Bidirectional Relationships Between Pain, Cannabis Use, and Tobacco Use in US Representative Sample

Dana Rubenstein, BA
Michael J. Green, PhD
Maggie M. Sweitzer, PhD
Francis J. Keefe, PhD
F. Joseph McClernon, PhD

Department of Psychiatry and Behavioral Sciences
Duke University School of Medicine

Introduction

- One-fifth of US adults suffer from chronic pain, which is associated with poor quality of life and poor mental health
- People with chronic pain are also at increased risk of tobacco and cannabis use
- Increased pain is associated with increased risk of co-use vs exclusive tobacco or cannabis use
- Bidirectional relationships between tobacco and pain have been demonstrated, but pathways between pain, cannabis use, and co-use are understudied
- We aimed to estimate the effect of substance use on later pain intensity and conversely, the effect of pain intensity on later substance use

Methods

- Data were from 30,575 adults in biennial surveys (2015-2021) of the US nationally-representative longitudinal cohort study: the Population Assessment of Tobacco and Health Study (n=65,686 pairs of consecutive surveys; T1 and T2)
- Participants rated past-week average pain intensity from 0 (no pain) to 10 (worst pain imaginable)
- Ratings >4/10 were deemed moderate/severe pain and ≤4/10 deemed no/low pain
- Four mutually exclusive substance use categories were defined based on past 30-day use: no cannabis/tobacco use; exclusive cannabis use; exclusive tobacco use; co-use
- Bidirectional effects of tobacco/cannabis and pain were estimated in two analyses:
    1) logistic regression assessing if T1 substance use affected moderate/severe pain at T2, with/without adjusting for T1 pain
    2) multinomial model assessing if pain status at T1 affected substance use at T2, with/without adjusting for T1 substance use

Causal diagrams of the relationship between substance use and pain in consecutive surveys
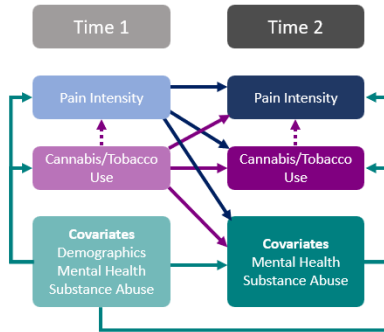
Results

Probability of T2 Pain by T1 Substance Use Category
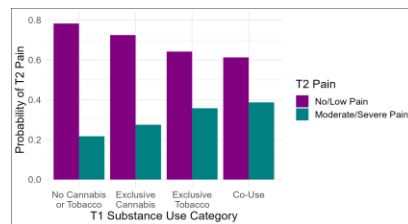
Weighted prevalence of demographic and psychosocial characteristics by T1 pain status across analytical sample (N= 65,686 pairs of waves)

| Characteristic	No/Low Pain n = 47,628	Moderate/Severe Pain n = 18,058	Overall N = 65,686
Sex			
Male	49.6%	44.8%	48.3%
Female	50.4%	55.2%	51.7%
Age			
18-24	13.9%	9.4%	12.7%
25-34	19.2%	13.5%	17.6%
35-44	17.2%	14.0%	16.3%
45-54	15.7%	19.0%	16.6%
55-64	16.1%	21.7%	17.7%
65-74	16.0%	20.1%	17.1%
75+	1.8%	2.4%	2.0%
Race/Ethnicity			
Non-Hispanic White	67.2%	63.9%	66.3%
Non-Hispanic Black	10.1%	14.4%	11.3%
Hispanic	13.8%	15.0%	14.2%
Non-Hispanic Other	8.8%	6.6%	8.2%
Education			
Less than High School	8.1%	16.2%	10.3%
High School or More	91.9%	83.8%	89.7%
Past 30-day Alcohol Use	58.2%	48.8%	55.6%
Internalizing Symptoms			
Low	72.0%	52.5%	66.7%
Moderate	18.2%	25.5%	20.2%
High	9.8%	22.0%	13.1%
Externalizing Symptoms			
Low	80.5%	70.5%	77.8%
Moderate	18.2%	26.1%	20.4%
High	1.3%	3.4%	1.9%
Substance Abuse			
Low	86.9%	81.8%	85.5%
Moderate	10.5%	13.0%	11.2%
High	2.6%	5.2%	3.3%

Logistic regression model of the effect of T1 substance use category on T2 moderate/severe pain (N= 65,686)

	Unadjusted				Main Effects[a]				Sensitivity Analysis[b]			
	OR	CI Low	CI High	P-value	OR	CI Low	CI High	P-value	OR	CI Low	CI High	P-value
Co-Use	1.81	1.67	1.96	<0.001	2.28	2.08	2.50	<0.001	1.74	1.61	1.89	<0.001
Exclusive Cannabis	1.08	0.91	1.29	0.396	1.37	1.14	1.64	0.001	1.15	0.97	1.36	0.103
Exclusive Tobacco	1.83	1.70	1.97	<0.001	2.01	1.87	2.15	<0.001	1.59	1.49	1.70	<0.001

Multinomial regression model of the effect of T1 moderate/severe pain on T2 substance use category (N= 65,686)

Reference Group	Outcome	Unadjusted				Main Effects[a]				Sensitivity Analysis[b]			
		OR	CI Low	CI High	P-value	OR	CI Low	CI High	P-value	OR	CI Low	CI High	P-value
No cannabis or tobacco	Exclusive cannabis	1.29	1.29	1.13	<0.001	1.49	1.31	1.71	<0.001	1.24	1.08	1.42	0.002
	Exclusive tobacco	2.00	1.91	2.29	<0.001	2.16	2.01	2.32	<0.001	1.24	1.08	1.42	0.002
	Co-use	2.09	2.00	1.85	<0.001	2.47	2.24	2.71	<0.001	1.67	1.51	1.85	<0.001
Exclusive cannabis	Exclusive tobacco	1.55	1.36	1.78	<0.001	1.45	1.27	1.65	<0.001	1.22	1.06	1.40	0.005
	Co-use	1.63	1.43	1.86	<0.001	1.65	1.45	1.88	<0.001	1.35	1.18	1.55	<0.001
Exclusive tobacco	Co-use	1.05	0.96	1.14	0.303	1.14	1.04	1.25	0.004	1.11	1.01	1.21	0.029

Probability of T2 Substance Use by T1 Pain Status
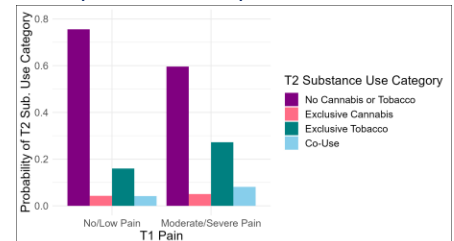
Conclusions

- Findings demonstrated bidirectional relationships between pain and the exclusive use and couse of cannabis and tobacco
- Results demonstrate that cannabis may be situated in a positive feedback loop with pain, as has been previously demonstrated for tobacco
- Results indicate potential synergy in the co-use of cannabis and tobacco with respect to pain
- Co-use was the most likely substance use pattern to lead to subsequent moderate/severe pain, and moderate/severe pain was more likely to lead to co-use than either exclusive cannabis or tobacco use
- The acute analgesia offered by both the exclusive and co-use of cannabis and tobacco may increase use of these substances, which ultimately worsens pain in the long-term via central sensitization, perpetuating the cycle of pain and cannabis and tobacco use