

# General and Domain-Specific Perceived Risk Demonstrate Unique Associations with Cannabis Use, Negative Outcomes, and Motivation to Change among Undergraduate Students

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## ABSTRACT

College student cannabis use is at an all-time high. Although frequent heavy cannabis use is related to cannabis problems, perceived risk of cannabis use is rapidly decreasing. Yet, it is unknown whether specific domains of risk perceptions (general and domain-specific risk, risk to others and personal risk) are related to more cannabis use or related problems. Thus, among 130 undergraduates who reported past-month cannabis use, the present study conducted secondary analyses to test whether, for both perceived risk to others and perceived personal risk: (1) general perceived risk was associated with cannabis-related outcomes (i.e., use, negative consequences, cannabis use disorder (CUD) symptoms, motivation to change), (2) seven specific domains of perceived risk were related to cannabis outcomes, and (3) domain-specific perceived risk was related to cannabis use frequency. General perceived risk to others was negatively associated with cannabis use frequency whereas general perceived personal risk was positively associated with cannabis-related negative consequences, CUD symptoms, and importance and readiness to change. Greater legal and withdrawal/dependence risks were uniquely related to several outcomes (e.g., CUD symptoms). Participants who used cannabis frequently perceived more personal risk in most risk domains and less general risk to others than those who used infrequently. Findings suggest personal risk is an important component to consider when assessing perceived risk of cannabis use and focusing on both general and domain-specific risks may provide valuable insight for future prevention and intervention efforts.

**Key words:** = perceived risk; undergraduates; cannabis; motivation to change; college students

Cannabis use among US undergraduate students is reaching some of the highest levels ever recorded. In 2021, 40.3% of undergraduates reported past-year and 24.2% past-month cannabis use (Patrick et al., 2019). Daily or near

daily cannabis use rates also remain high (Patrick et al., 2019), which is concerning given heavier use is associated with increased likelihood and severity of unwanted physical and psychosocial outcomes, including cannabis use disorder (CUD);

Caldeira et al., 2008; Gunn et al., 2020), poorer mental health (Keith et al., 2015), and worse academic outcomes (Suerken et al., 2016).

Despite known risks of cannabis, perceived risk of regular use (i.e., one's perceptions of the negative effects of using substances; Danseco et al., 1999) has rapidly *decreased* over the past 20 years and is at some of the lowest levels ever recorded among undergraduates (Lipari & Jean-Francois, 2016). This is particularly notable compared to trends in alcohol and tobacco risk perceptions, which remain relatively stable (Waddell, 2022; Lipari & Jean-Francois, 2016). Rapid decrease in perceived risk of cannabis use is especially troubling, as perceived risk is a critical determinant of health-related behavior (Janz & Becker, 1984; Kasten et al., 2019), contributes to motivation to change risky behaviors (Kasten et al., 2019), and prospectively predicts changes in cannabis use (Azofeifa et al., 2016; Bachman et al., 1998; Bachman et al., 1988; Compton et al., 2016).

Among undergraduates, perceived risk may protect against initiating cannabis use (D'Silva et al., 2020; Hanauer et al., 2021). However, few undergraduates report believing regular cannabis use confers "great risk" of harm (Lipari & Jean-Francois, 2016), and some evidence suggests more frequent cannabis use is associated with decreases in risk perception over time (Grevenstein et al., 2015). Students who experience negative consequences due to their cannabis use *still* report low perceived risk, with no difference in risk perception between those who had and had not experienced certain cannabis-related negative consequences (Kilmer et al., 2007). As such, a more detailed understanding of how undergraduates conceptualize risk of cannabis is needed, particularly among those using frequently.

Existing research has examined *perceived risk to others* (i.e., how much others risk harming themselves from using cannabis) and *perceived personal risk* (i.e., how much an individual risks harming themselves at their current rate of cannabis use). Most population-based studies assess perceived risk to others (Azofeifa et al., 2016; Bachman et al., 1998; Bachman et al., 1988; Compton et al., 2016; Grevenstein et al., 2015; Lipari & Jean-Francois, 2016) whereas research on perceived personal risk is limited. Some studies found perceived personal risk is higher

among undergraduates who use more frequently compared to those who use less frequently (O'Callaghan et al., 2006) and is cross-sectionally associated with cannabis-related negative consequences among adults who use cannabis (Magnan & Ladd, 2019). However, other studies did not find associations between perceived personal risk and use frequency (Kilmer et al., 2007; Magnan & Ladd, 2019) or the experience of negative consequences (Kilmer et al., 2007). Given these inconsistencies, additional research is needed to better understand and explain discrepancies. This is particularly important when considering how perceived risk may be useful to inform cannabis prevention and intervention programs, and how perceived risk to others versus personal risk may maintain varying salience for individuals.

There is also considerable variability in perceived risk across different domains of risk (e.g., physical harm, dependence, legal risks; O'Callaghan et al., 2006). Although only 30.4% of undergraduates reported believing regular cannabis use puts the user at great risk for harm generally, over 50% reported regular use puts the user at great risk for physical dependence, finding it hard to stop using, and performing worse at school/work. Thus, undergraduates may perceive specific aspects of cannabis use as risky, which may obfuscate effects on use patterns when only examining general risk.

### *The Current Study*

The current study sought to expand prior work (Kilmer et al., 2007; Magnan & Ladd, 2019; O'Callaghan et al., 2006) on general vs domain-specific perceived risk to self and others. First, we examined associations between general perceived risk to others and general perceived personal risk with cannabis outcomes (i.e., past 3-month cannabis use frequency, cannabis-related negative consequences, CUD symptoms, motivation to change). We hypothesized general perceived risk to others would be negatively associated with cannabis use, negative consequences, and CUD symptoms, general perceived personal risk would be positively associated with these outcomes, and both variables would be positively associated with motivation to change. Second, we tested whether seven domains of perceived risk (i.e., productivity,

lower energy, memory loss or cognitive impairment, problems at school/work, physical health problems, legal problems, dependence/withdrawal) to others and self were cross-sectionally associated with general perceived risk and outcomes. Consistent with prior work (O'Callaghan et al., 2006), we hypothesized dependence/withdrawal and problems at school/work would emerge as significant predictors of cannabis outcomes.

Third, as some prior work found differences in perceived risk by use frequency (e.g., Okaneku et al., 2015), we tested whether domains of risk differed by use frequency. Compared to students who use less than weekly, undergraduates who use cannabis weekly or more experience more negative consequences and CUD symptoms (Buckner et al., 2008; Burdzovic Andreas et al., 2021) and are more likely to meet criteria for CUD (Burdzovic Andreas et al., 2021). Thus, we hypothesized participants who engaged in cannabis use weekly or more (compared to less frequently) would rate perceived personal risk domains as higher, but risk to others as lower.

The present aims were tested through secondary data analyses from a study that developed and tested problem-focused personalized feedback (PFI) against brief personalized normative feedback (PNF; Morris & Buckner, 2023; Walukevich-Dienst et al., 2021; Walukevich-Dienst et al., 2019). Neither domains of risk nor baseline associations between risk domains and outcomes were examined as part of the parent study primary aims. Participants who received an extended problem-focused intervention were asked to reflect on and rate their perceived risk of cannabis as part of the intervention.<sup>1</sup>

## METHODS

### *Participants*

Participants were from a sample of 268 undergraduates recruited for the parent intervention trial (Morris & Buckner, 2023; Walukevich-Dienst et al., 2021; Walukevich-Dienst et al., 2019). For the parent study, eligible participants were current undergraduate

students at Louisiana State University who reported past-month cannabis use and at least one cannabis-related problem in the past three months. The current study utilized baseline data from 130 undergraduates (47.8% of total sample, 76.2% female,  $M_{\text{age}}=19.8$  years,  $SD=1.3$ ) who completed questions about domains of perceived risk as part of their intervention and passed attention check questions (described in Procedures below). Of participants, 73.1% identified as non-Hispanic/Latin White, 14.6% Black, 2.3% Asian, and 3.1% multiracial; 6.9% Hispanic/Latin.

### *Procedures*

Participants were recruited through the psychology department's online research pool or on-campus flyers. The parent study was advertised as a two-part study on cannabis use rather than an intervention study to recruit participants with a range of motivation to change. Interested participants first completed an online screening survey to determine eligibility. Eligible participants were immediately directed to the online baseline survey and randomized to the online PFI condition or PNF-only condition. The analytic sample for the current study includes participants randomized to the PFI condition, as only PFI participants answered questions about domain-specific perceived risks. The PFI condition included PNF on cannabis use and related problems and brief psychoeducation modules on seven empirically informed domains of risk (see Measures). Upon starting each module, participants were asked to rate domain-specific perceived risk (see Measures). Participants also indicated which of 10 DSM-5 symptoms of CUD they experienced in the past year during the dependence/withdrawal module.<sup>2</sup> Participants received personalized feedback on CUD based on number of endorsed CUD symptoms. Intervention modules were presented in a randomized order to control for order presentation effects. More information about the intervention and procedures can be found in Walukevich-Dienst et al. (2019) and Walukevich-Dienst et al. (2021).

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<sup>1</sup>Intervention findings indicated no main effect of condition on cannabis use frequency, consequences, or ratings of general perceived risk (Walukevich-Dienst, 2019). Further information can be found in Morris & Buckner, 2023, Walukevich-Dienst et al., 2021, and Walukevich-Dienst et al., 2019.

<sup>2</sup> Continued use despite having persistent or recurrent social and interpersonal problems was not included due to a programming error.

Psychology pool participants received research credits and non-psychology pool participants were compensated \$10 for baseline and \$20 for follow-up. The study was approved by the university's institutional review board and we obtained a Certificate of Confidentiality from the National Institute of Mental Health. Informed consent was obtained prior to data collection and all procedures maintained adherence to APA ethical guidelines for research with human subjects (Sales & Folkman, 2000).

### Measures

#### Marijuana Use

The *Marijuana Use Form* (MUF; Buckner et al., 2007) is an 11-item measure used to assess past 3-month cannabis use frequency (0=*none or less*, 6=*3 or 4 times a week*, 10=*21 times per week or more*). In addition to the categorical MUF outcome score, a categorical measure of use frequency was created to test whether perceived risk differed between participants who used frequently (i.e., once a week or more) or infrequently (i.e., less than once a week).

#### Marijuana Problems

The modified 30-item *Marijuana Problems Scale* (Stephens et al., 2000; Walukevich-Dienst et al., 2019) assessed past 3-month cannabis-related problems. Participants rated each problem from 0 (*no problem*) to 2 (*serious problem*) and items were converted to a count score of cannabis-related problems. The 30-item modified version demonstrated excellent internal consistency ( $\alpha=0.96$ ).

#### Perceived Risk of Cannabis Use

*General perceived risk* was measured using the perceived risk item from the Monitoring the Future Project (Schulenberg et al., 2021) which was modified to specify using “regularly” as using cannabis once a week or more per prior work (O’Callaghan et al., 2006). Participants were asked to rate *general perceived risk to others* (i.e., “How much do you think people risk harming themselves physically or in other ways if they use marijuana regularly [once a week or

more]?”) and *general perceived personal risk* (i.e., “How much do you think you risk harming yourself physically or in other ways if you use marijuana at your current rate of use?”) from 1 (*no risk*) to 4 (*great risk*). Additionally, using the same scale, participants rated *domain-specific perceived risk to others* (e.g., “How much do you think people risk having lower energy if they use marijuana regularly?”) and *domain-specific perceived personal risk* (e.g., How much do you think you risk having lower energy if you use marijuana at your current rate of use?”) for all seven domains (i.e., productivity, lower energy, cognitive impairment, problems at school/work, physical health problems, legal problems, dependence and withdrawal). Domains were empirically informed through prior work identifying areas of low perceived risk (O’Callaghan et al., 2006) and frequent cannabis-related problems among undergraduates (Buckner et al., 2010).

#### Cannabis Use Disorder (CUD) Symptoms

*CUD Symptoms* were measured by asking participants whether they had experienced (0=*no*, 1=*yes*) 10 different symptoms of CUD in the past year.<sup>2</sup> Responses were converted to a count score of the ten items ( $\alpha=0.77$ ). Symptoms were derived from DSM-5 criteria of CUD (e.g., “In the past year, have you used marijuana in larger amounts or for longer periods of time than you meant to?”). Number of CUD symptoms was significantly, positively associated with past 3-month cannabis use frequency ( $r=.44$ ,  $p<.001$ ) and negative consequences ( $r=.52$ ,  $p<.001$ ).

#### Motivation to Change Cannabis Use

*Motivation to Change Rulers* (Buckner et al., 2016) were used to assess readiness (0=*not ready to change* to 10=*trying to change*), importance (0=*not important* to 10=*very important*), and confidence (0=*not at all confident* to 10=*most confident*) to change. Rulers were based on work by Miller and Rollnick (2013) and shown to be associated with changes in cannabis use in prior work (Gates et al., 2012; Walukevich-Dienst et al., 2021).

To detect careless responding, three attention check questions were included in both

baseline and follow-up surveys (e.g., “Please select ‘strongly agree’ as your answer to this question”). Participants ( $n=2$ ) were excluded from data analysis if they failed attention check by answering two or more attention check questions incorrectly (Meade & Craig, 2012).

### *Data analyses*

Analyses were conducted using SPSS version 29. First, we examined descriptive statistics and bivariate correlations among measures. Second, we conducted 14 two-step hierarchical multiple regression analyses for each independent variable (IV): (1) perceived risk to others domains and (2) perceived personal risk domains on the following dependent variables (DV): general perceived risk to others, general perceived personal risk, cannabis use frequency, cannabis-related negative consequences, CUD symptoms, and readiness, importance, and confidence to change. Notably, both independent variables were only examined as predictors of their respective general perceived risk DVs. In step one, sex assigned at birth and age were entered as covariates. Use frequency was also entered as a covariate in step one for all models except the use frequency model. In step two, the seven risk domains were entered simultaneously as IVs. We conducted separate models for each DV and computed squared semi-partial correlations ( $sr^2$ ) as effect size indices. Third, we used a one-way analysis of covariance (ANCOVA) model to test differences in perceived risk by use frequency, controlling for age and sex assigned at birth, using a Bonferoni-corrected p-value ( $<.003$ ) to correct for multiple comparisons.

## RESULTS

### *Descriptive Statistics and Bivariate Correlations*

On average, participants used cannabis approximately twice per week and experienced 8.00 negative consequences ( $SD=5.08$ ) in the past 3-months. Average use was comparable to the defined “regular use” frequency (i.e., once or more a week) specified for perceived risk to others. Importance ( $M=4.6$ ,  $SD=3.03$ ) and readiness ( $M=3.25$ ,  $SD=3.12$ ) to change were

low, whereas confidence to change was high ( $M=8.18$ ,  $DS=2.42$ ). Nearly 85% of participants reported no-to-slight perceived risk of regular use to others, whereas nearly 94% reported no-to-slight perceived personal risk. Risk to others and self was highest for legal problems and lowest for physical health problems. On average, participants rated risk to others as having slight-to-moderate risk across domains, whereas personal risk was rated as no-to-slight risk across domains. Descriptive statistics are provided in Table 1.

Correlations between use frequency, negative consequences, CUD symptoms, and general and domain-specific perceived risk are displayed in Table 2. Both general perceived personal risk and the majority of perceived personal risk domains were significantly, positively associated with use frequency, negative consequences, and CUD symptoms. Perceived personal risk variables were not associated with most risk to others variables, with a few exceptions. Only a few perceived risk to others variables were associated with use frequency, consequences, and CUD symptoms. For example, use frequency was significantly, negatively associated with legal and dependence/withdrawal risk to others domains. For motivation to change variables, general perceived personal risk was significantly, positively associated with readiness ( $r=.23$ ,  $p=.007$ ) and importance ( $r=.24$ ,  $p=.005$ ) to change. Cognitive risk to others was significantly, positively associated with readiness ( $r=.22$ ,  $p=.013$ ) and importance ( $r=.23$ ,  $p=.008$ ) to change. Personal risk of lower productivity was positively related to importance ( $r=.23$ ,  $p=.030$ ), whereas confidence to change was negatively associated with five risk domains for both personal risk and risk to others (i.e., low energy, cognitive, school/work problems, physical health, dependence/withdrawal;  $rs = -.17$  to  $-.28$ ,  $ps < .05$ ).

Table 1. Means, Standard Deviations, and Frequencies of General Perceived Risk and Risk Domains

Item	Mean	SD	No risk (%)	Slight risk (%)	Moderate risk (%)	Great risk (%)
<b>Perceived Risk to Others</b>						
General perceived risk	1.73	0.81	46.2	38.5	11.5	3.8
Less productive	2.52	0.78	9.4	37.5	44.5	8.6
Lower energy	2.44	0.80	11.7	40.6	39.8	7.8
Cognitive impairment	2.25	0.78	15.6	49.2	29.7	5.5
Problems at school or work	2.35	0.84	17.1	37.2	39.5	6.2
Physical health problems	2.05	0.91	33.3	34.1	27.1	5.4
Legal problems	2.64	0.92	13.2	27.1	42.6	17.1
Dependence and withdrawal	2.30	0.9	21.3	36.2	33.9	8.7
<b>Perceived Personal Risk</b>						
General perceived risk	1.37	0.65	70.8	23.1	4.6	1.5
Less productive	1.84	0.85	38.8	44.2	10.9	6.2
Lower energy	1.77	0.83	43.4	41.9	9.3	5.4
Cognitive impairment	1.71	0.75	45.7	39.5	13.2	1.6
Problems at school or work	1.60	0.75	55.0	30.2	14.0	0.8
Physical health problems	1.54	0.71	56.6	34.1	7.8	1.6
Legal problems	1.82	0.92	45.0	35.7	11.6	7.8
Dependence and withdrawal	1.59	0.78	55.8	32.6	8.5	3.1

Table 2. Correlations between Use Frequency, Negative Consequences, CUD Symptoms, and General and Domain-Specific Perceived Risk

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Use Frequency	1	-																	
2. Consequences	-.01	1																	
3. CUD Symptoms	<b>.44**</b>	<b>.52**</b>	1																
4. General Risk <sup>P</sup>	.11	<b>.31**</b>	<b>.27*</b>	1															
5. General Risk <sup>O</sup>	<b>-.28*</b>	<b>.18</b>	.01	<b>.50**</b>	1														
6. Productivity <sup>P</sup>	<b>.33**</b>	<b>.24*</b>	<b>.42**</b>	<b>.26*</b>	-.001	1													
7. Low Energy <sup>P</sup>	<b>.42**</b>	<b>.21</b>	<b>.40**</b>	<b>.27*</b>	-.04	<b>.78**</b>	1												
8. Cognitive <sup>P</sup>	<b>.51**</b>	<b>0.2</b>	<b>.45**</b>	<b>.30**</b>	-.01	<b>.59**</b>	<b>.67**</b>	1											
9. School/Work <sup>P</sup>	<b>.31**</b>	<b>.22</b>	<b>.39**</b>	<b>.23*</b>	.05	<b>.68**</b>	<b>.73**</b>	<b>.60**</b>	1										
10. Physical Health <sup>P</sup>	<b>.27*</b>	<b>.24*</b>	<b>.31**</b>	<b>.38**</b>	<b>.18</b>	<b>.64**</b>	<b>.63**</b>	<b>.62**</b>	<b>.65**</b>	1									
11. Legal <sup>P</sup>	<b>.32**</b>	-.01	<b>.19</b>	.13	-.13	<b>.59**</b>	<b>.55**</b>	<b>.50**</b>	<b>.47**</b>	<b>.46**</b>	1								
12. Dependence <sup>P</sup>	<b>.39**</b>	<b>.29**</b>	<b>.42**</b>	<b>.30**</b>	.02	<b>.61**</b>	<b>.58**</b>	<b>.67**</b>	<b>.59**</b>	<b>.66**</b>	<b>.58**</b>	1							
13. Productivity <sup>O</sup>	.01	.17	.11	.15	.15	<b>.26*</b>	<b>.21</b>	<b>.22</b>	.12	<b>.18</b>	.09	<b>.19</b>	1						
14. Low Energy <sup>O</sup>	-.17	.16	-.04	<b>.17</b>	<b>.26*</b>	.11	<b>.20</b>	.07	.04	.15	-.10	.04	<b>.61**</b>	1					
15. Cognitive <sup>O</sup>	-.09	<b>.28*</b>	.06	<b>.22</b>	<b>.32**</b>	.14	<b>.20</b>	<b>.28*</b>	.17	<b>.28*</b>	.03	<b>.20</b>	<b>.54**</b>	<b>.45**</b>	1				
16. School/Work <sup>O</sup>	<b>-.21*</b>	<b>.28*</b>	.04	.17	<b>.26*</b>	-.01	.11	.09	<b>.19</b>	.12	-.16	.08	<b>.42**</b>	<b>.50**</b>	<b>.54**</b>	1			
17. Physical Health <sup>O</sup>	<b>-.18</b>	<b>.20</b>	.04	<b>.25*</b>	<b>.43**</b>	.08	.14	.11	<b>.20</b>	<b>.40**</b>	.01	<b>.21</b>	<b>.31**</b>	<b>.41**</b>	<b>.55**</b>	<b>.50**</b>	1		
18. Legal <sup>O</sup>	-.10	-.08	<b>-.18</b>	.12	.13	.11	.09	.08	.04	.05	<b>.44**</b>	.16	<b>.30**</b>	<b>.27*</b>	<b>.33**</b>	<b>.21</b>	<b>.27*</b>	1	
19. Dependence <sup>O</sup>	<b>-.29**</b>	.16	-.13	<b>.19</b>	<b>.30**</b>	-.03	.00	.01	.01	.10	-.12	.06	<b>.34**</b>	<b>.39**</b>	<b>.38**</b>	<b>.56**</b>	<b>.48**</b>	<b>.33**</b>	1

Note. bolded p<.05, \* p<.01, \*\* p<.001, <sup>O</sup> risk to others, <sup>P</sup> personal risk, CUD = cannabis use disorder

Regression Results

Predictors of General Perceived Risk (Table 3)

*Model 1. Risk to Others Domains Predicting General Perceived Risk to Others.* The general perceived risk to others model examined which domains of perceived risk to others predicted general perceived risk to others. Step one of the model accounted for significant variance in general perceived risk,  $F(3,122)=5.75$ ,  $p < .001$ ,  $R^2=0.12$ . In step two, the model remained significant,  $F(10,115)=4.48$ ,  $p < .001$ ,  $R^2=0.28$ , and accounted for a significant increase in  $R^2$ ,  $\Delta F(7,115)=3.58$ ,  $p=.002$ ,  $\Delta R^2=0.16$ . Perceived risk of physical health problems was significantly, positively associated with general perceived risk

( $sr^2=0.065$ ), whereas past 3-month use frequency was significantly, negatively associated with general perceived risk ( $sr^2=0.063$ ).

*Model 2. Personal Risk Domains Predicting General Perceived Personal Risk.* The perceived personal risk model examined which domains of perceived personal risk predicted general perceived personal risk. Step one did not account for significant variance in general perceived personal risk,  $F(3,125)=1.00$ ,  $p = .406$ ,  $R^2=0.02$ . At step two, the model was significant,  $F(10, 118) = 2.44$ ,  $p = .011$ ,  $R^2=0.17$ , and accounted for a significant increase in  $R^2$ ,  $\Delta F(7,118)=3.02$ ,  $p=.006$ ,  $\Delta R^2=0.15$ . Perceived risk of physical problems was significantly, positively associated with general perceived risk ( $sr^2=0.041$ ).

Table 3. Hierarchical Regression Results: General Perceived Risk

Effect	Estimate	SE	95% CI		p
			LL	UL	
<b>Model 1: General Perceived Risk to Others</b>					
<i>Step 1</i>	-	-	-	-	-
Sex assigned at birth	-0.05	0.16	-0.38	0.27	.751
Age	0.03	0.05	-0.08	0.13	.58
<b>Past 3-month use frequency</b>	<b>-0.11</b>	<b>0.03</b>	<b>-0.16</b>	<b>-0.06</b>	<b>&lt;.001</b>
<i>Step 2</i>	-	-	-	-	-
Sex assigned at birth	-0.09	0.16	-0.40	0.22	.572
Age	0.03	0.05	-0.07	0.13	.527
<b>Past 3-month use frequency</b>	<b>-0.08</b>	<b>0.03</b>	<b>-0.13</b>	<b>-0.03</b>	<b>.002</b>
Less productive	0.01	0.12	-0.22	0.24	.951
Lower energy	0.02	0.11	-0.21	0.25	.869
Cognitive impairment	0.11	0.12	-0.12	0.34	.353
Problems at school or work	-0.08	0.11	-0.29	0.13	.455
<b>Physical health problems</b>	<b>0.30</b>	<b>0.09</b>	<b>0.11</b>	<b>0.48</b>	<b>.002</b>
Legal problems	-0.02	0.08	-0.17	0.14	.828
Dependence/withdrawal	0.07	0.10	-0.12	0.25	.481
<b>Model 2: General Perceived Personal Risk</b>					
<i>Step 1</i>	-	-	-	-	-
Sex assigned at birth	-0.10	0.14	-0.37	0.18	.485
Age	-0.03	0.04	-0.12	0.06	.498
Past 3-month use frequency	0.03	0.02	-0.01	0.07	.188
<i>Step 2</i>	-	-	-	-	-
Sex assigned at birth	-0.06	0.13	-0.33	0.20	.644
Age	-0.07	0.04	-0.15	0.02	.131
Past 3-month use frequency	-0.01	0.02	-0.06	0.04	.708
Less productive	0.04	0.12	-0.19	0.27	.709
Lower energy	0.09	0.13	-0.16	0.34	.476
Cognitive impairment	0.14	0.12	-0.09	0.38	.227
Problems at school or work	-0.13	0.12	-0.37	0.11	.273
<b>Physical health problems</b>	<b>0.29</b>	<b>0.12</b>	<b>0.05</b>	<b>0.53</b>	<b>.017</b>
Legal problems	-0.06	0.08	-0.22	0.10	.427
Dependence/withdrawal	-0.01	0.12	-0.24	0.22	.95

Note. CI = confidence interval; LL = lower limit; UL = upper limit, CUD = cannabis use disorder,  $p < .05$  bolded in significant models.

*Perceived Risk to Others of Regular Cannabis Use (Table 4)*

*Model 3. Risk to Others Domains Predicting Use Frequency.* Step one including covariates only did not account for significant variance in past 3-month use frequency,  $F(2,123)=0.97$ ,  $p=.381$ ,  $R^2=0.02$ . In step two including perceived risk domains, the model was significant,  $F(9, 116)=2.22$ ,  $p=.026$ ,  $R^2=0.15$ , and accounted for significant change in  $R^2$ ,  $\Delta F(7,116)=2.55$ ,  $p=.026$ ,  $\Delta R^2=0.13$ . Perceived risk of dependence/withdrawal was significantly, negatively associated with use frequency ( $sr^2=0.034$ ).

*Model 4. Risk to Others Domains Predicting Negative Consequences.* Step one did not account for significant variance in past 3-month negative consequences,  $F(3,122)=1.97$ ,  $p=.122$ ,  $R^2=0.05$ . In step two, the model was significant,  $F(10,115)=2.48$ ,  $p=.010$ ,  $R^2=0.18$ , and accounted for significant

change in  $R^2$ ,  $\Delta F(7,115)=2.66$ ,  $p=.015$ ,  $\Delta R^2=0.13$ . Perceived risk of legal problems was significantly, negatively associated with negative consequences ( $sr^2=0.031$ ).

*Model 5. Risk to Others Domains Predicting CUD Symptoms.* Step one accounted for significant variance in CUD symptoms,  $F(3,122)=13.26$ ,  $p<.001$ ,  $R^2=0.50$ . In step 2, the model remained significant,  $F(10,115)=5.39$ ,  $p<.001$ ,  $R^2=0.57$ , although the change in the model was not,  $\Delta F(7,118)=1.77$ ,  $p<.001$ ,  $\Delta R^2=0.07$ . Perceived risk of legal problems ( $sr^2=0.031$ ) and age ( $sr^2=0.030$ ) were significantly, negatively associated with CUD symptoms. However, use frequency ( $sr^2=0.159$ ) was significantly, positively associated with CUD symptoms.

*Models 6, 7, and 8. Risk to Others Domains Predicting Motivation to Change.* The readiness, importance, and confidence to change models were not statistically significant.

Table 4. *Hierarchical Regression Results: Perceived Risk to Others Domains*

Effect	Estimate	SE	95% CI		p
			LL	UL	
<b>Model 3: Past 3-Month Use</b>					
<i>Step 1</i>	-	-	-	-	-
Sex assigned at birth	-0.71	0.57	-1.84	0.42	.216
Age	0.15	0.19	-0.22	0.51	.431
<i>Step 2</i>	-	-	-	-	-
Sex assigned at birth	-0.32	0.56	-1.43	0.79	.572
Age	0.05	0.18	-0.31	0.41	.793
Less productive	0.78	0.41	-0.03	1.60	.060
Lower energy	-0.65	0.41	-1.45	0.15	.112
Cognitive impairment	0.15	0.43	-0.70	0.99	.731
Problems at school or work	-0.26	0.39	-1.02	0.51	.506
Physical health problems	-0.17	0.33	-0.83	0.49	.604
Legal problems	-0.07	0.28	-0.62	0.48	.790
<b>Dependence/withdrawal</b>	<b>-0.72</b>	<b>0.33</b>	<b>-1.38</b>	<b>-0.06</b>	<b>.033</b>
<b>Model 4: Past 3-Month Negative Consequences</b>					
<i>Step 1</i>	-	-	-	-	-
Sex assigned at birth	-2.32	1.07	-4.44	-0.21	.032
Age	-0.27	0.35	-0.95	0.42	.442
Past 3-month use frequency	-0.05	0.17	-0.38	0.28	.772
<i>Step 2</i>	-	-	-	-	-
<b>Sex assigned at birth</b>	<b>-2.24</b>	<b>1.04</b>	<b>-4.31</b>	<b>-0.18</b>	<b>.033</b>
Age	-0.27	0.34	-0.94	0.39	.418
Past 3-month use frequency	0.05	0.17	-0.29	0.39	.767
Less productive	0.73	0.78	-0.81	2.26	.352
Lower energy	-0.30	0.76	-1.81	1.20	.692
Cognitive impairment	0.97	0.79	-0.59	2.53	.219
Problems at school or work	0.77	0.71	-0.64	2.19	.282
Physical health problems	0.46	0.62	-0.77	1.68	.460
<b>Legal problems</b>	<b>-1.08</b>	<b>0.51</b>	<b>-2.10</b>	<b>-0.06</b>	<b>.033</b>
Dependence/withdrawal	0.42	0.63	-0.83	1.66	.511

Effect	Estimate	SE	95% CI		p
			LL	UL	
<b>Model 5: Past-Year CUD Symptoms</b>					
<i>Step 1</i>					
Sex assigned at birth	-	-	-	-	-
Age	-0.69	0.46	-1.60	0.22	.133
<b>Past 3-month use frequency</b>	<b>-0.31</b>	<b>0.15</b>	<b>-0.61</b>	<b>-0.02</b>	<b>.037</b>
	<b>0.40</b>	<b>0.07</b>	<b>0.26</b>	<b>0.54</b>	<b>&lt;.001</b>
<i>Step 2</i>					
Sex assigned at birth	-	-	-	-	-
Age	-0.58	0.46	-1.49	0.33	.208
<b>Past 3-month use frequency</b>	<b>-0.33</b>	<b>0.15</b>	<b>-0.62</b>	<b>-0.04</b>	<b>.027</b>
	<b>0.39</b>	<b>0.08</b>	<b>0.24</b>	<b>0.54</b>	<b>&lt;.001</b>
Less productive	0.48	0.34	-0.20	1.16	.162
Lower energy	-0.30	0.33	-0.96	0.36	.374
Cognitive impairment	0.10	0.35	-0.59	0.78	.780
Problems at school or work	0.31	0.31	-0.32	0.93	.332
Physical health problems	0.39	0.27	-0.15	0.92	.160
<b>Legal problems</b>	<b>-0.52</b>	<b>0.23</b>	<b>-0.97</b>	<b>-0.07</b>	<b>.023</b>
Dependence/withdrawal	-0.26	0.28	-0.81	0.29	.356
<b>Model 6: Readiness to Change</b>					
<i>Step 1</i>					
Sex assigned at birth	-	-	-	-	-
Age	-1.63	0.63	-2.87	-0.38	.011
<b>Past 3-month use frequency</b>	<b>0.23</b>	<b>0.20</b>	<b>-0.18</b>	<b>0.63</b>	<b>.270</b>
	<b>-0.21</b>	<b>0.10</b>	<b>-0.40</b>	<b>-0.01</b>	<b>.038</b>
<i>Step 2</i>					
Sex assigned at birth	-	-	-	-	-
Age	-1.66	0.64	-2.93	-0.38	.011
Past 3-month use frequency	0.20	0.21	-0.21	0.61	.344
Less productive	-0.15	0.11	-0.36	0.06	.153
Lower energy	-0.53	0.48	-1.47	0.42	.274
Cognitive impairment	0.28	0.47	-0.65	1.21	0.550
Problems at school or work	0.96	0.49	-0.01	1.92	.051
Physical health problems	-0.21	0.44	-1.08	0.67	.639
Legal problems	0.03	0.38	-0.73	0.78	.942
Dependence/withdrawal	-0.21	0.32	-0.83	0.42	.518
	0.31	0.39	-0.46	1.08	.420
<b>Model 7: Importance to Change</b>					
<i>Step 1</i>					
Sex assigned at birth	-	-	-	-	-
Age	-0.61	0.67	-1.93	0.72	.365
Past 3-month use frequency	-0.09	0.22	-0.52	0.34	.681
	-0.06	0.11	-0.26	0.15	.599
<i>Step 2</i>					
Sex assigned at birth	-	-	-	-	-
Age	-0.62	0.68	-1.96	0.72	.360
Past 3-month use frequency	-0.13	0.22	-0.56	0.30	.559
Less productive	-0.01	0.11	-0.23	0.21	.927
Lower energy	-0.38	0.50	-1.38	0.62	.453
Cognitive impairment	0.50	0.49	-0.48	1.47	.316
Problems at school or work	1.17	0.51	0.16	2.18	.023
Physical health problems	-0.12	0.46	-1.04	0.80	.796
Legal problems	-0.24	0.40	-1.03	0.56	.556
Dependence/withdrawal	-0.42	0.33	-1.08	0.24	.214
	0.24	0.41	-0.57	1.05	.564
<b>Model 8: Confidence to Change</b>					
<i>Step 1</i>					
Sex assigned at birth	-	-	-	-	-
Age	0.19	0.51	-0.83	1.20	.361
Past 3-month use frequency	0.06	0.17	-0.27	0.38	.344
	-0.02	0.08	-0.18	0.14	.278
<i>Step 2</i>					
Sex assigned at birth	-	-	-	-	-
Age	0.17	0.54	-0.89	1.23	.746
Past 3-month use frequency	0.06	0.17	-0.28	0.40	.734
Less productive	-0.03	0.09	-0.21	0.14	.708
Lower energy	0.26	0.40	-0.53	1.05	.512
Cognitive impairment	-0.08	0.39	-0.85	0.69	.838
Problems at school or work	-0.09	0.40	-0.89	0.72	.832
Physical health problems	-0.29	0.37	-1.02	0.44	.428
Legal problems	0.04	0.32	-0.59	0.67	.899
Dependence/withdrawal	0.06	0.26	-0.47	0.58	.832
	0.11	0.32	-0.53	0.75	.733

Note. CI = confidence interval; LL = lower limit; UL = upper limit, CUD = cannabis use disorder,  $p < .05$  bolded in significant models

*Perceived Personal Risk (Table 5)*

*Model 9. Personal Risk Domains Predicting Use Frequency.* Step one including only covariates did not account for significant variance in past 3-month use frequency,  $F(2,12)=0.73$ ,  $p =.484$ ,  $R^2=0.01$ . In step two with perceived risk domains, the model was significant,  $F(9,119)=31.78$ ,  $p <.001$ ,  $R^2=0.29$  and accounted for a significant increase in  $R^2$ ,  $\Delta F(7,119)=6.70$ ,  $p <.001$ ,  $\Delta R^2=0.28$ . Perceived personal risk of cognitive impairment was significantly, positively associated with use frequency ( $sr^2=0.067$ ).

*Model 10. Personal Risk Domains Predicting Negative Consequences.* Step one did not account for significant variance in past 3-month negative consequences,  $F(3,125)=1.94$ ,  $p =.127$ ,  $R^2=0.04$ . Step two was significant,  $F(10,118)=2.57$ ,  $p =.007$ ,  $R^2=0.18$ , and accounted for a significant increase in  $R^2$ ,  $\Delta F(7,113)=2.76$ ,  $p=.011$ ,  $\Delta R^2=0.14$ . Perceived personal risk of legal problems was significantly, negatively associated with negative consequences ( $sr^2=0.053$ ).

*Model 11. Personal Risk Domains Predicting CUD Symptoms.* Step one accounted for

significant variance in CUD symptoms,  $F(3,125)=15.04$ ,  $p <.001$ ,  $R^2=0.26$ . Step two also accounted for significant variance,  $\Delta F(7,118)=3.82$ ,  $p <.001$ ,  $\Delta R^2=0.14$ . Perceived personal risk of legal problems ( $sr^2=0.024$ ) and age ( $sr^2=0.032$ ) were significantly, negatively associated with CUD symptoms. Perceived personal risk to productivity ( $sr^2=0.031$ ) and use frequency ( $sr^2=0.069$ ) were significantly, positively associated with CUD symptoms.

*Models 12, 13, and 14. Personal Risk Domains Predicting Motivation to Change.* Readiness (Model 12) and importance (Model 13) to change models were not statistically significant at step one or two. The confidence to change model (Model 14) was not significant at step one,  $F(3,125)=0.17$ ,  $p=.916$ ,  $R^2=0.00$  but was significant at step two,  $F(10,118)=2.14$ ,  $p=.026$ ,  $R^2=0.15$ , and accounted for a significant increase in  $R^2$ ,  $\Delta F(7,118)=3.00$ ,  $p <.001$ ,  $\Delta R^2=0.15$ . Perceived personal risk of dependence/withdrawal was significantly, negatively associated with confidence to change ( $sr^2=0.045$ ). Lower energy was also negatively associated with confidence to change, although not statistically significant ( $p=0.50$ ,  $sr^2=0.028$ ).

Table 5. Hierarchical Regression Results: Perceived Personal Risk Domains

Effect	Estimate	SE	95% CI		p
			LL	UL	
<b>Model 9: Past 3-Month Use</b>					
<i>Step 1</i>					
Sex assigned at birth	0.14	0.19	-0.23	0.51	.464
Age	-0.61	0.58	-1.76	0.55	.299
<i>Step 2</i>					
Sex assigned at birth	0.00	0.17	-0.34	0.34	.990
Age	-0.28	0.53	-1.32	0.76	.598
Less productive	-0.22	0.45	-1.12	0.68	.626
Lower energy	0.83	0.49	-0.15	1.81	.094
<b>Cognitive impairment</b>	<b>1.48</b>	<b>0.45</b>	<b>0.60</b>	<b>2.37</b>	<b>.001</b>
Problems at school or work	-0.32	0.47	-1.25	0.60	.493
Physical health problems	-0.56	0.47	-1.50	0.37	.235
Legal problems	0.16	0.31	-0.46	0.78	.607
Dependence/withdrawal	0.44	0.45	-0.46	1.34	.331
<b>Model 10: Past 3-Month Negative Consequences</b>					
<i>Step 1</i>					
Sex assigned at birth	-0.17	0.34	-0.85	0.51	.619
Age	-2.42	1.06	-4.52	-0.31	.025
Past 3-month use frequency	-	-	-	-	-
<i>Step 2</i>					
Sex assigned at birth	-0.19	0.34	-0.87	0.49	.578
Age	-2.01	1.05	-4.08	0.06	.057
Past 3-month use frequency	-0.30	0.18	-0.66	0.06	.105
Less productive	1.26	0.90	-0.53	3.05	.166
Lower energy	0.79	0.99	-1.18	2.76	.429
Cognitive impairment	0.79	0.92	-1.04	2.62	.396
Problems at school or work	-0.17	0.93	-2.01	1.67	.856
Physical health problems	-0.26	0.94	-2.13	1.61	.786
<b>Legal problems</b>	<b>-1.74</b>	<b>0.63</b>	<b>-2.98</b>	<b>-0.50</b>	<b>.006</b>
Dependence/withdrawal	1.32	0.90	-0.47	3.11	.147

Effect	Estimate	SE	95% CI		<i>p</i>
			LL	UL	
<b>Model 11: Past-Year CUD Symptoms</b>					
<i>Step 1</i>					
Sex assigned at birth	-0.68	0.45	-1.58	0.21	.134
<b>Age</b>	<b>-0.32</b>	<b>0.15</b>	<b>-0.61</b>	<b>-0.03</b>	<b>.030</b>
<b>Past 3-month use frequency</b>	<b>0.42</b>	<b>0.07</b>	<b>0.28</b>	<b>0.55</b>	<b>&lt;.001</b>
<i>Step 2</i>					
Sex assigned at birth	-0.36	0.43	-1.22	0.50	.415
<b>Age</b>	<b>-0.36</b>	<b>0.14</b>	<b>-0.64</b>	<b>-0.08</b>	<b>.013</b>
<b>Past 3-month use frequency</b>	<b>0.28</b>	<b>0.08</b>	<b>0.13</b>	<b>0.43</b>	<b>&lt;.001</b>
<b>Less productive</b>	<b>0.93</b>	<b>0.38</b>	<b>0.18</b>	<b>1.67</b>	<b>.015</b>
Lower energy	-0.06	0.41	-0.87	0.76	.890
Cognitive impairment	0.56	0.38	-0.20	1.32	.148
Problems at school or work	0.20	0.39	-0.57	0.96	.609
Physical health problems	-0.27	0.39	-1.05	0.51	.494
<b>Legal problems</b>	<b>-0.56</b>	<b>0.26</b>	<b>-1.08</b>	<b>-0.05</b>	<b>.033</b>
Dependence/withdrawal	0.38	0.38	-0.36	1.12	.314
<b>Model 12: Readiness to Change<sup>a</sup></b>					
<i>Step 1</i>					
Sex assigned at birth	0.22	0.20	-0.17	0.62	.271
Age	-1.62	0.62	-2.85	-0.39	.011
Past 3-month use frequency	-0.18	0.10	-0.37	0.00	.054
<i>Step 2</i>					
Sex assigned at birth	0.20	0.22	-0.23	0.62	.357
<b>Age</b>	<b>-1.57</b>	<b>0.65</b>	<b>-2.86</b>	<b>-0.28</b>	<b>.018</b>
Past 3-month use frequency	-0.19	0.11	-0.41	0.04	.104
Less productive	0.02	0.57	-1.10	1.14	.973
Lower energy	-0.10	0.62	-1.32	1.13	.878
Cognitive impairment	-0.02	0.58	-1.17	1.12	.966
Problems at school or work	0.11	0.58	-1.04	1.26	.848
Physical health problems	0.74	0.59	-0.43	1.91	.210
Legal problems	-0.31	0.39	-1.09	0.46	.423
Dependence/withdrawal	-0.10	0.56	-1.22	1.02	.861
<b>Model 13: Importance to Change<sup>a</sup></b>					
<i>Step 1</i>					
Sex assigned at birth	-0.57	0.66	-1.88	0.74	.392
Age	-0.08	0.21	-0.50	0.34	.704
Past 3-month use frequency	-0.02	0.10	-0.22	0.18	.860
<i>Step 2</i>					
Sex assigned at birth	-0.34	0.67	-1.67	0.99	.618
Age	-0.12	0.22	-0.56	0.32	.591
Past 3-month use frequency	-0.10	0.12	-0.33	0.14	.417
Less productive	1.12	0.58	-0.03	2.27	.057
Lower energy	-0.11	0.64	-1.38	1.15	.859
Cognitive impairment	0.57	0.59	-0.61	1.74	.342
Problems at school or work	0.17	0.60	-1.01	1.36	.771
Physical health problems	0.05	0.61	-1.16	1.25	.940
Legal problems	-0.83	0.40	-1.63	-0.04	.041
Dependence/withdrawal	-0.21	0.58	-1.36	0.94	.721
<b>Model 14: Confidence to Change</b>					
<i>Step 1</i>					
Sex assigned at birth	0.11	0.51	-0.89	1.12	.826
Age	0.09	0.16	-0.24	0.41	.593
Past 3-month use frequency	-0.03	0.08	-0.18	0.12	.703
<i>Step 2</i>					
Sex assigned at birth	0.04	0.50	-0.95	1.02	.939
Age	0.06	0.16	-0.26	0.38	.717
Past 3-month use frequency	0.12	0.09	-0.06	0.29	.181
Less productive	0.68	0.43	-0.17	1.53	.115
Lower energy	-0.94	0.47	-1.87	0.00	.050
Cognitive impairment	-0.21	0.44	-1.08	0.66	.629
Problems at school or work	-0.10	0.44	-0.98	0.77	.820
Physical health problems	0.04	0.45	-0.84	0.93	.921
Legal problems	0.55	0.30	-0.04	1.13	.069
<b>Dependence/withdrawal</b>	<b>-1.07</b>	<b>0.43</b>	<b>-1.92</b>	<b>-0.22</b>	<b>.014</b>

Note. CI = confidence interval; LL = lower limit; UL = upper limit, CUD = cannabis use disorder, *p* <.05 bolded in significant models, <sup>a</sup>overall model not significant

*Differences by Cannabis Use Frequency (Table 6)*

Compared to individuals who used cannabis infrequently (n=64), individuals who used more frequently (n=65) reported significantly lower general perceived risk to others, but did not significantly differ on any risk to others

domains. Individuals who used infrequently did not differ from those who used more frequently on general personal risk but reported significantly higher ratings of personal risk domains (medium to large effects), except for personal physical and legal risk.

Table 6. Means, Standard Deviations, and One-Way Analyses of Variance by Use Frequency

Measure	Infrequent Use (n=64)		Frequent Use (n=65)		F(4,123)	p	$\eta^2$
	M	SD	M	SD			
<b>Perceived Risk to Others</b>							
Less productive	2.56	0.80	2.49	0.77	0.21	.652	0.002
Lower energy	2.59	0.73	2.29	0.84	4.19	.043	0.033
Cognitive impairment	2.36	0.8	2.14	0.75	2.44	.121	0.019
Problems at school or work	2.53	0.84	2.17	0.80	6.28	.014	0.048
Physical health problems	2.22	0.98	1.88	0.80	4.50	.036	0.035
Legal problems	2.77	0.85	2.51	0.97	2.47	.119	0.019
Dependence/withdrawal	3.06	1.02	2.78	1.01	2.55	.113	0.020
<b>General risk to others</b>	<b>1.98</b>	<b>0.86</b>	<b>1.48</b>	<b>0.69</b>	<b>13.10</b>	<b>&lt;.001</b>	<b>0.094</b>
<b>Perceived Personal Risk</b>							
<b>Less productive</b>	<b>1.56</b>	<b>0.77</b>	<b>2.12</b>	<b>0.84</b>	<b>16.21</b>	<b>&lt;.001</b>	<b>0.115</b>
<b>Lower energy</b>	<b>1.47</b>	<b>0.67</b>	<b>2.06</b>	<b>0.88</b>	<b>19.37</b>	<b>&lt;.001</b>	<b>0.134</b>
<b>Cognitive impairment</b>	<b>1.44</b>	<b>0.56</b>	<b>1.97</b>	<b>0.83</b>	<b>18.31</b>	<b>&lt;.001</b>	<b>0.128</b>
<b>Problems at school or work</b>	<b>1.39</b>	<b>0.63</b>	<b>1.82</b>	<b>0.81</b>	<b>10.58</b>	<b>.001</b>	<b>0.078</b>
Physical health problems	1.41	0.61	1.68	0.77	5.13	.025	0.039
Legal problems	1.59	0.75	2.05	1.02	8.72	.004	0.065
<b>Dependence/withdrawal</b>	<b>1.34</b>	<b>0.54</b>	<b>1.83</b>	<b>0.89</b>	<b>13.46</b>	<b>&lt;.001</b>	<b>0.097</b>
General personal risk	1.28	0.58	1.45	0.71	2.08	.152	0.016

Note. Sex assigned at birth and age included as covariates (not shown), significant at Bonferroni corrected  $p < .003$  (bolded)

## DISCUSSION

The present study tested how general and domain-specific perceived risks to others and oneself were cross-sectionally associated with cannabis use frequency, negative outcomes, and motivation to change among a sample of undergraduates who use cannabis. Results partially supported hypotheses. For Aim 1, general perceived risk to others was negatively correlated with use frequency, whereas general

perceived personal risk was positively associated with consequences/CUD symptoms and some facets of motivation to change (i.e., importance, readiness). For Aim 2, after accounting for shared variance among risk domains, legal and dependence/withdrawal risk were uniquely associated with outcomes. For Aim 3, undergraduates who used cannabis more frequently reported greater perceived personal risk in five of seven risk domains and less perceived general risk to others compared to those

who used less frequently, despite no significant differences in general personal risk or domain-specific risk to others. Findings suggest assessing both general and domain-specific risk, as well as risk to others and oneself, can provide a more nuanced understanding of perceived risk and its association with cannabis outcomes among undergraduates.

Perceived personal risk was rated in the no-to-slight risk range, on average, whereas perceived risk to others was rated in the slight-to-moderate risk range, even though average use in the sample was higher than “regular use” as defined in risk to others items. Thus, undergraduates may minimize their personal risk of cannabis use, despite acknowledging a similar level of use poses risk to their peers. Although general perceived risk to others was negatively associated with use frequency, general perceived *personal* risk was not. Rather, general perceived personal risk was positively related to negative consequences and CUD symptoms. In contrast with prior work finding no association between perceived risk and the experience of negative consequences (i.e., academic, social) among undergraduates who use cannabis (Kilmer et al., 2007), the present findings indicate individuals who experience problems related to their use may perceive greater personal risk, despite viewing their personal use as less risky than a similar level of use for others.

Findings also underscore the importance of considering domain-specific perceived risk. Only the physical risk domain predicted general perceived risk to self and others. Undergraduates may be focusing on the “physical risk” portion of the item when rating general perceived risk. Importantly, although only the physical risk domain significantly predicted general risk, students rated physical risk as having the lowest risk of any domain. Physical health problems are rarely reported by young adults who use cannabis (Buckner et al., 2010; Terry-McElrath et al., 2022), and negative physical health effects of cannabis tend to be cumulative (Volkow et al., 2014). The infrequency and lack of immediacy of these consequences may contribute to an inaccurate perception of actual physical risks associated with heavy, frequent cannabis use. Second, given the increase in legalization of medical cannabis use in the past decade and attention toward prescribing cannabis to manage physical concerns (National Academies of

Sciences & Medicine, 2017), students may view cannabis as being less risky physically. This is supported in part by decreases in perceived risk post-legalization (Mennis et al., 2023).

Several domains of risk emerged as important predictors of outcomes. Consistent with hypotheses, dependence/withdrawal risk was a significant predictor of cannabis outcomes; however, cognitive, productivity, and legal risks also served as unique predictors. Perceived dependence/withdrawal risk to others and perceived personal cognitive risk were negatively associated with use frequency, and perceived personal risk to productivity was positively associated with CUD symptoms. Similar to other work finding greater perceived risk is protective against cannabis use (e.g., D’Silva et al., 2020), present findings indicate some domain-specific perceived risks might mitigate risk associated with certain cannabis use behaviors. Additionally, perceived legal risk to self and others were negatively associated with consequences and CUD symptoms. Knowing perceived legal risk may mitigate harms associated with cannabis use, college campuses may consider maintaining strict cannabis policies with required intervention post-violation as evidence suggests undergraduates decrease their cannabis use post-sanction (Buckner et al., 2018). In addition to decreasing use, strict campus policies and an associated intervention may result in higher-risk students experiencing fewer negative outcomes and maintaining more accurate perception of legal/systemic risk despite changes in state/federal policies.

General perceived personal risk (but not general or domain-specific perceived risk to others) was positively associated with importance and readiness to change. Thus, perceiving risk to others may be too distal an association to motivate individuals to change their own cannabis use. Notably, even though the overall sample reported high confidence to change, greater personal risk of dependence/withdrawal was negatively associated with confidence to change. Individuals who perceive themselves at risk of withdrawal/dependence may experience uncertainty about how to change use and/or manage withdrawal/dependence symptoms. As high confidence to change is an especially important predictor of changes in substance use among young adults (Bertholet et al., 2012), it

may be advantageous to emphasize personal risk, rather than risk to others, when working with individuals who use cannabis. Further, as confidence to change increases early on in cannabis-related treatment (Chung & Maisto, 2016), continuing to provide psychoeducation, problem-solving, and skills around managing withdrawal/dependence to increase confidence remains important.

Consistent with hypotheses, participants who used frequently reported less general perceived risk to others than those who used infrequently. However, regarding domain-specific perceived personal risk, those who use more frequently perceived five out seven domains as riskier than those who use infrequently, consistent with prior research finding undergraduates who engage in more frequent cannabis use rate their personal risk higher (O'Callaghan et al., 2006). Notably, results could reflect differences in how personal risk vs risk to others items were framed. Specifically, participants were asked to rate risk to others who used once a week or more, but rate personal risk based on one's current frequency of use. If a participant's personal use rate was much higher than once per week, they may view their use as inherently riskier given consequences they are currently or have previously experienced. It will be important to test whether results remain consistent if risk to others is assessed more similarly to personal risk (i.e., "if others use marijuana at your current rate of use").

Clinicians may want to focus on increasing perceived personal risk among undergraduates who use cannabis rather than general risk, as perceived personal risk (but not perceived risk to others) was associated with negative consequences and CUD symptoms. Further, the current study suggests it may be particularly useful to emphasize psychoeducation on long-term risks and consequences of cannabis including physical, legal, and dependence risks for undergraduates who use cannabis more broadly. Individuals may be reporting short-term perceived personal risks more accurately as they may have already experienced them; however, there may be a misperception of risks associated with long-term consequences due to their lack of immediacy. Additionally, it may be beneficial to provide psychoeducation on domains individuals are most concerned about (e.g., dependence/withdrawal among individuals who

use heavily, legal risk among individuals in states with illegal recreational cannabis). Notably, as perceived risk appears to be a protective factor for undergraduates who do not use or use infrequently (e.g., Hanauer et al., 2021; Kilmer et al., 2007), targeting perceived risk to others may be particularly useful in prevention programs when paired with education on safer use to protect against potential negative consequences.

Results should be viewed in light of study limitations. First, data were collected cross-sectionally. Further examination of research questions longitudinally could provide critical information regarding temporal relations among study variables including how individuals' risk perceptions change over time and how various risk perceptions may protect against or contribute to the onset or maintenance of problematic cannabis use. Second, questions were administered as part of an intervention which may have impacted results. Relatedly, participants rated general and domain-specific risk to others "if they use marijuana regularly [once a week or more]" and personal risk "if you use marijuana at your current rate of use." Future research would benefit from using a consistent use frequency anchor to assess risk to self and others. Third, data was collected in a state where recreational cannabis was illegal which may contribute to findings associated with perceived legal risk. Given previous research has shown a decrease in felony convictions, arrests, and police involvement related to cannabis following legalization in certain states (Maxwell & Mendelson, 2016), it is critical to assess perceived risk of cannabis use across states with varying legal status. Further, the sample was relatively small and predominantly comprised of non-Hispanic/Latin, White, female participants; replication with larger and more diverse samples in terms of race/ethnicity, age, and sex assigned at birth will be important. Notably, legal risk may differ unfairly among racial and ethnic minority groups due to bias-driven racial disparities in cannabis-related arrests and convictions (Bunting et al., 2013). Clinicians working with patients who use cannabis should consider the legal status and related legal risks in their state of practice, and potential impacts of legal disparities for their clients; exploring perceived legal risk and providing psychoeducation if indicated may be

useful for patients expressing ambivalence about changing their use.

Fourth, although the present study provides important information on various domains of risk, domains were not comprehensive. Measures of domain-specific perceived risk to self and others were developed specifically as part of the PFI for this study. Although results suggest preliminary construct validity, future work testing other psychometric properties of these measures is necessary. Further, although risk domains were empirically informed, there may be other risk domains (e.g., driving while intoxicated, financial challenges) not captured in the present study. Future work could use qualitative interviews to further identify the most relevant domains to undergraduates and test whether results replicate in a larger, more diverse sample. Taken together, future research should examine relations posed in this study longitudinally, utilize questions with consistent use rates for risk to others and oneself, in states with varying legal status of cannabis, in larger, more diverse samples, outside the context of an intervention study, and include a wider variety of risk domains.

Perceived risk of using cannabis is on a consistent decline despite known risks (Lipari & Jean-Francois, 2016; Waddell, 2022). Results of the present study suggest future research could benefit from expanding current conceptualizations of perceived risk to include perceived personal risk and domain-specific risks in addition to general risk to others. College-based psychoeducation and prevention efforts should consider various facets of risk including identifying the most salient areas of perceived risk for different undergraduates based on their personal circumstances.

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