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Justin Ho

Introduction

Background and Objective

In 2012, the National Survey on Drug Use and Health reported about 5.2% of its respondents using tobacco and marijuana, with strong evidence of increasing marijuana use among tobacco users.¹ While smoking cigarettes has been shown to cause lung cancer,² additional studies associate habitual marijuana smoking with abnormal airway tissue histology, impeded airway conductance,³ decreased memory, psychomotor speed, and manual dexterity.⁴ Cigarette smoking and marijuana use are shown to have similar withdrawal symptoms such as irritability, anxiety, and depression,^{2,5} meaning that this example of polysubstance dependence could become a valid public health concern, especially with the legalization of recreational marijuana in some states. In addition, men and women exhibit different habits, psychological, and physiological symptoms for cigarette and marijuana use. For example, women who smoke have a much harder time quitting,⁶ and men who are depressed are more likely than women who are depressed to use marijuana.⁷ Thus, understanding gender differences could allow for the possibility of developing gender specific rehabilitation processes when treating those with cigarette and marijuana addiction.⁸

The objective of this study was to examine the gender differences in marijuana-related problems among those who self-reported daily cigarette smoking and marijuana use. The problems which we investigated are: time spent getting marijuana, time spent recovering from marijuana use, using marijuana even though it caused social problems, reduction in daily activity involvement stemming from marijuana use, experiencing withdrawal symptoms, and using marijuana to stop being sick or to avoid withdrawal problems.

Methods

Study Design and Sample

The dataset comes from the Wave 1 Population Assessment of Tobacco and Health (PATH) study launched in 2011.⁹ The PATH study is publically available data, containing 45,971 participants. Only adult participants over age 18 who smoked cigarettes daily and smoked marijuana were included in this study. A daily cigarette smoker was defined as: having ever smoked a cigarette, has smoked over 100 cigarettes, and currently smokes one or more cigarettes daily. A current marijuana smoker was defined as having used marijuana, hash, THC, grass, pot, or weed in the past 30 days in the form of a cigar, cigarillo, or filtered cigar. Participants were excluded if they were not daily cigarette smokers, if they did not use marijuana in the past 30 days, if they had missing data, or if they indicated a response of “Don’t know” or “Refused.” Since the number of missing values was less than 10%, no data were imputed.

Defining outcomes and data handling

The main outcome of marijuana related problems was assessed based off participant responses to the following questions:

- 1) When was the last time that you spent a lot of time getting alcohol or other drugs?

- 2) When was the last time you spent a lot of time using or recovering from alcohol or other drugs?
- 3) When was the last time you kept using alcohol or other drugs even though it was causing social problems, leading to fights, or getting you into trouble with other people?
- 4) When was the last time your use of alcohol or other drugs reduced your involvement with activities at work, school, home, or social events?
- 5) When was the last time you had withdrawal problems such as shaky hands, throwing up, having trouble sitting still or sleeping?
- 6) When was the last time you used any alcohol or other drugs to stop being sick or avoid withdrawal problems?

Possible responses for survey questions were: “Past month”, “2 to 12 months ago”, “Over a year ago”, and “Never”. Numerical values from 1 to 4 were assigned to these choices, with 1 corresponding to “Never”, 2 corresponding to “over a year ago”, 3 corresponding to “2 to 12 months ago”, and 4 corresponding to “Past month”, allowing for the survey to be represented as a pseudo-continuous distribution. A sum of the total marijuana-related problems ranging from 6 to 24 was taken, with lower numbers indicating fewer marijuana-related problems and higher numbers indicating more marijuana-related problems. The main predictor was gender, which was categorized as “male” or “female”. The variables age, race, education, and income were all categorical variables and were used for adjustment. Age was categorized into 7 levels: 18-24, 25-34, 35-44, 45-54, 55-64, 65-74, and >75. Race was categorized into White, Black, or Other. Education was divided into 6 categories: less than high school, GED, high school graduate, some college (no degree) or Associate’s degree, Bachelor’s degree, or advanced degree. Income was divided into 5 categories: <\$10,000, \$10,000-\$24,999, \$25,000-\$49,999, \$50,000-\$99,999, >\$100,000.

Statistical analysis

Gender differences for daily smokers using marijuana were performed using STATA 14.2 on the 6 questions of interest and the total marijuana-related problems score using 3 different models. Model 1 used a t-test and considered gender only. Model 2 used a multivariable linear regression model, and included gender and the covariates age, race, income, and education level for adjustment. Model 3 included the variables listed in model 2 and the interaction term between age and gender. A likelihood ratio test was also conducted to test for the significance of the interaction term.

Sensitivity analysis

Since the dataset contained a significant number of individuals who indicated that alcohol caused problems for them, a sensitivity analysis was conducted in addition to the primary analysis to control for the effect of alcohol. To assess this, participants who indicated that alcohol had caused problems for them were removed from the analysis. The multivariable linear regression model with gender, age, race, education, and income was used for analysis on this dataset.

Results

Participants and descriptive data (flow diagram)

Of the 45,971 participants in the Wave 1 PATH dataset, 32,320 were adult participants aged 18+. Of those 32,320 adults, 1,453 were daily cigarette smokers who used marijuana within the last

month. 21 participants were missing survey responses or refused the answer, and 104 participants were missing or refused to answer questions related to race, education level, or income, resulting in a final population of 1,328. A visual representation of participant selection and a table of participant demographics are shown below.

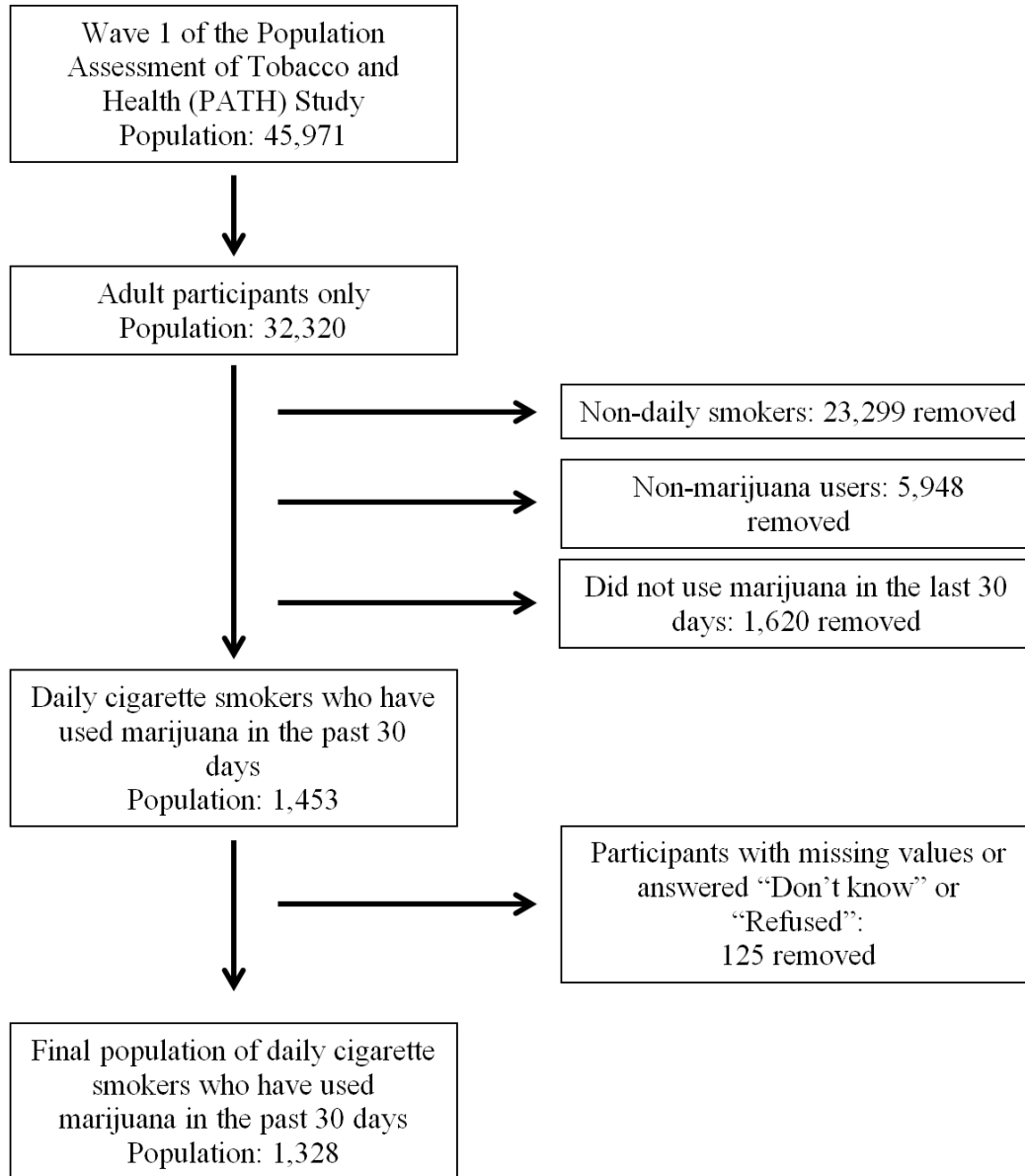


Figure 1: Flowchart of the final study population

Table 1: Descriptive statistics for PATH study. Values shown are n (%)

	Male	Female
	821 (61.8%)	507 (38.2%)
Age (Years)		
18-24	327 (39.8%)	178 (35.1%)
25-34	232 (28.3%)	152 (30.0%)
35-44	136 (16.6%)	93 (18.3%)
45-54	83 (10.1%)	57 (11.2%)
55-64	40 (4.9%)	23 (4.5%)
65-74	3 (0.4%)	2 (0.4%)
>75	0 (0%)	2 (0.4%)
Race		
White	565 (68.8%)	340 (67.1%)
Black	149 (18.2%)	105 (20.7%)
Other	107 (13.0%)	62 (12.2%)
Education		
Less than high school	171 (20.8%)	80 (15.8%)
GED	133 (16.2%)	61 (12.0%)
High school graduate	202 (24.6%)	123 (24.3%)
Some college (no degree) or associate's	276 (33.6%)	214 (42.2%)
Bachelor's degree	35 (4.3%)	22 (4.3%)
Advanced degree	4 (0.5%)	7 (1.4%)
Income		
<\$10,000	227 (27.7%)	195 (38.5%)
\$10,000-\$24,999	259 (31.6%)	147 (29.0%)
\$25,000-\$49,999	193 (23.5%)	98 (19.3%)
\$50,000-\$99,999	102 (12.4%)	48 (9.5%)
\$100,000	40 (4.9%)	19 (3.8%)

Main results

The mean score for men and women, the unadjusted difference, the adjusted difference for each of the 6 questions of interest, and the significance of the interaction between gender and age were calculated and summarized in Table 2 below.

Table 2: Mean (SD) unadjusted scores for men and women, unadjusted, adjusted differences between genders, and P-values for the unadjusted, adjusted, and interaction model for marijuana-related problems. Values shown are Male-Female (95% confidence interval).

Outcome	Mean score for Men (SD)	Mean score for Women (SD)	Model: 1 unadjusted difference (95% CI)	P-value unadjusted	Model 2: adjusted difference (95% CI)	P-value adjusted	Model 3: model 2 + gender*age (P-value)
1) Spending a lot of time getting marijuana	1) 2.65 (1.25)	1) 2.46 (1.23)	1) 0.19 (0.05, 0.32)	1) 0.007	1) 0.19 (0.05, 0.33)	1) 0.008	1) 0.14
2) Time recovering from marijuana use	2) 2.25 (1.24)	2) 2.13 (1.17)	2) 0.12 (-0.02, 0.25)	2) 0.09	2) 0.13 (-0.01, 0.26)	2) 0.08	2) 0.08
3) Using marijuana despite social problems	3) 1.79 (1.07)	3) 1.74 (1.02)	3) 0.05 (-0.07, 0.17)	3) 0.40	3) 0.04 (-0.07, 0.16)	3) 0.46	3) 0.32
4) Reduction in daily activity involvement	4) 1.72 (1.05)	4) 1.65 (0.97)	4) 0.07 (-0.05, 0.18)	4) 0.25	4) 0.07 (-0.04, 0.19)	4) 0.22	4) 0.82
5) Experiencing withdrawal symptoms	5) 1.72 (1.10)	5) 1.70 (1.08)	5) 0.02 (-0.10, 0.14)	5) 0.73	5) 0.04 (-0.08, 0.17)	5) 0.49	5) 0.29
6) Using marijuana to stop feeling sick	6) 1.64 (1.09)	6) 1.60 (1.05)	6) 0.04 (-0.08, 0.15)	6) 0.55	6) 0.05 (-0.07, 0.17)	6) 0.39	6) 0.29
Total marijuana-related problems	11.78 (3.80)	11.30 (3.65)	0.48 (-0.06, 1.01)	0.08	0.53 (-0.02, 1.08)	0.06	0.12

Model 1: Unadjusted; *Model 2: Adjustment for age, race, income, and education level; **Model 3: Model 2 + gender*age.

Males self-reported average values of 2.65 (1.25) for the last time spent getting alcohol or other drugs, 2.25 (1.24) for the last time the participant spent a lot of time recovering from alcohol or other drugs, 1.79 (1.07) for the last time the participant used alcohol or other drugs despite it causing social problems, 1.72 (1.05) for the last time alcohol or other drugs interfered with daily activity involvement, 1.72 (1.10) for the last time the participant had withdrawal problems, and 1.62 (1.09) for the last time the participant used alcohol or other drugs to stop being sick or to avoid withdrawal problems. Women self-reported average values of 2.46 (1.23), 2.13 (1.17), 1.74 (1.02), 1.65 (0.97), 1.70 (1.08), and 1.60 (1.05) in the same 6 questions of interest. A value between 2 and 3 corresponded to sometime between “over a year ago” and “2 to 12 months ago”, and a value between 1 and 2 corresponded to sometime between “never” and “over a year ago”. Overall, males self-reported more marijuana-related problems on the survey.

The unadjusted differences (Male-Female) and their 95% CIs are 0.19 (0.05, 0.32, $P=0.007$) for the last time spent getting alcohol or other drugs, 0.12 (-0.02, 0.25, $P=0.09$) for the last time the participant spent a lot of time recovering from alcohol or other drugs, 0.05 (-0.07, 0.17, $P=0.40$) for the last time the participant used alcohol or other drugs despite it causing social problems, 0.07 (-0.05, 0.18, $P=0.25$) for the last time alcohol or other drugs interfered with daily activity involvement, 0.02 (-0.10, 0.14, $P=0.73$) for the last time the participant had withdrawal problems, and 0.04 (-0.08, 0.15, $P=0.55$) for the last time the participant used alcohol or other drugs to stop being sick or to avoid withdrawal problems. Adjusting for age, race, education, and income did not significantly change these differences.

Since women were more likely to first use marijuana at a later age than men do,¹⁰ it is hypothesized that age would have an effect on gender differences for marijuana related problems, and that gender differences would decrease with an increase in age. Interaction was not found to be significant ($P>0.05$) for all 6 questions of interest.

Sensitivity analysis

580 out of the 1,328 participants indicated that alcohol had caused them problems. Since alcohol abuse is linked to social disorders and produces withdrawal symptoms similar to that of cigarettes and marijuana,^{2,5,11} a sensitivity analysis was performed to remove those who indicated that they had alcohol-related problems in order to control for the effect of alcohol. After these 580 participants were removed, there was no significant difference between genders for marijuana-related problems. However, women self-reported higher, but insignificant, scores than men for experiencing withdrawal symptoms, and using marijuana to stop feeling sick or to avoid withdrawal problems. A comparison between Model 2 and the sensitivity analysis is shown in the table below.

Table 3: Mean (SD) adjusted scores for men and women, adjusted differences between genders for marijuana-related problems compared to mean (SD) scores for men and women and differences between genders for marijuana-related problems, and P-values for differences with those who indicated alcohol problems removed. Values shown are Male-Female (95% confidence interval).

Outcome	Mean score for Men (SD)	Mean score for Women (SD)	Model 2: adjusted difference (95% CI)	Mean score for Men (SD): alcohol removed	Mean score for Women (SD): alcohol removed	Sensitivity analysis (95% CI): alcohol removed	P-value Sensitivity analysis
1) Spending a lot of time getting marijuana	1) 2.65 (1.25)	1) 2.46 (1.23)	1) 0.19 (0.05, 0.33)	1) 2.41 (1.27)	1) 2.33 (1.27)	1) 0.08 (-0.10, 0.27)	1) 0.37
2) Time recovering from marijuana use	2) 2.25 (1.24)	2) 2.13 (1.17)	2) 0.13 (-0.01, 0.26)	2) 1.85 (1.16)	2) 1.77 (1.11)	2) 0.10 (-0.07, 0.27)	2) 0.26
3) Using marijuana despite social problems	3) 1.79 (1.07)	3) 1.74 (1.02)	3) 0.04 (-0.07, 0.16)	3) 1.55 (0.93)	3) 1.48 (0.92)	3) 0.06 (-0.08, 0.20)	3) 0.38
4) Reduction in daily activity involvement	4) 1.72 (1.05)	4) 1.65 (0.97)	4) 0.07 (-0.04, 0.19)	4) 1.52 (0.92)	4) 1.46 (0.87)	4) 0.09 (-0.04, 0.22)	4) 0.21
5) Experiencing withdrawal symptoms	5) 1.72 (1.10)	5) 1.70 (1.08)	5) 0.04 (-0.08, 0.17)	5) 1.50 (0.96)	5) 1.54 (0.98)	5) -0.02 (-0.16, 0.13)	5) 0.84
6) Using marijuana to stop feeling sick	6) 1.64 (1.09)	6) 1.60 (1.05)	6) 0.05 (-0.07, 0.17)	6) 1.49 (0.99)	6) 1.53 (1.01)	6) -0.02 (-0.17, 0.13)	6) 0.77
Total marijuana-related problems	11.78 (3.80)	11.30 (3.65)	0.48 (-0.06, 1.01)	10.32 (4.62)	10.12 (4.62)	0.30 (-0.40, 0.99)	0.40

Model 2: Adjustment for age, race, income, and education level; Sensitivity analysis: Model 2 with participants who indicated alcohol problems removed

Discussion

Key results and Interpretation

While previous studies have explored the effects of cigarette smoking and smoking marijuana separately, there are few studies investigating gender differences in daily cigarette smokers who use marijuana to the extent of this study.

The multivariable linear regression model investigating gender differences in marijuana-related problems included gender, age, race, income, and education. Even though men indicated slightly higher responses in each of the 6 questions, the only statistically significant gender difference was the amount of time spent getting alcohol or other drugs. One prior study reported that men were more likely to buy marijuana from dealers, and women were more likely to acquire marijuana as a gift.¹² Our results suggest that men spend more effort and time acquiring marijuana, which seems to concur with the previous study.

Although males indicated in the questionnaire that they were more likely to have spent more time recovering from marijuana use, there were no significant difference in genders for the last time participants spent a significant amount of time recovering from marijuana use. However, previous research has shown that women are more likely to report dizziness and memory impairment¹³ following marijuana use, indicating that further research should be done to investigate these differences.

While there were no significant gender differences in continuing to use marijuana even though it had caused social problems, previous studies have shown that having social problems precedes marijuana use,¹⁴ and men are more likely to use marijuana when they have low socioeconomic status or when they have bad relationships with their peers.¹⁵

The difference in daily activity reduction due to marijuana use was not statistically significant, even though more males self-reported daily activity reduction. Previous studies have shown that

cigarette smokers report more difficulties in their daily activities in general, and frequent marijuana users self-report increased absences from work¹⁶ and increased procrastination with decreased productivity.¹⁷

There was no statistically significant difference between genders for the last time participants experienced withdrawal symptoms, or the last time participants used marijuana to stop feeling sick or to avoid withdrawal symptoms. Previous studies have shown that while there was no difference in marijuana withdrawal symptoms (irritability, nausea, violent outbursts) or their severity, a greater proportion of women reported these withdrawal symptoms.⁶ In addition marijuana relapse rate is high: one study reported that 71% of its participants used marijuana at least once within 6 months of quitting, with an average of 73 days until relapse.¹⁸ Finally, one other study reports that smoking tobacco and marijuana had greater odds of marijuana dependence symptoms than just smoking marijuana alone,¹⁹ but does not explore gender differences in withdrawal symptoms. However, it is plausible that female daily cigarette smokers who use marijuana would experience more severe withdrawal symptoms than those who used cigarettes only, and that females who used both substances would report more severe withdrawal symptoms than males who used both substances as well.

The interaction between gender and age was also shown to be insignificant. One previous study showed that women were more likely to first use marijuana after the age of 30,¹⁰ indicating that both age and gender have an effect on marijuana use. Another previous study showed that while women were less likely to use marijuana overall, the age of initiation of use for women is dropping, with evidence of increasing marijuana-related problems, also for women.²⁰ Future studies could adjust for the amount of time between first use and current age to re-examine the possible effect of age or gender on marijuana use.

The sensitivity analysis resulted in no gender differences in marijuana-related problems and increased 95% confidence interval widths for those differences. Although the gender differences were insignificant, women reported higher scores for experiencing withdrawal symptoms and using marijuana to stop feeling sick or to avoid withdrawal problems, which would confirm results done by a previous study⁶. It is reasonable to assume that alcohol contributed to some of these social and physical problems, or that alcohol was a confounder for gender differences in marijuana-related problems.

Strengths, Limitations, and Generalizability

The main strength of this analysis was the large population size of 1,328. The PATH study was also a national longitudinal study, meaning that the results obtained from this study are generalizable to the U.S. population as well. In addition, poor physical and mental health resulting from substance abuse falls under the category of substance abuse disorders in the DSM-V²¹ meaning that further research in marijuana-related problems could be applicable to other substances that cause dependence and abuse as well.

One of the limitations of this study is the lack of specificity in other peer-reviewed articles: there is limited information available on the gender differences in marijuana related problems for daily cigarette smokers and marijuana users. Thus, the results from this study must be interpreted with caution, and more research must be done to verify the validity of these results.

A second limitation of this study is that it does not account for the number of cigarettes smoked, or the amount of marijuana smoked. Substance abuse withdrawal symptoms are shown to have dose-dependence,²² meaning that heavy cigarette and marijuana users are more likely to have more severe marijuana-related problems as well.

The third limitation of this study is that it analyzes survey responses, which is categorical data, using a pseudo-continuous distribution. In addition, the large sample size may allow the differences to appear significant, even though the actual difference was not that big to begin with.

Finally, this study does not distinguish between medical marijuana use, recreational marijuana use, and polysubstance abuse. The questionnaire indicated that a large number of the 1,328 participants were polysubstance users, with the largest majority reporting alcohol abuse problems. Further studies should be done to control for the effects of alcohol and multiple substances.

In summary, the multivariable linear regression model offers insight on some of the problems daily cigarette smokers that use marijuana experience. The information from this study can be applied to other substance abuse research as well. Finally, with the information from this study and future studies, healthcare professionals can develop gender specific rehabilitation processes to help those with cigarette and marijuana addiction.

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