No smoke, no fire: What the initial literature suggests regarding vapourized cannabis and respiratory risk

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As more municipalities relax restrictions on access to cannabis, questions about the plant's potential for respiratory effects become more common. Given current limitations in developing an inhalant alternative for delivering cannabis medication, smoked marijuana remains the most readily accessible form of cannabis among medicinal users (1). An important question that remains is how to improve safety for the respiratory system in individuals who choose to use cannabis medicinally. Although frequent comparisons with tobacco emphasize that the smoke from cannabis has more carcinogens and respiratory irritants, the absence of nicotine likely mitigates the impact of some of these compounds (2). Evidence suggesting a link between cannabis and lung cancer is equivocal (2-4), but other concerns remain important. Frequent smokers of cannabis often report respiratory problems. Many users experience symptoms of bronchitis including coughing, wheezing and tightness in the chest (5,6). Informed health care professionals may consider making recommendations to their medicinal cannabis patients for vapourization of the plant, particularly for those who want the rapid relief that oral administration fails to provide. It is not our intention to encourage inappropriate use of the plant, but to increase safety for those who choose to use it. Vapourization of cannabis is likely less harmful than smoking. Nevertheless, researchers have yet to gather some of the most necessary data regarding the topic. There have been no published randomized clinical trials investigating vapourization with long-term follow-up; therefore, drawing firm conclusions about the impact of the technique is difficult. Preliminary findings do support the idea that vapourization is an improvement over smoking.

PULMONARY IMPACT OF CANNABIS

The plant's effect on bronchial passages appears to vary with exposure; acute administration can lead to bronchodilation. Cannabis actually served as an asthma treatment in the 1800s and, perhaps, in ancient times (7). A meta-analytic review of 12 studies revealed average increases of 0.15 L to 0.25 L in forced expiratory volume in 1 s (FEV_1), as well as improved peak flows and airway conductance (7). No overall metric of significance was reported; however, the majority of reviewed studies found statistically significant improvements. Data regarding the role of long-term exposure is less consistent. The long-term impact of cannibis use on measures of lung function, particularly FEV_1, forced vital capacity (FVC) and their ratios, is significant in some studies but not others. A review of 14 studies emphasized vast variation in the quality of the research and found little impact of use on relevant measures of lung function, particularly when investigators applied appropriate statistical controls for cigarette smoking, age and weight (6). One 2010 study (8) found that after controlling for nicotine use and other factors, cannabis users had an FVC, total lung capacity, functional residual capacity and residual volume comparable with those who had not used it. These data did reveal cannabis-related increases in airway resistance and significant decreases in specific airway conductance adjusted for thoracic gas volume. Potential changes such as these are worthy of the attention of health professionals (3).

Further work is needed to determine whether a link exists between cannabis use and lung cancer. A review of 19 studies (4) revealed elevated exposure to tars, dysfunctions in alveolar macrophages and histological deviations in bronchial mucosa, but no elevated risk for lung cancer, particularly after controlling for tobacco use. Work subsequent to the review focused on a large sample of Swedish conscripts in a 40-year cohort study. Results suggest that heavy use (defined as >50 occasions in a lifetime in this study) had a large and statistically significant impact on lung cancer, increasing rates by a factor of two in the subsequent 40 years. Most individuals reporting marijuana use in the study sample, however, were also tobacco users (91%). In contrast, smoking >10 cigarettes a day (a cut-off chosen by the authors of the article) increased risk by a factor of five. Any attempt to try to equate cigarettes and cannabis exactly is probably a fool's errand, but these comparisons may help readers put cannabis's impact on lung cancer into perspective. Only 189 cases of lung cancer occurred in >49,000 participants; therefore, all of these results must be interpreted cautiously (9). The teen years may be a particularly important time to avoid smoking entirely given that it is a critical period in lung development when exposure to irritants may have a dramatic impact. This point does, however, support the need for some type of intervention, such as the vapourizer, if teens need medical cannabis (10).

INCREASING POTENCY TO INCREASE SAFETY

At first glance, an obvious attempt to increase the plant's safety would require higher concentrations of cannabinoids, thereby increasing the proportion of active ingredients to irritants in a single inhalation. Stronger cannabis would require smoking less, thereby decreasing exposure to byproducts of the high-heat decomposition of organic materials (pyrolytic compounds). This option relies on the assumption that higher-potency strains of cannabis do, in fact, deliver a higher ratio of cannabinoids to irritants. It also assumes that users are capable of titrating the dosages on their own. Recent evidence suggests that cannabis users will modify the amount of marijuana that they inhale depending on its active dose (11). Nevertheless, a significant proportion of medicinal users report that they prefer lower-dose forms of flower cannabis to concentrates for the very reason that effects can occur too swiftly. These participants also reported that extracts led to more tolerance (12). For these reasons, vapourized plant material may have advantages over extracts.

VAPOURIZING WHOLE-PLANT CANNABIS

Previous reviews of respiratory risk are quick to note that most research investigating cannabis has failed to control for the type of inhalation mechanism (13). The variability in mode of inhalation used across users (eg, joints, pipes, bongs, vapourizers), coupled with a lack of research differentiating users based on inhalation method, makes estimating risk associated with smoked cannabis difficult. Findings from the few studies that do attempt to isolate the respiratory risk associated specifically with vapourizers all demonstrate some level of benefit (5,14-16). Vapourizer technologies attempt to sidestep

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potential respiratory risks. Vapourizers heat the entire plant without igniting it, releasing the cannabinoids in a vapour that is relatively free from the byproducts of combustion. Most cannabis vapourizers require that users draw heated air across plant material. Other devices blow the air past the plant material independently so that the cannabinoid-rich vapour can fill a container, eliminating the user's exposure to the heat source. The majority of studies suggest that vapourizers adequately reduce risk of pulmonary symptoms (5,14-16), although complete safety may require a regulated source of plant material, rather than 'street' samples, which produce ammonia (17).

One of the first vapourizer experiments compared the emissions from multiple samples of vapourized or combusted research-grade cannabis (18).The vapour formed in the gas phase of vapourization of cannabis is composed overwhelmingly of cannabinoids with no significant pyrolytic compounds. Only trace amounts of three other compounds were found, including the terpene caryophyllene and two other substances of undetermined origin. Analysis of the smoke produced through the burned cannabis method, however, resulted in a much lower ratio of cannabinoids to overall gas space (12% of the total mass compared with 94.8%), with 111 total detectable compounds. Five of these byproducts of combustion were known polynuclear aromatic hydrocarbons, organic pollutants with known toxic and carcinogenic effects. The findings suggest that vapourization reduces the delivery of toxic byproducts associated with the use of smoked cannabis. A subsequent experiment addressed exhaled carbon monoxide (CO) (14). The researchers found a statistically significant difference between the increase in CO exhaled following smoking cannabis versus vapourization. The amount of exhaled CO showed little to no increase following vapourization compared with large increases following smoking, which would be expected for inhalation of a combustion product. These findings give further evidence that vapourization reduces exposure to gaseous combustion toxins.

These results are consistent with self-report research, which suggests that users experience less respiratory irritation when using a vapourizer compared with a classic burning technique (5). After controlling for other known risk factors, using a vapourizer was associated with fewer reported respiratory symptoms overall relative to other burning techniques. Moreover, the study found a noteworthy interaction between amount of cannabis used and choosing to use a vapourizer on reported symptoms. The protective effect of the vapourizer on respiratory symptoms was greatest among those who used cannabis the most. These findings are particularly notable for medicinal users, who typically use more cannabis in both density and frequency than other types of users (1). Regular users appear to have strong intuitions about the potential for less respiratory irritation with the vapourizer. They report reduced emissions and perceived health benefits as two of the most prominent reasons for preferring vapourizers to smoked cannabis (19). Randomized clinical trials, in which users switch to the vapourizer, could bolster these data. One pre-post trial of regular users who reported at least two symptoms of bronchitis found that switching to the vapourizer for one month improved self-reported respiratory symptoms by a statistically significant 73% and FVC by a statistically significant 4.8% (0.22 L), with a trend toward significant improvement in FEV_1 of 0.38 L (11.8%) (16). Suggestions to patients to consider choosing vapourization over burning methods appear to be worthwhile.

UNDERGROUND MARKET RISKS

Despite evidence supporting increased respiratory safety when switching to a vapourizer, some risks related to the underground market are noteworthy. Aside from the obvious legal sanctions in some municipalities, research confirms the presence of toxins in 'street' samples of cannabis that even a vapourizer cannot eliminate. Ion-flow tube mass spectrometry revealed toxins, including ammonia, in smoke and vapour from confiscated 'street' samples relative to cannabis obtained from the National Institute on Drug Abuse (17). Although the smoked samples released significantly more ammonia than those that were vapourized, the 'street' cannabis vapour contained approximately 70 parts per million (ppm) of ammonia, compared with 6 ppm for vapourized National Institute on Drug Abuse samples. The findings have important implications for those assisting in vapourization of cannabis in health care and hospital settings given the known toxicity of ammonia exposure (20). Although a regulated market could help sidestep these problems, health care professionals working where patients can only obtain cannabis from the underground market should be aware of this potential risk.

SUMMARY

As marijuana laws change, questions about the plant's impact on respiratory function will undoubtedly increase. The human lung did not evolve to inhale the byproducts of combustion efficiently. Smoking marijuana does not harm lung function as dramatically as smoking tobacco does. Links between smoking marijuana and actual lung cancer are weak and difficult to replicate. Nevertheless, the habit clearly increases symptoms of respiratory irritation such as tightness in the chest, wheezing and coughing. It also has the potential to alter lung function when dose and frequency of use are high. Using stronger cannabis extracts has the potential to limit exposure to irritants, but data regarding this phenomenon are lacking. Many medical marijuana users prefer to use the entire plant. It appears to alter subjective state less dramatically as well as show lower potential for creating tolerance. Edible preparations are an obvious choice that would certainly not add byproducts of combustion to the lung, but these lack the rapid onset and easy titration of dosage available with inhaled products. Thus, the cannabis vapourizer appears to be an ideal harm-reduction approach to safer use.

The vapourizer runs heated air across the plant without igniting it, releasing the cannabinoids in a vapour free from the byproducts of combustion. Some types rely on the user's own inhalation to draw the hot air past the plant material, potentially exposing the lungs to more heat. Other devices blow air into an isolated bag, separating the heating element from the user and avoiding heat exposure. Laboratory work shows that cannabis vapour is composed almost exclusively of cannabinoids with virtually no pyrolitic compounds. The vapourizer raises cannabinoid levels in humans but does not raise exhaled CO levels. One pre-post design clinical trial showed that users with respiratory irritation improved symptoms and lung function after switching to a vapourizer. In short, vapourizers show promise for cannabis users who want to avoid pulmonary problems and prefer a more rapid onset than edibles provide.

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