Pergamon

Life Sciences, Vol. 56, No.s 23/24, pp. 2185-2191, 1995

0024-3205/95 $9.50 + .00

0024-3205(95)00206-5

THE RELATIONSHIP OF TOBACCO AND MARIJUANA SMOKING CHARACTERISTICS

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Summary

In an ongoing study of the pulmonary effects of heavy, habitual marijuana smoking, detailed marijuana and tobacco smoking histories were obtained from 467 adult regular smokers of marijuana and/or tobacco. Frequency and cumulative amounts of tobacco and marijuana smoking were similar for smokers and non-smokers of tobacco, except that pack-years and cigarettes/day at the time of the interview were both significantly less for tobacco smokers who also smoked marijuana compared those who did not. For all subjects who smoked both substances at any time, changes in tobacco and marijuana smoking amounts after commencement of regular smoking of the other substance were similar for tobacco and marijuana; the existing smoking habit decreased in approximately one third of the subjects and remained the same in slightly more than one half of the subjects. Of the dual smokers, 49% began smoking tobacco before marijuana, while 33% began smoking marijuana first; 85% of marijuana smokers who quit tobacco smoking did so after beginning regular marijuana smoking. Self-reported depth of inhalation and breath-holding time of marijuana smoke were similar for tobacco and non-tobacco smokers; smoking topography for tobacco was also comparable for smokers and non-smokers of marijuana.

Key Words: tobacco, marijuana, smoking history, smoking topography

Introduction

Little information has been published concerning long-term changes in the smoking characteristics of either tobacco or marijuana after a regular smoking habit of the other substance is established. The commencement of smoking of tobacco or marijuana might be expected to have long-term effects on the frequency or quantity of smoking of the other substance compared to smokers who maintain the habit of smoking only a single substance. Striking differences in the manner in which tobacco and marijuana are usually smoked have been demonstrated.(1-3)

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Therefore, if the inhaling pattern established in one habit is carried over to a new habit, then the depth of inhalation and/or breath-holding time might be different in smokers of multiple substances compared to those who smoke only one substance, therefore changing exposure of the lung to the smoke. The ages at which each smoking habit is established and/or terminated may also be affected by concomitant smoking of another substance. Kandel, et. al., reported that early onset of tobacco smoking is associated with more frequent progression to marijuana smoking, as well as the use of other illicit drugs, although changes in characteristics of the pre-existing tobacco smoking habit after the start of regular marijuana use were not reported.(4)

In order to examine the relationship between tobacco and marijuana smoking characteristics, we analyzed the responses to a detailed respiratory and smoking history questionnaire administered to 467 adult regular smokers and non-smokers of marijuana and/or tobacco in an ongoing study of the effects of heavy, habitual marijuana smoking on the lung. Our purpose was to determine the effect of a pre-existing smoking habit on both the commencement and smoking characteristics of tobacco and marijuana. In addition, we investigated whether smoking topography for marijuana or tobacco is influenced by the initiation of a second smoking habit.

Methods

To study the effects of heavy, habitual marijuana smoking on lung function and respiratory symptoms, 529 regular smokers and non-smokers of marijuana and/or tobacco between the ages of 22 and 49 years were recruited into a longitudinal study beginning in 1983.(5) Along with pulmonary function tests, a detailed respiratory questionnaire was administered that included lifetime tobacco and marijuana smoking histories as well as estimated inhalation volumes and breath-holding times for both substances. Histories recorded smoking information on a yearly basis. Tobacco smoking was defined as having smoked at least one cigarette per day for at least one year, and marijuana smoking was defined as having smoked at least one cigarette (joint) of marijuana per month for at least one year. Marijuana smokers were excluded from the analysis if their lifetime marijuana smoking amount was less than 3.57 joint-years (joints/day times years smoked) and non-smokers of marijuana were excluded if their lifetime marijuana smoking exceeded 0.55 joint-years. The depth of inhalation during smoking of each substance was assessed by self-report with the aid of a visual analog scale of subdivisions of lung volume. The breath-holding time during smoking of each substance was assessed by self-report using a categorical scale ($<$ 3 seconds, 3 to 5, 6 to 10 and $>$ 10 seconds). Data from the baseline interviews were used for analysis. The UCLA Human Subjects Protection Committee approved the study protocol.

Of the 529 subjects entered into the study, eight were excluded from analysis because their lifetime marijuana smoking amounts were either too low for a smoker of marijuana or too high for a non-marijuana smoker. Fourteen additional subjects were excluded for regular cocaine smoking. Twenty-eight subjects had missing or inconsistent data on their smoking histories that made accurate assessment of their smoking habits impossible, while 12 subjects underwent pulmonary function testing but failed to respond to the smoking history questionnaire. Thus, 467 subjects are included in this analysis. Eighty-six subjects had never smoked either tobacco or marijuana on a regular basis, 69 were regular smokers of tobacco only, 100 were regular smokers of marijuana only and 212 were regular smokers of both tobacco and marijuana.

Comparisons of means between smoking groups were made using unpaired t-tests. The proportion of subjects reporting breath-holding times in each category were compared between groups using a chi-square test. A significance level of $p < .05$ was used for all statistical tests (two-tailed for the t-tests).

Results

The number of male and female subjects who were non-smokers or smokers of tobacco and/or marijuana, their age at the time of the interview and the age they started smoking are given in Table I. Smoking characteristics of the subjects are shown in Table II. The mean lifetime cumulative smoking amount of marijuana (joint-years) for marijuana-only smokers was higher than for those marijuana smokers who also smoked tobacco, but this difference was not statistically significant. Among all marijuana smokers, current marijuana smoking amounts were similar for smokers and non-smokers of tobacco. Pack-years of tobacco and the smoking amount at the time of the interview were both significantly less for those tobacco smokers who also smoked marijuana compared to those who did not ($p < 0001$, t-test). Tobacco-only smokers had a 50% greater mean lifetime tobacco smoking amount (21.2 vs. 14.2 pack-years) and almost twice the current tobacco smoking amount (28.1 vs. 14.5 cigarettes/day) than those who also smoked marijuana.

TABLE I

Number of subjects, age and age began smoking for each smoking group, mean (sem)

Substances	Number of subjects		Age at interview	Age began smoking	
	Male	Female		Tobacco	Marijuana
None	51	35	31.7 (0.7)	----	----
Tobacco only	35	34	36.9 (0.8)	18.5 (0.6)	----
Marijuana only	83	17	30.6 (0.5)	----	17.9 (0.5)
Tobacco and marijuana	154	58	33.3 (0.7)	17.0 (0.3)	18.8 (0.4)

TABLE II

Smoking characteristics of subjects in each smoking group, mean (sem)

Substances	Pack-years	Cigarettes / day (current)†	Joint-years*	Joints / week (current)‡
None	-----	-----	-----	-----
Tobacco only	21.2 (1.8)	28.1 (1.8)	-----	-----
Marijuana only	-----	-----	61.7 (15.7)	28.2 (5.5)
Tobacco and marijuana	14.2 (0.8)**	14.5 (1.0)**	49.1 (3.4)	25.8 (2.2)

†Only current smokers of tobacco
‡Only current smokers of marijuana
*Joint-years = joints/day times years smoked
**Significantly different from tobacco only, $p < .0001$, t-test

For all subjects who smoked both substances at any time, changes in tobacco and marijuana smoking amounts one year before versus one year after commencement of regular smoking of the other substance were similar for tobacco and marijuana. Tobacco smoking did not change in 57% of subjects who began smoking marijuana, while 34% increased their tobacco smoking after starting regular marijuana smoking. Similarly, marijuana smoking remained unchanged in 54% of marijuana smokers with commencement of regular tobacco smoking, with 35% increasing their marijuana smoking after starting regular tobacco smoking. Only 9% of tobacco smokers and 11% of marijuana smokers decreased their smoking amount after commencing smoking the other substance.

For those subjects who smoked both tobacco and marijuana at any time, the percentages of subjects who started smoking each substance first were as follows: 49% began smoking tobacco before marijuana, while 33% began smoking marijuana first. Eighteen percent began smoking both substances simultaneously.

Among smokers of both substances, the temporal relationship between quitting tobacco smoking and the commencement of marijuana smoking was as follows: 85% of marijuana smokers who quit tobacco smoking did so after beginning regular marijuana smoking, while only 13% quit tobacco smoking before beginning regular marijuana smoking. Only two subjects quit smoking marijuana before beginning smoking tobacco.

Means of self-reported depth of inhalation and breath-holding time of marijuana and tobacco smoke are presented in Table III. Mean depth of inhalation and the proportion of subjects in each category of breath-holding time for each substance were similar regardless of the presence or absence of concomitant smoking of the other substance. Marijuana was inhaled by marijuana-only smokers to a mean of 79% of their inspiratory capacity (IC), while those who also smoked tobacco reported a mean depth of inhalation of 84% of IC during marijuana smoking. The percentages of subjects reporting breath-holding times for marijuana smoke in each time category were similar for those who did and did not also smoke tobacco. Tobacco was inhaled by tobacco-only smokers to a mean of 63% of their IC, while those who also smoked marijuana reported a mean of 61% of IC. Tobacco smokers reported breath-holding times in only the two categories representing the shortest times. Sixty-nine percent of the tobacco-only smokers reported holding the smoke in their lungs for less than three seconds, while 83% of those who also smoked marijuana reported less than three second breath-holding. There were no statistically significant differences between groups in the self-reported depth of inhalation (t-test) or breath-holding time (chi-square test).

Demographic values differed between male and female subjects with respect to age and marijuana smoking history. The females were slightly older than the males in this study (34.2 vs. 32.4 years; $p < .01$, t-test). Males had significantly greater current marijuana smoking amounts (28.8 vs. 19.4 joints/week; $p < .05$, t-test) and lifetime marijuana smoking amounts (57.5 vs. 39.3 joint-years; $p < .05$, t-test) than females. Males began smoking marijuana at a slightly younger age than females (18.1 vs. 19.8 years; $p < .05$, t-test). However, there were no statistically significant differences between males and females for any outcome measure, including the temporal relationships between starting and quitting tobacco and marijuana smoking, and changes in each smoking habit when another smoking habit is initiated.

TABLE III
Self-reported depth of inhalation and breath-holding time during smoking of tobacco and marijuana for each smoking group

Substances	Depth of inhalation, % IC*		Percent of subjects in each breath-holding time category (sec)					
			Tobacco		Marijuana			
	Tobacco	Marijuana	< 3	3 - 5	< 3	3 - 5	6 - 10	> 10
Tobacco only	63	---	69	31	---	---	---	---
Marijuana only	---	79	---	---	5	33	33	29
Tobacco and marijuana	61	84	83	17	7	27	37	29

* IC = Inspiratory capacity

Discussion

While some aspects of the interaction between tobacco and marijuana smoking characteristics have been well studied, long-term effects of changes in marijuana or tobacco smoking behavior on the characteristics of smoking of other substances are not entirely understood. The nature of tobacco as a "gateway" substance preceding the use of illicit drugs, and that of marijuana as a precursor to the use of other illicit drugs, has been well-established.(4,6-8) Yamaguchi and Kandel first demonstrated that, in adolescents and young adults (age<25 years), regular marijuana use is almost invariably preceded by tobacco use(7), while a followup study by Kandel, et. al., found that, in older adults (age 34-35 years), marijuana use was often initiated without prior tobacco use, particularly among women.(4) Short-term changes in tobacco smoking characteristics following marijuana smoking have also been investigated.(9-12) In a placebo-controlled study of the effect of self-administered marijuana smoking on tobacco smoking during the following 90 minutes, Nemeth-Coslett, et. al., found no effect on short-term tobacco smoking behavior.(12) By contrast, in a strictly-regimented residential study, Kelly, et. al., found that the quantity of tobacco smoked was reduced following marijuana smoking, although no changes in tobacco smoking topography (puff duration, puffs per smoking bout) were noted.(9)

In our study of 467 smokers and non-smokers of tobacco and marijuana, we found that, with a single exception, the commencement and maintenance of a regular tobacco or marijuana smoking habit does not appear to affect the amount or the continuance of smoking of the other substance. Among habitual smokers of marijuana, smoking histories for marijuana were similar for smokers and non-smokers of tobacco. However, the smoking histories of tobacco smokers were affected by their marijuana smoking status in that tobacco smokers who also smoked marijuana regularly at any time smoked less tobacco than those who smoked tobacco only. Thus, marijuana smoking characteristics appear to be independent of the presence or absence of concomitant tobacco smoking, while tobacco smoking seems to be decreased when marijuana is also smoked. The latter observation is consistent with the findings of Kelly, et. al., of short-term decreases in tobacco use immediately following marijuana smoking compared to tobacco use following placebo smoking.(9) Our finding of a long-term decrease in tobacco smoking among habitual marijuana smokers, rather than simply a short-term decrease, could be explained by the heavy, habitual nature of the marijuana smoking habits of our subjects, i.e., there is no placebo period. The

marijuana smoking frequency of our subjects was similar to that of the prescribed smoking frequency in the Kelly study(9), which included both placebo and THC-reduced marijuana cigarettes.

Among those subjects with a single smoking habit of either tobacco or marijuana who subsequently began smoking the other substance, the amount of the first substance smoked decreased in approximately one third of the subjects, while the amount did not change in slightly more than half of the subjects. This result was similar for both tobacco smokers who began smoking marijuana and for marijuana smokers who began smoking tobacco. Thus *initiation* of a new smoking habit can lead to reduced smoking of the other substance regardless of which substance was smoked first. Although the cause of this behavioral phenomenon is unknown, it is possible that one smoking habit may partially substitute for another in some subjects, or that social factors (e.g., peer pressure or family values), which we did not measure, could be affecting the smoking behavior of those whose smoking decreased.

Of all smokers of both tobacco and marijuana, one half began smoking tobacco before marijuana, while one third began smoking marijuana first. The finding that so many subjects began smoking marijuana before smoking tobacco is at odds with the generally held belief that cigarette smoking almost always precedes marijuana smoking in young people.(6,7) The ages of onset of marijuana (18.5 ± 0.3) and tobacco (17.4 ± 0.3) smoking of the subjects in our study are well within the range of ages during which the tobacco/marijuana progression has been demonstrated. While 85% of marijuana smokers who quit tobacco smoking did so after beginning regular marijuana smoking, it should be noted that, among those who smoked both tobacco and marijuana at some time but eventually quit tobacco, the mean age of starting regular marijuana smoking was only 19.6 years (range 11 to 30). Thus, it is not surprising that those who quit smoking tobacco did so mainly after starting regular marijuana smoking.

Because the subjects in this study were particularly heavy smokers of marijuana (61.7 ± 15.7 joint-years, marijuana-only smokers; 49.1 ± 3.4 joint-years, marijuana and tobacco smokers), it is possible that their general smoking characteristics are dissimilar to those of marijuana smokers in other studies; the latter smokers encompassed a broad range of lifetime quantities of marijuana and included smokers who simply experimented with marijuana or used it for a short time. The heavy, habitual cannabis users we studied may have been influenced by a different constellation of psychosocial factors, including peer pressure or family values, that led to a progression of substance use dissimilar to that of other marijuana users. In addition, our subjects may have been more likely to have used alcohol rather than tobacco cigarettes before progressing to marijuana use, which would still fit the accepted models of substance use progression. Unfortunately, in this study, only current alcohol use information was collected and not the historical data necessary to determine the extent of alcohol use prior to starting regular marijuana smoking.

While others have investigated the sequence of initiation of tobacco and marijuana smoking, there has been little focus on the changes in an existing habit when a new habit is begun with respect to the frequency as well as the technique of use. Changes in a tobacco or marijuana smoking habit could imply a change in the effective pulmonary risk associated with inhalation of the smoke. The effective dose could be influenced by changing either the amount of smoke inhaled or the manner in which it is inhaled. The observation that the marjority of subjects in this study who developed a second regular smoking habit did not quit or even reduce the frequency of smoking for the already existing smoking habit implies that their exposure to inhaled smoke, and therefore the pulmonary and other risks associated with smoking, were increased.

With respect to smoking topography, the results from the present study indicate that self-assessed

depth of inhalation and breath-holding time of marijuana and tobacco smoke were not affected by the presence or absence of concomitant, regular smoking of the other substance. This observation is consistent with, and extends the findings from, studies of smoking topography using direct, objective, physiological measurements of inhaled volume and breath-holding time in a limited sample of smokers of marijuana and/or tobacco.(1-3)

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