
Changes in Marijuana Use Patterns, Systematic Literature Review, and Possible Marijuana-Related Health Effects

Presented to the Colorado State Board of Health, the Colorado Department of Revenue, and the Colorado General Assembly on Friday, January 30, 2015 by The Retail Marijuana Public Health Advisory Committee pursuant to C.R.S. 25-1.5-110 (2014).

This report has been reviewed by Larry Wolk, MD, MSPH, Executive Director and Chief Medical Officer, Colorado Department of Public Health and Environment.
Marijuana Use and Respiratory Effects

Systematic Literature Review

Retail Marijuana Public Health Advisory Committee
Final Approval: January 12, 2015

Primary Authors:
Todd Carlson, MD, Internal Medicine Resident, University of Colorado.
Mike Van Dyke, PhD, CIH, Chief, Environmental Epidemiology, Occupational Health and Toxicology Branch, Colorado Department of Public Health and Environment.

Primary Reviewer:
Russell Bowler, MD, PhD, Professor of Medicine, National Jewish Health, University of Colorado.

Introduction
The risks to lung health related to cigarette smoking are well-defined. This is not the case for marijuana smoking, and all types of marijuana use. Smoking lung topography differs greatly among the two substances. Marijuana smokers typically inhale a greater volume of smoke into their lungs and tend to hold the particulate-filled smoke in the lungs much longer.[1] Thus, while some commonalities exist between tobacco and cigarette smoke, there is a great deal we don’t yet know about marijuana use and the potential for adverse health effects to the respiratory system, including the mucosal surfaces of the mouth, tongue, and throat and into the lungs.

Key Findings
This literature review focuses on marijuana use and potential adverse effects to the respiratory tract. Findings are outlined in Table 1: Findings Summary, Marijuana Use and Respiratory Effects. We found substantial evidence that marijuana smoke contains many of the same carcinogens found in tobacco smoke. We also found substantial evidence that acute use, in the preceding hour, results in immediate, short-term improvement in lung airflow. This finding includes use of both smoked and edible marijuana products. However, we found moderate evidence that heavy marijuana smoking is associated with mild airflow obstruction. In addition, we found substantial evidence that heavy marijuana smoking is associated with chronic bronchitis, including chronic cough, sputum production, and wheezing. We found substantial evidence heavy marijuana smoking is associated with pre-malignant lesions in the airway, but mixed evidence for whether or not marijuana smoking is associated with lung cancer.
An important note for all key findings is that the available research evaluated the association between marijuana use and potential adverse health outcomes. This association does not prove that the marijuana use alone caused the effect. Despite the best efforts of researchers to account for confounding factors, there may be other important factors related to causality that were not identified. In addition, marijuana use was illegal everywhere in the United States prior to 1996. Research funding, when appropriated, was commonly sought to identify adverse effects from marijuana use. This legal fact introduces both funding bias and publication bias into the body of literature related to marijuana use.

The Retail Marijuana Public Health Advisory Committee recognizes the limitations and biases inherent in the published literature and made efforts to ensure the information reviewed and synthesized is reflective of the current state of medical knowledge. Where information was lacking - for whatever reason - the committee identified this knowledge gap and recommended further research. This information will be updated as new research becomes available.

**Recommendations**
Recommendations from the committee reflect the need for standardization of data collection mentioned in many previous chapters. Improvements are needed in consistent collection of information on amount, frequency, and method of marijuana use in both clinical settings and for public health surveillance data collection methodologies. Current methods for marijuana exposure assessment need improvement in both testing methodology and reporting requirements (i.e., blood THC levels instead of self-reports of use). Public health monitoring should include the assessment of new cases of lung cancer possibly related to marijuana use using data available in the Colorado Central Cancer Registry. Additionally, monitoring for the prevalence of more chronic conditions such as COPD and asthma should be conducted in collaboration with the Colorado Hospital Association (CHA) and the All-Payer Center for Improving Value in Health Care (CIVHC) claims data systems. Educational opportunities exist with both primary and more specialized health care providers regarding the potential adverse health effects related to marijuana use and respiratory disease, including the importance of understanding the possible additive risks to lung health related to smoking both tobacco and marijuana.

Research gaps identified include the need for studies of chronic obstructive pulmonary disease (COPD), lung function and lung cancer using older subjects with better defined marijuana-use histories. Prospective studies of groups of marijuana users’ lung function and symptoms over long time periods are needed to address the long-term risk of marijuana use on respiratory diseases such as chronic bronchitis, asthma, and lung and oropharyngeal cancers. Additional research on the potential respiratory effects of newer methods of marijuana use (including vaporizing and dabbing) is needed to assess the long-term safety of these methods.
Table 1:
Findings Summary: Marijuana Use and Respiratory Effects

<table>
<thead>
<tr>
<th>Substantial</th>
<th>Moderate</th>
<th>Limited</th>
<th>Insufficient</th>
<th>Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic bronchitis with cough/wheeze/sputum</td>
<td>Bullous lung disease</td>
<td>Respiratory infections</td>
<td>Lung cancer</td>
<td>COPD</td>
</tr>
</tbody>
</table>

Pre-malignant lesions in airways
Smoke from water pipes or bongs contain more cancer-causing chemicals
Respiratory health effects from vaporizing

Acute use improves airflow

Evidence Statements
Evidence statements are based on systematic scientific literature reviews performed by Colorado Department of Public Health and Environment staff with oversight and approval by the Retail Marijuana Public Health Advisory Committee.

1. We found SUBSTANTIAL evidence that marijuana smoke, both mainstream and sidestream, contains many of the same cancer-causing chemicals as tobacco smoke.\(^2\)\(^-\)\(^5\)

2. We found LIMITED evidence from simulated smoking studies that smoke from water pipes or bongs contains more cancer-causing chemicals per milligram of THC compared to smoke from unfiltered joints\(^6\)\(^-\)\(^7\).

3. We found LIMITED evidence that smoking marijuana deposits more particulate matter per puff in the lungs compared to tobacco smoke.\(^1\)

4. We found SUBSTANTIAL evidence that marijuana use (inhaled or oral) results in an immediate short-term improvement of lung airflow.\(^8\)\(^-\)\(^10\)

5. We found MODERATE evidence that heavy marijuana smoking is associated with mild airflow obstruction.\(^11\)\(^-\)\(^14\)
6. We found MIXED evidence for whether or not smoking marijuana is associated with chronic obstructive pulmonary disease (COPD). \[14-20\]

7. We found INSUFFICIENT evidence to suggest that marijuana smoking alone is associated with emphysema. \[12, 13\]

8. We found SUBSTANTIAL evidence that heavy marijuana smoking is associated with chronic bronchitis, including chronic cough, sputum production, and wheezing. \[11, 13, 17, 21-24\]

9. We found LIMITED evidence that heavy marijuana smoking is associated with bullous lung disease. \[25-27\]

10. We found INSUFFICIENT evidence to determine if smoking marijuana is associated with increased risk of respiratory infections. \[23, 28\]

11. We found SUBSTANTIAL evidence that heavy marijuana smoking is associated with premalignant lesions in the airway. \[22, 26, 28\]

12. We found MIXED evidence for whether or not marijuana smoking is associated with lung cancer. \[11-14\]

13. We found INSUFFICIENT evidence to determine if vaporizing marijuana is associated with respiratory health effects. \[6\]

Public Health Statements
Public health statements are plain language translations of the major findings (Evidence Statements) from the systematic literature reviews. These statements have been officially approved by the Retail Marijuana Public Health Advisory Committee.

1. Marijuana smoke, both firsthand and secondhand, contains the same cancer-causing chemicals as tobacco smoke.

2. Marijuana smoke may deposit more particulate matter in the lungs per puff compared to tobacco smoke.

3. Smoke from water pipes or bongs may contain more cancer-causing chemicals per milligram of THC compared to smoke from unfiltered joints.

4. Regular marijuana smoking is associated with mild decreased airflow in the lungs. However, one-time marijuana use (edible or smoked) is strongly associated with immediate, short-term (1 to 6 hours) improved airflow in the lungs of healthy marijuana users and asthmatics.

5. There is conflicting research for whether or not regular marijuana smoking is associated with chronic obstructive pulmonary disease (COPD).

6. Heavy marijuana smoking is strongly associated with chronic bronchitis, including chronic cough, sputum production and wheezing.

7. Heavy marijuana smoking may be associated with a specific type of lung tissue destruction called bullous lung disease.
8. Heavy marijuana smoking is strongly associated with pre-malignant lesions that may lead to cancer in the airways of your lungs.

9. There is conflicting research for whether or not marijuana smoking is associated with lung cancer.

Public Health Recommendations
Public health recommendations have been suggested and approved by the Retail Marijuana Public Health Advisory Committee with the goals of: 1) improving knowledge regarding population-based health effects of retail marijuana use, 2) developing and targeting public health education and prevention strategies for high-risk subpopulations.

Data Quality Issues
- Standardization of questionnaire data collection to include marijuana use, including method of use, frequency and dose, during spirometry and pulmonary function testing.
- Better quality exposure measures of marijuana use, for example, blood THC levels instead of self-reported cannabis use.

Surveillance
- Monitor statewide prevalence of Chronic Obstructive Pulmonary Disease (COPD) and asthma through existing population-based surveys.
- Monitor health care use involving bullous lung disease using Colorado Hospital Association and/or All-Payer Claims databases.
- Monitor lung cancer incidence using the Cancer Registry.

Education
- Public education on marijuana use and chronic respiratory diseases.
- Public education on the potential for additive risks to lung health related to smoking both tobacco and marijuana.
- Public education that smoking marijuana is not a long-term treatment for asthma.

Research Gaps
The Retail Marijuana Public Health Advisory Committee identifies important gaps in the scientific literature that may impact public health policies and prevention strategies. Colorado should support unbiased research to help fill the following research gaps identified by the committee.

- Improved studies of COPD, lung function and lung cancer using older subjects with better defined marijuana-use histories.
- Prospective studies of groups of marijuana users’ lung function and symptoms over time.
- Improved studies of bullous lung disease to better define its relationship to marijuana use.
- Improved studies assessing the risk of lung and oropharyngeal cancers related to marijuana use.
- Respiratory effects of newer methods of marijuana use (dabbing, vaporizing).
Definitions
• COPD: often used as umbrella term for emphysema and chronic bronchitis
• Emphysema: lung destruction and air trapping
• Chronic bronchitis: sputum production and cough

Levels of Marijuana Use
• Heavy marijuana use: daily or near daily (5-7 days/week)
• Regular marijuana use: weekly (1-4 days/week)
• Occasional marijuana use: less than weekly
• Acute marijuana use: Used within the last hour.
• Any level of use: evidence for all of the above

Age Groups
• Young Adult: 18 through 24 years of age
• Adult: 25 through 64 years of age
• Older Adult: 65 years of age and older

References


90(16): p. 1198-205.


