



## Cannabis and flying

### Bottom line

The evidence is that pilots used to smoking cannabis and trained in simulator tasks have impaired function up to 24 hours after smoking cannabis.

### Review

This review was carried out after a request from a **Bandolier** reader who acting as a medical advisor to private pilots who wanted to know what the evidence was that cannabis altered pilot performance.

**Bandolier** used PubMed and the Cochrane Library to December 2001 to look for reports that might help. All the various names for cannabis (and the various spellings) were used, plus words like pilot, aviation, flying etc. Reference lists of retrieved reports were also examined. It is probable that not all reports have been found by this means, as several papers refer to technical reports that may have been directed to US aviation authorities. All the reports found were from the USA, and it may be that other national aviation or military authorities have conducted work that is not in the public domain, or MEDLINE, or exists only in the grey literature. Search results should be considered preliminary, but are what can be achieved quickly using available search sources and the aid of a good medical library.






### Results

Five relevant reports were found [1-5], one of which [2] was a duplicate publication.

Details of the four studies and their main results are in Table 1. Two were randomised and double blind (though pilots could tell the difference between cannabis and placebo), one was a comparative study that made no mention of randomisation, and one was a non-

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comparative study.

All the studies used simulators in which pilots were trained in specific tasks for familiarisation before the study began. They then used a baseline set of measurements of flying ability which measured a number of different criteria. For example, deviations of height or heading could be measured, or ability to land the aeroplane at a fixed point on a runway, or the number of flap or aileron movements, and with climbs, descents, and in calm or turbulent conditions. The set tasks were repeated at time after smoking from 15 minutes to 48 hours.

The dose of THC (it was always THC) varied between 0.09 mg/kg (6.3 mg for a 70 kg man) to 20 mg. All the pilots were men, and all had prior experience of cannabis use, usually in a social setting. Some studies measured subjective "high", and some measured blood concentrations of THC.

All of the studies found that with cannabis pilots' performance deteriorated, predominantly in the first few hours after smoking, but also at later times.

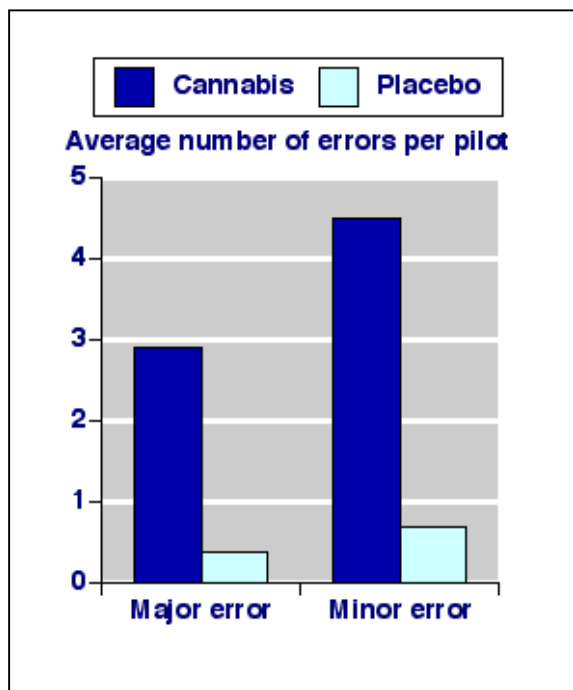
Table 1: Main details of reports of the effects of cannabis on flying.

Reference	Design	Subjects	Cannabis dose	Task	Main results
Janowsky et al, 1974a (duplicated in Janowsky, 1974b)	Randomised, double blind crossover	Seven professional and three private male pilots who smoked cannabis socially	Active (0.09 mg/kg THC) or placebo smoked in a pipe	Four consecutive four minute holding patters in simulator, with different degrees of difficulty, 30 minutes after smoking	Significantly worse performance on altitude, heading deviation and number of minor and major errors.
JA Yesavage et al, 1985	Cohort study without placebo because subjects could identify active drug	Ten private pilots experienced at smoking cannabis	19 mg THC smoked	Simulator flights with prior practice at baseline and 1, 4 and 24 hours after smoking	Significant changes from baseline in tasks at all times after smoking

VO Leirer et al, 1989	Randomised, double blind crossover	Nine younger pilots (18-29 years) and nine older pilots (30-48 years)	Placebo and 10 and 20 mg THC smoked	15 minute flight scenario (calm and turbulent flight) after training on a simulator at baseline and 1, 4, 8, 24 and 48 hours after smoking	Dose, time after smoking, conditions, and age were important factors. Worst performance 1 and 4 hours after smoking in turbulent conditions
VO Leirer et al, 1991	Comparative study, randomisation and blinding not stated	Eleven pilots smoking cannabis in past, but two were present users and excluded	Placebo and 20 mg THC cigarettes	Standard scenario in flight simulator with training at baseline and 15 minutes, and 4, 8 and 24 hours after smoking	Impaired performance at all times after smoking

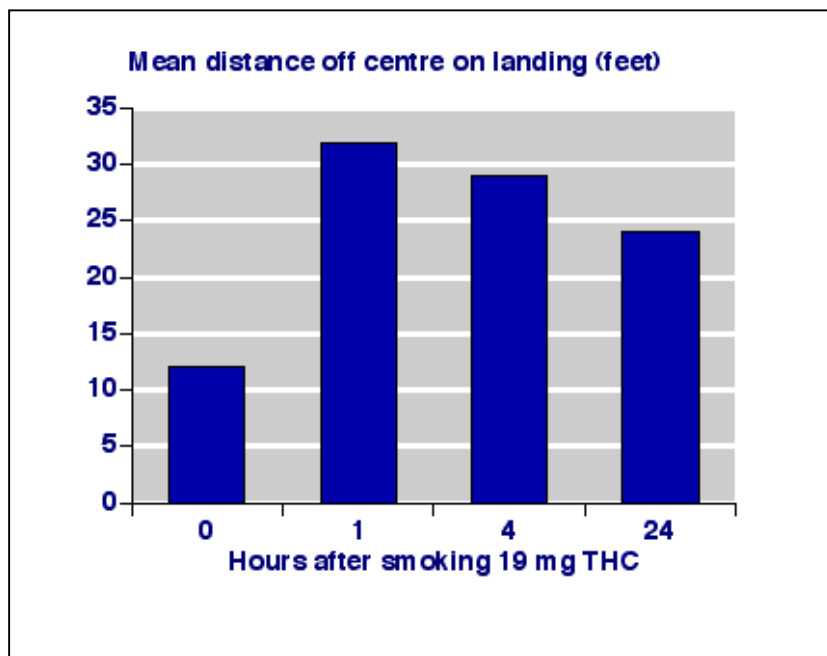
One of the difficulties of these studies is that of assessing the seriousness of the differences found with cannabis. For instance, 30 minutes after smoking 6.3 mg/70kg [1], pilots had an average total height deviation from the assigned path of 2,600 feet, compared with 680 feet with placebo. Statistically significant, but would we worry as a passenger? Perhaps the more interesting finding was that the number of major errors (if committed in actual flight would take the aeroplane out of its designated air space with potential dire consequences) and minor errors (height deviations of more than 100 feet or heading deviations of more than 30 degrees) were much greater with cannabis (Figure 1).

Figure 1: Major and minor errors 30 minutes after cannabis and placebo.



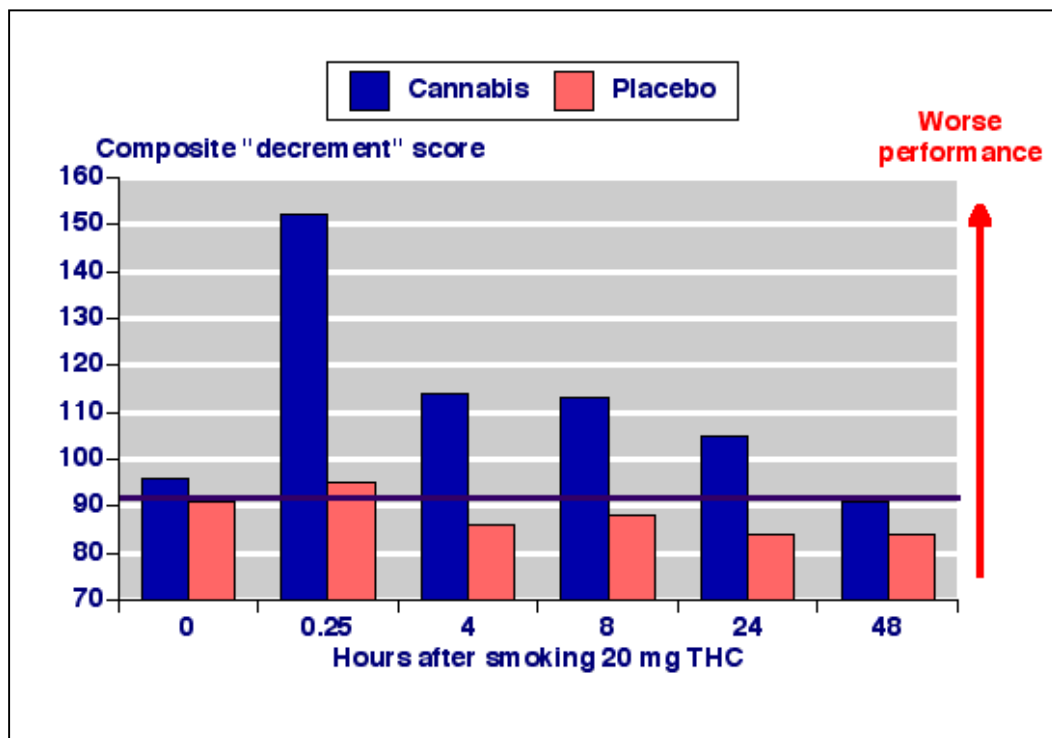
One of the studies [3] recorded the average distance off-centre on landing up to 24 hours after smoking 19 mg THC. Before smoking it was 12 feet with a narrow standard deviation. After smoking, the average off-centre distance on landing increased dramatically (Figure 2) and remained significantly large for 24 hours. Moreover, the standard deviation was also dramatically increased, so that some of the pilots must have landed well over 60-70 feet off-centre. That is equivalent to the width of about five motorway lanes. Similar effects were seen on lateral and vertical deviations and the number of aileron, flap, and throttle changes.

Figure 2: Mean off-centre landing distance for pilots before and after smoking 19 mg THC



The effects of cannabis were found to be greater in older pilots, and when performance demands, like flying in simulated turbulent conditions, were greater [4]. It was also the case that, as in Figure 2, motor effects of cannabis extended long after subjective "high", which tended to wane after about four hours. One study measured the overall average "decrement" in performance through a variety of simulated actions [5] and had similar results, with performance not back to baseline until 48 hours after smoking cannabis (Figure 3).

Figure 3: Performance decrements up to 48 hours after smoking 20 mg THC or placebo



## Comment

Despite studies having what, in clinical trial terms, would be regarded as lowish quality, the attention paid to standardising tasks pilots had to perform was detailed in all four studies. Results were also consistent, though only for men, usually younger men, and those using cannabis socially. Most of us, with this evidence, would not want to fly with a pilot who had smoked cannabis within the last day or so, especially when pilots could be less competent despite no sense of "high", and be unaware of their lowered competence. What might we think of our stockbroker or pension fund manager making decisions for us after a weekend of social cannabis smoking, or, indeed, anyone making important decisions from a bus driver to a brain surgeon?

## References:

1. DS Janowsky et al. Marijuana effects on simulated flying ability. *Am J Psychiatry* 1976a 133: 384-388.
2. DS Janowsky et al. Simulated flying performance after marijuana intoxication. *Aviation, Space, and Environmental Medicine* 1976b 47: 124-128.
3. JA Yesavage et al. Carry-over effects of marijuana intoxication on aircraft pilot performance: a preliminary report. *Am J Psychiatry* 1985 142: 1325-1329.
4. VO Leirer et al. Marijuana, aging, and task difficulty effects on pilot performance. *Aviation, Space, and Environmental Medicine* 1989 60: 1145-1152.

5. VO Leirer et al. Marijuana carry-over effects on aircraft pilot performance. *Aviation, Space, and Environmental Medicine* 1991 62: 221-227.

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