Does Marijuana Pose Risks for Chronic Airflow Obstruction?

Donald P. Tashkin

Division of Pulmonary and Critical Care Medicine, Department of Medicine, David Geffen School of Medicine at University of California, Los Angeles, Los Angeles, California

Marijuana is the second most widely smoked substance after tobacco, and its current (past-month) and near-daily to daily use in the United States among teenagers and adults has been increasing steadily since 2007 (1). With the increasing number of states in the United States that legally sanction marijuana for medical and even recreational use, it is likely that the prevalence of regular marijuana use may increase even further. Because the smoke contents of marijuana include the same panoply of injurious compounds, including carcinogens, that are found in tobacco (2), there has long been concern that smoking marijuana (particularly on a regular basis) may lead to harmful consequences to lung health (e.g., increased risks for chronic obstructive pulmonary disease [COPD], lung cancer, and pneumonia) that have been well documented for tobacco. Recent trends of increasing marijuana use might heighten this concern.

To address the possibility that use of marijuana might predispose to COPD, a limited number of observational studies (mostly cross-sectional and a few longitudinal) have been conducted to assess possible associations between marijuana use and the presence of chronic respiratory symptoms and lung function abnormality. The results of these studies have shown that marijuana use was uniformly associated with an increased prevalence of symptoms of chronic bronchitis (3–7), but the associations with spirometric findings have been less uniform, variably revealing no differences in forced expired volume in 1 s (FEV₁) or forced vital capacity (FVC) (3–6), an actual increase in FVC and/or FEV₁ (8, 9), and either a decrease or no change in the FEV₁/FVC ratio (4, 5, 7, 8,

10) when comparisons were made between smokers of marijuana (either alone or adjusted for tobacco) and nonsmokers, as recently reviewed (11).

A few studies have shown modest but statistically significant increases in airway resistance and reciprocal decreases in specific airway conductance (3, 8, 12), consistent with findings of mucosal edema, vascular congestion, and increased secretions in the central airways of habitual marijuana smokers (13). One study has also demonstrated associations of marijuana use with increases in functional residual capacity, total lung capacity, and residual volume (8), but others have not shown any differences in these subdivisions of lung volume (3, 7). In those studies in which diffusing capacity for carbon monoxide has been measured, no differences have been noted between smokers of marijuana alone and nonsmokers (3, 7, 8).

The studies cited here have been mainly population-based and have included from slightly less than 400 to slightly more than 5,000 participants, most of whom have been relatively young (≤ 45 yr of age), and thus less likely to have developed smoking-related COPD. Moreover, with the exception of one study involving a relatively small convenience sample of habitual marijuana smokers (3), only a small minority reported smoking marijuana regularly or heavily, and thus were less likely to experience adverse effects on lung function. In view of the mixed lung function results from these studies and the general paucity of habitual heavy smokers of marijuana included therein, further studies have been warranted.

This need is addressed by the article from Kempker and colleagues (pp. 135–141) in this month's issue of *AnnalsATS* (14),

which analyzes spirometric data from a large U.S. cohort, the latest National Health and Nutrition Examination Survey (NHANES) 2009–2010, in which information on cumulative lifetime use of marijuana was collected. Findings from this analysis fail to show any association of light to moderate use of marijuana (1–20 joint-years, calculated as the number of marijuana joints smoked per day times the number of years smoked), with a reduced FEV₁/FVC ratio ($< 70\%$), a spirometric indicator of airflow obstruction. Although the authors did show a significant association of heavy lifetime use of marijuana (> 20 joint-years) with an FEV₁/FVC ratio less than 70%, they appropriately attributed this finding to an association of increasing marijuana use with a significantly increased FVC that would tend to spuriously reduce the ratio of FEV₁ to FVC. This interpretation is bolstered by the parallel finding of a trend toward an association of increasing marijuana use with an increased FEV₁ that was of lesser magnitude than the increased FVC.

These findings are consistent with those of a few previous investigators who have shown a significant relationship between marijuana use and an increase in FVC (8, 9), as well as increases in FRC, TLC, and residual volume (8). The mechanism for the increased lung volumes associated with marijuana smoking is speculative but may be a result of stretching the lung from the repeated deep inhalations associated with the usual technique of smoking marijuana, in which inhaled volumes are significantly larger and breathholding times after deep inhalations are much longer compared with the usual topography for smoking tobacco cigarettes (15).

(Received in original form December 17, 2014; accepted in final form December 31, 2014)

Correspondence and requests for reprints should be addressed to Donald P. Tashkin, M.D., Division of Pulmonary and Critical Care Medicine, David Geffen School of Medicine, 10833 Le Conte Ave., Los Angeles, CA 90095. E-mail: dtashkin@mednet.ucla.edu

Ann Am Thorac Soc Vol 12, No 2, pp 235–236, Feb 2015

Copyright © 2015 by the American Thoracic Society

DOI: 10.1513/AnnalsATS.201412-581ED

Internet address: www.atsjournals.org

According to the latest study from Kempker and colleagues, when considered together with previous studies, it is therefore reasonable to conclude that smoking marijuana, when adjusted for tobacco, is unlikely to increase the risk of developing COPD (14). This conclusion is generally supported by the results of longitudinal studies, although the latter are few in number (8, 16).

The study of Kempker and colleagues has important strengths. One strength is the examination of participants in a cohort (NHANES) that is generally representative of the U.S. population in the broad age range of 18–59 years. A second strength is the comparatively large size of the cohort in whom data on cumulative lifetime use of marijuana was collected ($n = 2,956$). A third strength is the performance of well-standardized spirometry with rigorous quality control. Fourth, the authors used multivariate statistical models to adjust for influential covariates as well as demographic characteristics that differed between those with full versus incomplete data.

In contrast, the study also has significant weaknesses. First, as is true for almost all observational studies concerning the health effects of marijuana, reliance was placed on uncorroborated self-reported marijuana use over one's lifetime, which is subject to recall bias, including inaccuracies related to incomplete consumption and

sharing of joints or bongs (water pipes). Second, as also acknowledged by the authors, a large amount of data regarding covariates was missing from the 2009–2010 cohort, although an attempt was made to adjust for these missing data in the analysis. Third, because more than 60% of the self-reported marijuana smokers were younger than 40 years, the use of FEV_1/FVC lower than 70% as an indicator of airflow obstruction would tend to underestimate the proportion of such smokers with airflow obstruction because of the effect of age on the FEV_1/FVC ratio. Fourth, it is not clear exactly how many cohort participants were heavy habitual users of marijuana (>20 joint-years); if this number were low, it could have resulted in a type II error.

The cross-sectional design of the NHANES surveys precludes the ability to assess the effect of marijuana use on the rate of decline in lung function, acceleration of which is a defining feature of COPD as a usually progressive disease and has seldom been evaluated in marijuana smokers (8, 16). Moreover, the questionnaires used by Kempker and colleagues elicited responses concerning respiratory symptoms within only the past week from participants in both the 2007–2008 and 2009–2010 NHANES surveys who were current (within past month) smokers of marijuana (12.2% of the full cohort). Although the

past-week symptom questionnaire indicated an increase in recent respiratory symptoms in relation to the frequency of marijuana use over the past month, no information could be elicited concerning the relationship between marijuana use and chronic respiratory symptoms, including symptoms of chronic bronchitis. In contrast, the latter association has already been well established by previous investigators.

Finally, the article by Kempker and colleagues focuses only on the association of marijuana use with expiratory airflow and related symptoms. Unfortunately, the full effect of marijuana use on respiratory health could not be assessed using the NHANES database, including aspects of lung health with which a causal association of marijuana use is more controversial than that pertaining to lung function abnormality. The former include lung cancer, pneumonia, tuberculosis, bullous lung disease, and pneumothorax/pneumomediastinum (11). Furthermore, we know little about the potential respiratory effects of marijuana use in those with underlying lung disease or in immunocompromised individuals who may resort to marijuana for medicinal purposes. These are areas that require further study using appropriate epidemiologic methods. ■

Author disclosures are available with the text of this article at www.atsjournals.org.

References

- 1 Substance Abuse and Mental Health Services Administration. Results from the 2012 National Survey on Drug Use and Health. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2013 [updated 2013 Oct 2; accessed 2014 Dec 17]. Available from: <http://www.samhsa.gov/data/NSDUH/2012SummNatFindDetTables/Index.aspx>
- 2 Moir D, Rickert WS, Levasseur G, Larose Y, Maertens R, White P, Desjardins S. A comparison of mainstream and sidestream marijuana and tobacco cigarette smoke produced under two machine smoking conditions. *Chem Res Toxicol* 2008;21:494–502.
- 3 Tashkin DP, Coulson AH, Clark VA, Simmons M, Bourque LB, Duann S, Spivey GH, Gong H. Respiratory symptoms and lung function in habitual heavy smokers of marijuana alone, smokers of marijuana and tobacco, smokers of tobacco alone, and nonsmokers. *Am Rev Respir Dis* 1987;135:209–216.
- 4 Bloom JW, Kaltenborn WT, Paoletti P, Camilli A, Lebowitz MD. Respiratory effects of non-tobacco cigarettes. *Br Med J (Clin Res Ed)* 1987;295:1516–1518.
- 5 Taylor DR, Poulton R, Moffitt TE, Ramankutty P, Sears MR. The respiratory effects of cannabis dependence in young adults. *Addiction* 2000;95:1669–1677.
- 6 Moore BA, Augustson EM, Moser RP, Budney AJ. Respiratory effects of marijuana and tobacco use in a U.S. sample. *J Gen Intern Med* 2005;20:33–37.
- 7 Aldington S, Williams M, Nowitz M, Weatherall M, Pritchard A, McNaughton A, Robinson G, Beasley R, Beasley R. Effects of cannabis on pulmonary structure, function and symptoms. *Thorax* 2007;62:1058–1063.
- 8 Hancox RJ, Poulton R, Ely M, Welch D, Taylor DR, McLachlan CR, Greene JM, Moffitt TE, Caspi A, Sears MR. Effects of cannabis on lung function: a population-based cohort study. *Eur Respir J* 2010;35:42–47.
- 9 Pletcher MJ, Vittinghoff E, Kalhan R, Richman J, Safford M, Sidney S, Lin F, Kertesz S. Association between marijuana exposure and pulmonary function over 20 years. *JAMA* 2012;307:173–181.
- 10 Tan WC, Lo C, Jong A, Xing L, Fitzgerald MJ, Vollmer WM, Buist SA, Sin DD; Vancouver Burden of Obstructive Lung Disease (BOLD) Research Group. Marijuana and chronic obstructive lung disease: a population-based study. *CMAJ* 2009;180:814–820.
- 11 Tashkin DP. Effects of marijuana smoking on the lung. *Ann Am Thorac Soc* 2013;10:239–247.
- 12 Tashkin DP, Calvarese BM, Simmons MS, Shapiro BJ. Respiratory status of seventy-four habitual marijuana smokers. *Chest* 1980;78:699–706.
- 13 Roth MD, Arora A, Barsky SH, Kleerup EC, Simmons M, Tashkin DP. Airway inflammation in young marijuana and tobacco smokers. *Am J Respir Crit Care Med* 1998;157:928–937.
- 14 Kempker JA, Honig EG, Martin G. The effects of marijuana exposure on respiratory health in US Adults. *Ann Am Thorac Soc* 2015;12:135–141.
- 15 Wu T-C, Tashkin DP, Djahed B, Rose JE. Pulmonary hazards of smoking marijuana as compared with tobacco. *N Engl J Med* 1988;318:347–351.
- 16 Tashkin DP, Simmons MS, Sherrill DL, Coulson AH. Heavy habitual marijuana smoking does not cause an accelerated decline in FEV_1 with age. *Am J Respir Crit Care Med* 1997;155:141–148.