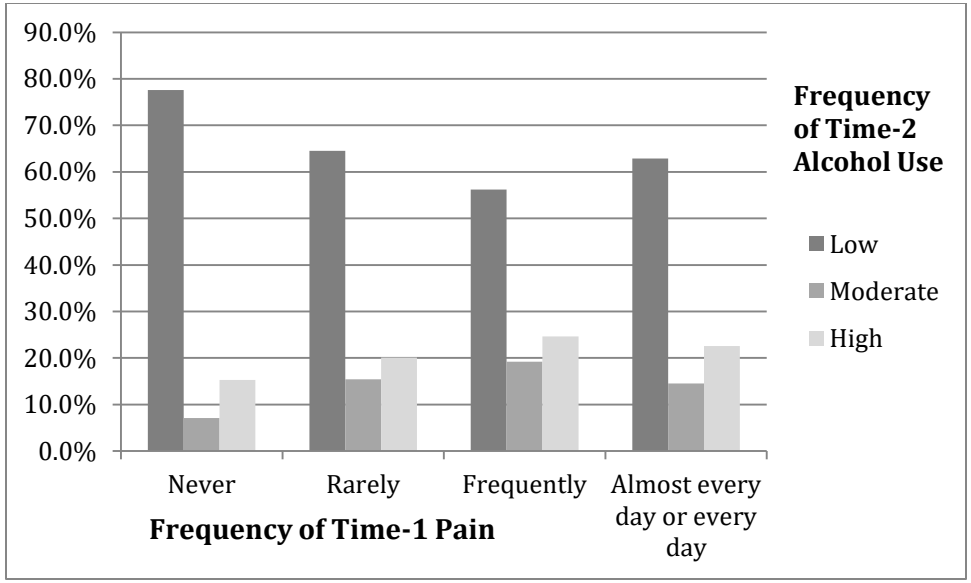

Figure 4. Frequency of time-1 pain, grouped by frequency of time-2 alcohol use.

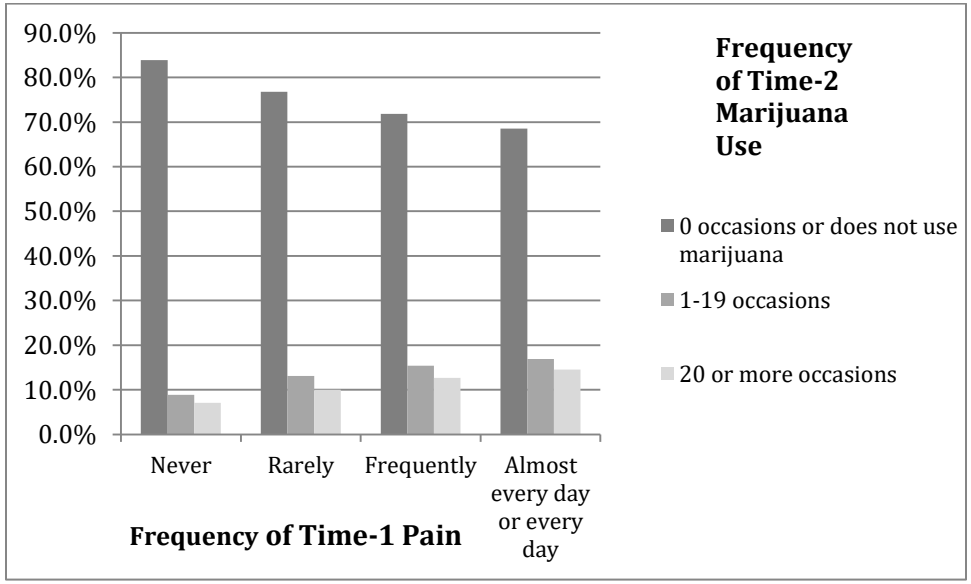

Figure 5. Frequency of time-1 pain, grouped by frequency of time-2 marijuana use.

Tables

Table 1

Age in 2002

Mean	15.05
St. Dev.	1.41
Median	15
Mode	15

Age	N	%
13	238	19.0
14	236	18.9
15	275	22.0
16	235	18.8
17	265	21.2
18	2	.2
Total	1251	100.0

Table 2

Gender

	N	%
Male	613	49.0
Female	638	51.0
Total	1251	100.0

Table 3

Race/Ethnicity

	N	%
African American	366	45.0
White	365	44.9
Hispanic	49	6.0
Asian/Pacific Islander	9	1.1
American Indian or Alaskan Native	2	.2
Multi-Racial	22	2.7
Total	813	100.0
Don't Know	*75*	
Refused	*70*	
Other Missing	*293*	

Table 4

Frequency of Pain

	N	%
Never	206	21.5
Rarely	305	24.4
Frequently	304	24.3
Almost every day or every day	144	11.5
Total	959	100.0
Missing	*292*	

Table 5

Frequencies, Time-1 Pain by Time-2 Substance Use

	Smokes Cigarettes (%)		Drinks Alcohol (%)		Uses Marijuana (%)		Uses Other Drugs (%)	
Pain Frequency	No	Yes	No	Yes	No	Yes	No	Yes
Never	77	23	47	53	68	32	86	14
Rarely	78	22	40	60	60	40	83	17
Frequently	75	25	29	71	54	46	75	25
Almost every day or every day	68	32	30	70	53	47	78	22

Note. Percentages are of total cases in each pain category that did/did not report use of each drug.

Table 6

Regression Results, Time-1 Pain by Time-2 Cigarette Use

	B (SE)	OR (95% CI)	β	*p*
Whether Smokes Cigarettes	.229 (.104)	1.257 (1.025, 1.542)		.028
Whether Ever Smoked Cigarettes	.193 (.095)	1.213 (1.007, 1.461)		.041
# of Cigarettes per Day	.034 (.027)		.041	.204
Age When First Smoked	-.493 (.163)		-.227	.003

Note. "Whether Smokes Cigarettes" and "Whether Ever Smoked Cigarettes" are binary variables; as such, results are those of logistic regression. Other results are of multiple regression analyses.

Table 7

Regression Results, Time-1 Pain by Time-2 Alcohol Use

	B (SE)	OR (95% CI)	β	*p*
Whether Drinks Alcohol	.257 (.090)	1.294 (1.085, 1.543)		.004
Frequency of Past-12-Months Alcohol Use	.142 (.059)		.085	.015
# Alcoholic Drinks per Day	.044 (.028)		.072	.120
# Days Had 4-5 Drinks	1.537 (3.130)		.029	.624

Note. "Whether Drinks Alcohol" is a binary variable; as such, results are those of logistic regression. All other results are of multiple regression analyses.

Table 8

Regression Results, Time-1 Pain by Time-2 Marijuana Use

	B (SE)	OR (95% CI)	β	*p*
Whether Ever Taken Marijuana	.195 (.082)	1.216 (1.035, 1.428)		.017
Frequency of Past-12-Months Marijuana Use	.143 (.071)		.077	.043
Frequency of Past-30-Days Marijuana Use	.076 (.049)		.060	.120
Age When First Used Marijuana	.043 (.143)		.018	.764

Note. "Whether Ever Taken Marijuana" is a binary variable; as such, results are those of logistic regression. All other results are of multiple regression analyses.

Table 9

Regression Results, Time-1 Pain by Time-2 Use of Other Drugs

	B (SE)	OR (95% CI)	β	*p*
Whether Ever Taken Other Drugs	.310 (1.338)	1.303 (1.116, 1.522)		.001
Lifetime Use of Other Drugs	.178 (.060)		.120	.003
Past-12-Months Use of Other Drugs	.063 (.041)		.063	.125
Past-30-Days Use of Other Drugs	.042 (.028)		.061	.136
Age When First Used Other Drugs	-.019 (.200)		-.009	.925
# of Other Drugs Used	.087 (.029)		.120	.003

Note. "Whether Ever Taken Other Drugs" is a binary variable; as such, results are those of logistic regression. All other results are of multiple regression analyses.

Table 10

Regression Results Examining the Interaction Effect of Time-1 Pain and Time-1 Belonging on Time-2 Use of Cigarettes

	B (SE)	OR (95% CI)	*p*
Age	-.064 (.078)	.938 (.805, 1.092)	.410
Gender	-.352 (.203)	.703 (.472, 1.047)	.083
Race/Ethnicity	.121 (.207)	1.129 (.752, 1.695)	.559
Time-1 Frequency of Past-30-Days Cigarette Use	1.050 (.122)	2.856 (2.247, 3.631)	<.001
Frequency of Pain	-.053 (.488)	.948 (.364, 2.469)	.914
Belonging Composite	-1.063 (2.117)	.345 (.005, 21.888)	.616
Frequency of Pain x Belonging	.443 (.752)	1.558 (.356, 6.807)	.556

Table 11

Regression Results Examining the Interaction Effect of Time-1 Pain and Time-1 Belonging on Time-2 Reporting of Age of First Use of Cigarettes

	B (SE)	β	p
Age	.656 (.136)	.375	<.001
Gender	-.072 (.351)	-.015	.837
Race/Ethnicity	-.111 (.358)	-.024	.758
Time-1 Frequency of Past-30-Days Cigarette Use	-.819 (.113)	-.589	<.001
Frequency of Pain	.146 (.763)	.067	.848
Belonging Composite	1.491 (3.465)	.090	.668
Frequency of Pain x Belonging	-.993 (1.180)	-.347	.402

Table 12

Regression Results Examining the Interaction Effect of Time-1 Pain and Time-1 Belonging on Time-2 Use of Alcohol

	B (SE)	OR (95% CI)	*p*
Age	.358 (.069)	1.431 (1.251, 1.637)	<.001
Gender	-.438 (.181)	.645 (.453, .920)	.015
Race/Ethnicity	-1.129 (.188)	.323 (.224, .467)	<.001
Time-1 Frequency of Past-12-Months Alcohol Use	.325 (.078)	1.384 (1.187, 1.614)	<.001
Frequency of Pain	.107 (.434)	1.113 (.476, 2.603)	.805
Belonging Composite	-2.786 (1.720)	.062 (.002, 1.794)	.105
Frequency of Pain x Belonging	.257 (.656)	1.293 (.357, 4.678)	.695

Table 13

Regression Results Examining the Interaction Effect of Time-1 Pain and Time-1 Belonging on Time-2 Frequency of Past-12-Months Use of Alcohol

	B (SE)	β	*p*
Age	1.352 (.984)	.133	.170
Gender	-.542 (.115)	-.163	<.001
Race/Ethnicity	-.804 (.117)	-.243	<.001
Time-1 Frequency of Past-12-Months Alcohol Use	.261 (.042)	.222	<.001
Frequency of Pain	.181 (.276)	.108	.512
Belonging Composite	-.639 (1.132)	-.052	.573
Frequency of Pain x Belonging	-.058 (.425)	-.136	.892

Table 14

Regression Results Examining the Interaction Effect of Time-1 Pain and Time-1 Belonging on Time-2 Reporting of Use of Marijuana

	B (SE)	OR (95% CI)	*p*
Age	.235 (.062)	1.265 (1.120, 1.429)	<.001
Gender	-.559 (.164)	.572 (.414, .789)	.001
Race/Ethnicity	-.441 (.165)	.644 (.466, .889)	.008
Time-1 Frequency of Past-30-Days Marijuana Use	.105 (.039)	1.111 (1.029, 1.199)	.007
Frequency of Pain	.274 (.394)	1.315 (.608, 2.844)	.487
Belonging Composite	-.520 (1.638)	.595 (.024, 14.753)	.751
Frequency of Pain x Belonging	-.138 (.606)	.871 (.266, 2.857)	.820

Table 15

Regression Results Examining the Interaction Effect of Time-1 Pain and Time-1 Belonging on Time-2 Frequency of Past-12-Months of Use of Marijuana

	B (SE)	β	*p*
Age	-.064 (.233)	-.032	.783
Gender	-.968 (.564)	-.196	.090
Race/Ethnicity	-1.753 (.571)	-.356	.003
Time-1 Frequency of Past-30-Days Marijuana Use	.308 (.271)	.136	.258
Frequency of Pain	.503 (1.117)	.206	.654
Belonging Composite	2.149 (4.566)	.129	.639
Frequency of Pain x Belonging	-.192 (1.697)	-.504	.910

Table 16

Regression Results Examining the Interaction Effect of Time-1 Pain and Time-1 Absence on Time-2 Use of Cigarettes

	B (SE)	OR (95% CI)	*p*
Age	-.061 (.078)	.941 (.808, 1.096)	.434
Gender	-.428 (.207)	.652 (.434, .978)	.039
Race/Ethnicity	.096 (.209)	1.100 (.731, 1.656)	.647
Time-1 Frequency of Past-30-Days Cigarette Use	1.059 (.125)	2.884 (2.258, 3.683)	<.001
Frequency of Pain	-.684 (.329)	.505 (.265, .962)	.038
Absence Composite	-4.319 (1.953)	.013 (.000, .612)	.027
Frequency of Pain x Absence	2.042 (.713)	7.710 (1.905, 31.193)	.004

Table 17

Regression Results Examining the Interaction Effect of Time-1 Pain and Time-1 Absence on Time-2 Reporting of Age of First Use of Cigarettes

	B (SE)	β	p
Age	.656 (.134)	.378	<.001
Gender	-.011 (.348)	-.002	.974
Race/Ethnicity	.265 (.185)	.109	.155
Time-1 Frequency of Past-30-Days Cigarette Use	-.839 (.112)	-.605	<.001
Frequency of Pain	.424 (.482)	.196	.381
Absence Composite	4.415 (2.754)	.327	.112
Frequency of Pain x Absence	-1.923 (.981)	-.633	.052

Table 18

Regression Results Examining the Interaction Effect of Time-1 Pain and Time-1 Absence on Time-2 Use of Alcohol

	B (SE)	OR (95% CI)	*p*
Age	.338 (.067)	1.402 (1.228, 1.600)	<.001
Gender	-.382 (.179)	.682 (.480, .970)	.033
Race/Ethnicity	-1.145 (.186)	.318 (.221, .458)	<.001
Time-1 Frequency of Past-12-Months Alcohol Use	.314 (.077)	1.369 (1.177, 1.592)	<.001
Frequency of Pain	.194 (.285)	1.213 (.694, 2.123)	.497
Absence Composite	-.745 (1.608)	.475 (.020, 11.090)	.643
Frequency of Pain x Absence	.157 (.625)	1.170 (.344, 3.984)	.801

Table 19

Regression Results Examining the Interaction Effect of Time-1 Pain and Time-1 Absence on Time-2 Frequency of Past-12-Months Use of Alcohol

	B (SE)	β	*p*
Age	.163 (.403)	.134	<.001
Gender	-.540 (.116)	-.163	<.001
Race/Ethnicity	-.834 (.117)	-.252	<.001
Time-1 Frequency of Past-12-Months Alcohol Use	.273 (.043)	.230	<.001
Frequency of Pain	-.056 (.185)	-.033	.763
Absence Composite	-1.012 (1.069)	-.090	.344
Frequency of Pain x Absence	.470 (.405)	.170	.247

Table 20

Regression Results Examining the Interaction Effect of Time-1 Pain and Time-1 Absence on Time-2 Reporting of Use of Marijuana

	B (SE)	OR (95% CI)	*p*
Age	.238 (.062)	1.269 (1.123, 1.433)	<.001
Gender	-.566 (.165)	.568 (.411, .785)	.001
Race/Ethnicity	-.489 (.165)	.613 (.444, .846)	.003
Time-1 Frequency of Past-30-Days Marijuana Use	.101 (.038)	1.106 (1.026, 1.192)	.009
Frequency of Pain	.219 (.263)	1.245 (.743, 2.086)	.405
Absence Composite	.958 (1.522)	2.607 (.132, 51.518)	.529
Frequency of Pain x Absence	-.096 (.574)	.908 (.295, 2.798)	.867

Table 21

Regression Results Examining the Interaction Effect of Time-1 Pain and Time-1 Absence on Time-2 Frequency of Past-12-Months of Use of Marijuana

	B (SE)	β	p
Age	-.068 (.236)	-.034	.228
Gender	-.838 (.581)	-.169	.153
Race/Ethnicity	-1.739 (.565)	-.352	.003
Time-1 Frequency of Past-30-Days Marijuana Use	.372 (.274)	.159	.180
Frequency of Pain	.305 (.798)	.123	.704
Absence Composite	-1.239 (4.120)	-.086	.765
Frequency of Pain x Absence	.157 (1.538)	.042	.919

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