

# driving under the influence of cannabis: a brief review of the literature

Against a backdrop of clarity about the dangers of driving under the influence of alcohol, questions have rightfully been raised in the general community about the impact of cannabis use on driving performance and the risk of motor vehicle accidents. Although research examining this issue has gained momentum in recent years, the picture remains muddled by inconsistent findings and methodologies. A potentially alarming consequence of this muddled view may be evident in the findings of a recent study suggesting that young people perceive the negative consequences of driving after cannabis use as less likely than those of driving after alcohol use, and that such perceptions are associated with increased engagement in, and frequency of, driving under the influence of cannabis.<sup>1</sup>

The current literature review explores briefly the current state of research in the area of cannabis and driving, and looks toward a future of coherence and enlightenment.

## prevalence of driving under the influence of cannabis

Results from the 2007 National Drug Strategy Household Survey (NDSHS)<sup>2</sup> indicate that 2.9% of Australians aged at least 14 years have driven a motor vehicle while under the influence of illicit drugs in the last 12 months. This percentage has reduced from 3.9% and 3.3% in the 2001 and 2004 versions of the survey, respectively.<sup>3,4</sup> These results are similar to those found in United States' national substance use surveys, where 4.4% and 4.3% of respondents in 2004 and 2005, respectively, reported having driven under the influence of illicit drugs in the last 12 months.<sup>5</sup>

Relating to cannabis in particular, several researchers have surveyed the general driving population about their use of the drug prior to driving. Three Canadian studies have shown drivers to report having driven a vehicle during the previous 12 months under the influence of cannabis at rates of 1.5% to 2.9%.<sup>6-8</sup> A recent review of drug use, impaired driving and traffic accidents by the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA)<sup>9</sup> revealed that between 0.3% and 7.4% of drivers tested positive for cannabis across seven roadside surveys conducted between 1997 and 2007 in Australia, Denmark, the Netherlands, Norway, the United Kingdom, and the United States, using blood, urine or saliva tests (3.9% on average; Australia had the lowest rate among these studies).

In Scotland, researchers found that, among 537 drivers surveyed at toll bridges, 15% of 17 to 39 year-olds and 3% of over 40 year-olds reported having ever driven within 12 hours after using cannabis.<sup>10</sup> Among students with drivers' licences in Canada, these rates were as high as 19.7%.<sup>7,11</sup> In British studies of youthful populations with drivers' licences, self-reported rates of having ever driven under the influence of cannabis were 59% for dance- or night-club patrons<sup>10</sup> and 40% for university students.<sup>12</sup>

Among samples of those who use cannabis, between 43.1% and 82% reported having ever driven a vehicle shortly after using cannabis;<sup>12-15</sup> between 23% and 80.3% reported having done so in the last 12 months;<sup>6,13,15,16</sup> 76.1% reported having done so in the last month;<sup>16</sup> and 21% reported having done so in the last week.<sup>13</sup>

## relationship between cannabis use and driving performance

Three groups of studies have examined the relationship between cannabis use and driving performance: (1) laboratory studies, which investigate the effects of cannabis on skills used in driving; (2) driving simulator studies, which test the effects of cannabis use on driving car simulators designed to replicate actual driving conditions; and (3) field studies, which explore the degree to which cannabis use is responsible for motor vehicle accidents in the real world.<sup>17</sup> These studies are reviewed below.

### laboratory studies

According to a review by Kelly, Darke, and Ross,<sup>17</sup> laboratory studies examining the effects of cannabis on skills utilised while driving detected impairments in tracking, attention, reaction time, short-term memory, hand-eye coordination, vigilance, time and distance perception, decision making, and concentration. More recent controlled laboratory research has suggested similarly that cannabis impairs tasks of selective and divided attention, time estimation, and executive function.<sup>18</sup>

Although most of these studies examined the effects of low doses of cannabis, recent research has suggested that decrements in performance are generally dose-related and typically persist for two to four hours.<sup>19-21</sup> In addition, an EMCDDA<sup>22</sup> review concluded that “the acute effect of moderate or higher doses of cannabis impairs the skills related to safe driving and injury risk”, particularly “attention, tracking and psychomotor skills” (p. 175). This review also concluded that the combined effects of cannabis and alcohol on laboratory performance measures are typically greater than the effects of cannabis alone, and act in either an additive or a multiplicative manner.<sup>22</sup>

### driving simulator studies

In their review of driving simulator studies, Kelly and colleagues<sup>17</sup> concluded that there is evidence of dose-dependent impairments in cannabis-affected individuals’ ability to control a vehicle in the areas of steering, headway control, speed variability, car following, reaction time and lane positioning. They noted, however, that the levels of impairment detected in simulator studies did not appear to replicate those found in laboratory studies, and speculated that this may be due to the cannabis-affected participants consciously compensating for their impairments. Nonetheless, it should be acknowledged that “even in those who learn to compensate for a drug’s impairing effects, substantial impairment in performance can still be observed under conditions of general task performance (i.e. when no contingencies are present to maintain compensated performance.” (p. 176).<sup>22</sup>

Recent simulator studies have produced findings that replicate and build on those reviewed by Kelly and colleagues. These studies have suggested that cannabis use acts in a dose-dependent manner to reduce drivers’ average speed, and increase their lane position and steering wheel variability and reaction times.<sup>23,24</sup> In addition, one simulator study found that cannabis-affected drivers were more likely to report subjectively increased physical effort and discomfort, and reduced energy, than were drivers in control conditions, again in a dose-dependent manner.<sup>23</sup> However, cannabis use did not appear to impact on driver sleepiness or motivation, and there were no effects of cannabis on driving (in relation to either driving ability or subjective feelings) 24 hours following administration.

### field studies

Among field research examining the culpability of cannabis-affected drivers involved in road accidents, there appears to exist three types of studies: (1) those that test for the presence of cannabis in injured drivers, (2) those that study collision risk among samples of cannabis users, and (3) those that study collision risk among general populations of drivers.<sup>22,25</sup> Each of these subcategories of studies is examined below.

EMCDDA's reviews<sup>9,22</sup> showed that across 14 studies conducted in Australia, Denmark, France, the Netherlands, and the United States between 1993 and 2005, the rates of cannabis detected (primarily via blood samples) in drivers injured in traffic accidents ranged from 3.3% to 26.9% (11.8% on average; 7.1% and 15.2% in Australia). Furthermore, the reviews revealed that, among 23 studies of drivers killed in car accidents in Australia, Canada, France, Hong Kong, Italy, Spain, Sweden, the United Kingdom and the United States, cannabis was detected in 1.4% to 37% of drivers (11.7% on average; 11% and 13.5% in Australia).<sup>9,22</sup>

A review of studies exploring the relationship between self-reported cannabis use and collision risk concluded that such studies have yielded mixed results.<sup>25</sup> Although some research has found an association between long-term cannabis use and motor vehicle accidents, other studies suggest that this association decreases or even disappears once other variables—such as gender and risky driving behaviour—have been controlled for.<sup>25-28</sup> Similarly, the association between self-reported cannabis intoxication and involvement in motor vehicle accidents has been demonstrated in some studies but not others.<sup>14,28,29</sup>

In a review of studies examining driver culpability among the general population, Ramaekers, Berghaus, van Laar, and Drummer<sup>29</sup> concluded that the suggestion from early studies that cannabis was unlikely to increase drivers' risk of being involved in a traffic crash may have been inaccurate, on account of their analysing drivers' urine samples, which contain only an inactive THC metabolite that does not necessarily indicate recent cannabis use or impairment. In reviewing more recent studies featuring blood samples that detect active THC metabolites, Ramaekers and colleagues<sup>29</sup> found that although crash culpability was not elevated for low concentrations of THC, risk of involvement in a traffic crash increased as drivers' THC levels increased, and became significantly (up to 6.6 times) greater than that for drug free drivers, at higher concentrations of THC.

A more recent study revealed that increasing instances of driving under the influence of cannabis are associated with an increased risk of motor vehicle accidents. More specifically, after adjusting for confounding variables, young adults in a New Zealand birth cohort who drove under the influence of cannabis more than 20 times across a 4 year period had a risk of collisions 1.4 times greater than did those who had never driven under the influence of cannabis.<sup>30</sup>

Finally, driver culpability studies have suggested that drivers testing positive to cannabis are significantly more likely to be responsible for *fatal* car crashes than are drug-free drivers.<sup>31,32</sup>

## conclusions: methodological limitations and future directions

There are numerous methodological limitations in the studies reviewed above that may account for the great variations and inconsistencies in their findings, which detracts from the likelihood of a clear synthesis of results. Although a comprehensive discussion of the limitations involved is beyond the scope of this review (see the EMCDDA review<sup>9</sup> for more detail), some of the inconsistencies that lend to the difficulties in synthesising the findings across studies include: differences in sample populations; different types of biological samples used to identify cannabis intoxication in field studies; unaccounted for differences in concentrations of cannabis used or detected; and a paucity of field studies involving control groups enabling the estimation of relative risk of accident involvement.<sup>9,22</sup>

The increasing recognition of these limitations has culminated in the recent development of guidelines for research on drugged driving.<sup>33,34</sup> Additional efforts are being made to improve the methodology of cannabis crash culpability studies.<sup>35</sup> In the context of these developments, it is anticipated that future research efforts will help alleviate the current ambiguity in the degree to which cannabis intoxication deteriorates driving performance and increases the risk of motor vehicle accidents.

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