Addictive Behaviors 79 (2018) 178–188

Contents lists available at ScienceDirect

Addictive Behaviors

journal homepage: www.elsevier.com/locate/addictbeh

Cognitive, physical, and mental health outcomes between long-term cannabis and tobacco users

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HIGHLIGHTS

- We examined health outcomes of long-term cannabis users and long-term tobacco users.
- Cannabis users had poorer learning and memory than tobacco users.
- Cannabis users had slower reaction time on some tasks than tobacco users.
- Tobacco users reported poorer physical and mental health than cannabis users.
- Tobacco should be controlled in research investigating cannabis health outcomes.

ARTICLE INFO

Keywords:
Cannabis
Tobacco
Cognition
Mental health
Adult

ABSTRACT

Introduction: Cannabis intoxication adversely affects health, yet persistent effects following short-term abstinence in long-term cannabis users are unclear. This matched-subjects, cross-sectional study compared health outcomes of long-term cannabis and long-term tobacco-only users, relative to population norms.

Methods: Nineteen long-term (mean 32.3 years of use, mean age 55.7 years), abstinent (mean 15 h) cannabis users and 16 long-term tobacco users (mean 37.1 years of use, mean age 52.9 years), matched for age, educational attainment, and lifetime tobacco consumption, were compared on measures of learning and memory, response inhibition, information-processing, sustained attention, executive control, and mental and physical health.

Results: Cannabis users exhibited poorer overall learning and delayed recall and greater interference and forgetting than tobacco users, and exhibited poorer recall than norms. Inhibition and executive control were similar between groups, but cannabis users had slower reaction times during information processing and sustained attention tasks. Cannabis users had superior health satisfaction and psychological, somatic, and general health than tobacco users and had similar mental and physical health to norms whilst tobacco users had greater stress, role limitations from emotional problems, and poorer health satisfaction.

Conclusions: Long-term cannabis users may exhibit deficits in some cognitive domains despite short-term abstinence and may therefore benefit from interventions to improve cognitive performance. Tobacco alone may contribute to adverse mental and physical health outcomes, which requires appropriate control in future studies.

1. Introduction

Whilst it is established that acute cannabis intoxication can contribute to adverse effects on cognitive functioning and mental and physical health, less is known about the health outcomes of long-term cannabis use following short-term abstinence (see Battisti et al., 2010; Hall, 2009; Hall & Solowij, 1998). Cannabis use has more than doubled in the last 10 years in the United States, with one in 10 users subsequently developing cannabis use disorder (Hasin et al., 2015). Given its increased use, it is important to gain greater understanding of the effects of long-term cannabis use on health (Choo & Emery, 2016). Research into the effects of long-term cannabis use on cognition provides conflicting

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https://doi.org/10.1016/j.addbeh.2017.12.009
Received 20 July 2017; Received in revised form 17 November 2017; Accepted 7 December 2017
Available online 09 December 2017
0306-4603/

evidence. Solowij et al. (2002b) found in their cross-sectional study that long-term (mean 23.9 years of use) cannabis users with a median abstinence of 17 h exhibited poorer performance on tests of learning and memory and attention than short-term users and controls, with moderate to large effect sizes (Cohen's *d* 0.47 to 1.29). Conversely, meta-analyses have demonstrated that long-term cannabis users do not exhibit substantial cognitive deficits (Grant, Gonzalez, Carey, Natarajan, & Wolfson, 2003; Schreiner & Dunn, 2012). Abstinence and dose effects may explain conflicting evidence to date. An abstinence effect may occur in which long-term users exhibit cognitive deficits following short periods of abstinence (i.e., several hours or days) that reverse following several weeks of abstinence (Pope, Gruber, & Yurgelun-Todd, 2001). Recent electroencephalography data show a similar process of recovery, moderated by age of first cannabis use, in two-week abstinent cannabis users (Allsop & Copeland, 2015). A dose-dependent relationship can occur whereby cognitive deficits may reverse following abstinence from light (2–14 joints per week) and moderate (18–70 joints per week) but not heavy use (78–117 joints per week; Bolla, Brown, Eldreth, Tate, & Cadet, 2002). Abstinence and dose therefore need to be controlled in cannabis research.

Researchers must also control for substances other than cannabis. It is common practice, in Australia, to mix cannabis with tobacco but tobacco may be a confound as it is associated with adverse cognitive outcomes, such as memory deficits (see Hill, Nilsson, Nyberg, & Bäckman, 2003; Nooyens, van Gelder, & Verschuren, 2008; Ott et al., 2004). However, it has both been reported that tobacco is not associated with cognitive deficits among cannabis users and that tobacco may mask detrimental effects of cannabis on cognition, such as episodic memory (Meier et al., 2012; Schuster, Crane, Mermelstein, & Gonzalez, 2015). Consistent with the former, cross-sectional evidence indicated that abstinent cannabis users, but not tobacco-only users or controls, had deficits in visual recognition, verbal fluency, and delayed visual recall (McHale & Hunt, 2008). Researchers must investigate and account for such potential confounding variables to gain an accurate understanding of the impact that long-term cannabis use has on health, particularly during short-term abstinence.

Cannabis use is also associated with poor mental and physical health. Cannabis is related to increased risk of psychological distress, depression, and anxiety relative to non-users, however, the nature of the association remains unclear due to lack of control of major confounds (Australian Institute of Health and Welfare, 2011; Danielsson, Lundin, Allebeck, & Agardh, 2016; Hoch et al., 2015; Lev-Ran et al., 2014). Long-term cannabis use is also associated with increased respiratory symptoms, myocardial infarction, and greater pulmonary problems than tobacco use alone (Mittleman, Lewis, Maclure, Sherwood, & Muller, 2001; Tashkin, 2010; Tashkin, Baldwin, Sarafian, Dubinett, & Roth, 2002; Tetrault et al., 2007; Tzu-Chin, Tashkin, Djahed, & Rose, 1988). Cannabis may produce more harmful health effects than tobacco because cannabis tar contains carcinogenic agents (e.g., benzanthracenes) in higher concentrations than tobacco smoke (Ashton, 2001). It therefore appears that both substances are harmful, but cannabis may be more deleterious than tobacco. As tobacco alone is also associated with poor physical and mental health, it needs to be controlled in studies investigating health outcomes of cannabis use.

The aim of the current study was to compare cognitive functioning and mental and physical health between long-term cannabis users, following short-term abstinence, to long-term tobacco users and population norms. It was hypothesised that long-term cannabis users would have significantly poorer learning and memory, sustained attention, information-processing speed, executive control, and response inhibition as well as significantly poorer mental and physical health compared to chronic tobacco users and, where available, population norms.

2. Method

2.1. Participants and procedure

Ethical approval was provided by Universities of Sydney and Tasmania (#EC00113 and #H0014300). Participants were recruited via social medial and adverts in New South Wales and Hobart. Participants were screened by telephone (New South Wales) or internet survey (Hobart) prior to a two-hour face-to-face interview. Twenty-three non-treatment seeking cannabis users and 20 tobacco-only users were recruited. All cannabis users and three tobacco users were tested in New South Wales. Data from three tobacco users testing positive for THC, acetaminophen (APEP), and opiates, respectively, was excluded; along with four cannabis users reporting abstinence under eight hours. One further tobacco smoker was removed due to misunderstanding task instructions. The final sample included 19 cannabis users (M = 55.7 years, SD = 8.5) and 16 tobacco users (M = 52.9 years, SD = 7.5; Table 1). Inclusion criteria was current daily/near daily (4 + days a week) cannabis and tobacco use for 10 years or greater for cannabis and tobacco users, respectively. Exclusion criteria was active or unstable mental/physical health condition, current use of drugs

Table 1
Demographic and substance use details of cannabis and tobacco users.

	Group			
	Cannabis n = 19	Tobacco n = 16	g	p
Demographics				
Age (years)	55.7 (8.5)	52.8 (7.7)	0.35	0.303
Male sex, % (n)	68.4 (13.0)	31.3 (5.0)	0.37[b]	0.028*
Education years, M (SD)	14.2 (3.6)	13.7 (3.4)	0.14	0.665
Married, including de facto, % (n)	42.1 (8.0)	68.8 (11.0)	0.35[b]	0.236
Non-Indigenous status, % (n)	100 (19.0)	100 (16.0)		
WTAR std. score, M (SD)	111.6 (11.5)	106.2 (10.23)	0.42	0.216
Substance use history				
Alcohol use per occasion past month, standard drinks	4.4 (4.3) range 1.8–18.0	5.1 (4.0) range 1.0–18.0	0.16	0.635
Alcohol use, days per month (n)	14.1 (13.1)	9.6 (11.0)	0.36	0.326
Tobacco pack years[c]	20.7 (24.8)	22.8 (7.8)	0.11	0.725
Age first used tobacco, years	14.9 (3.9)	15.8 (3.2)	0.22	0.521
Nicotine dependence, Fagerstrom score	0.5 (1.3)	4.6 (2.5)	2.08[a]	< 0.001*
Age first used cannabis, years	18.1 (4.5)	17.5 (2.0)	0.15	0.621
Past month cannabis use, days	27.6 (3.9)			
Cannabis severity of dependence score	2.1 (2.5)			
Cannabis abstinence	15.0 h (7.9) range 8–36	23.6 years (9.8)	4.42[a]	< 0.001*
Lifetime illicit drug use				
Hallucinogens, % (n)	94.7 (18.0)	6.3 (1.0)	0.89[b]	< 0.001*
Amphetamines, % (n)	78.9 (15.0)	25.0 (4.0)	0.54[b]	0.002*
Cocaine, % (n)	73.7 (14.0)	18.8 (3.0)	0.55[b]	0.001*
Ecstasy, % (n)	68.4 (13.0)	6.3 (1.0)	0.63[b]	< 0.001*
Opiates, % (n)	57.9 (11.0)	20.0 (3.0)	0.38[b]	0.038*
Benzodiazepines, % (n)	21.1 (4.0)	37.5 (6.0)	0.28[b]	0.454
Synthetic cannabinoids, % (n)	16.7 (3.0)	0.0 (0.0)	0.29[b]	0.230

SDS ≥ 3 indicates cannabis dependence (Swift, Copeland, & Hall, 1998). Two cannabis users had used benzodiazepines and synthetic cannabinoids in the past month; however, their drug results were negative.

[a] Moderate effect size classified as > 0.5.

[b] Cramer's V effect size for categorical data.

[c] Tobacco pack years was calculated with respect to lifetime use, regardless of current tobacco status.

* $p < 0.05$.