

# Changes over time in prevalence rates of past-year cannabis use by men and women with a psychotic disorder.

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## Research article

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# Abstract

Background: General population data show cannabis use by younger people is declining but increasing in older adults. Overall, the gap between men and women appears to be narrowing. Little has been documented about sex and age differences in patterns of cannabis use over time by people with a psychotic disorder. We examined rates of past-year cannabis use by sex and age to determine whether use by this population has changed over time. Methods: Data on cannabis use from Australian National Psychosis Surveys (1997, 2010) were analysed by sex and age and compared to National Drug Strategy Household Surveys (1998, 2010). Results: Prevalence of past-year cannabis use by people with psychotic illness dropped significantly from 38.2% to 33.7%. Both sexes showed a decline in use. The steeper decline in use by men aged 18-29 years (70.2% to 47.8%) contributed to a narrowing of the sex gap. Conversely, use by men aged 55-64 increased from 4.8% to 18.8%. General population data showed a similar pattern of change across sex and age groups. Conclusions: Despite declining rates of past-year cannabis use in people with a psychotic illness, rates remain more than double that of the general population. Traditionally, men were more likely to use cannabis than women, but convergence in rates in younger people shows this is changing. Furthermore, cannabis use is not restricted to young people. Increasing use of cannabis by older men will place additional demands on drug and alcohol services.

## Background

Evidence indicates that cannabis is the most widely used illicit drug <sup>1</sup>. Traditionally, cannabis has been used more commonly by men than women <sup>2</sup>. Typically, use is initiated in teenage years and, as people mature, use declines <sup>3,4</sup>. However, Australian general population data show that the patterns of past-year cannabis use have been changing. Since its peak in 1998, at 16.9% of the adult population (aged 18 years and over), rates of past-year cannabis use in Australia have gradually been decreasing; current rates are reported to be 10.6% <sup>5,6</sup>. Similar trends of declining cannabis use have been reported in the UK <sup>7</sup>, although not in the USA <sup>8-10</sup>. Over time, contrasting patterns of past-year cannabis use are seen across age groups. Past-year and lifetime cannabis use by younger people (12–17 year olds) has declined in Australia, North America and Western Europe <sup>11,12</sup>, but increased in people aged 50 and over <sup>5,10,13,14</sup>. Over this same period, rates of alcohol and tobacco use have been declining, particularly in younger people and men <sup>5,15,16</sup>. As cannabis is commonly co-consumed with other licit and illicit substances <sup>17,18</sup>, it has been suggested that changing rates of cannabis use may be associated with changing rates of alcohol and tobacco consumption <sup>19</sup>.

The pattern of cannabis use by men and women may also be changing, with evidence suggesting that the sex gap may be narrowing particularly in younger cohorts <sup>2,20-22</sup>. However, the literature is inconsistent regarding whether there is convergence or even divergence and, if the sex gap is narrowing, whether this is due to changing cannabis use by males or females <sup>12,15,23-25</sup>.

It is well recognised that rates of past-year cannabis use by people with a psychotic disorder are much higher than that of the general population<sup>26</sup>. However little has been documented about sex differences in patterns of cannabis use in this population, and whether rates of past-year use have declined over time, as they have in the general population. Understanding trends in cannabis use by men and women with a psychotic illness is important for patients, service-providers and policy-makers alike, as ongoing cannabis use has been associated with treatment non-compliance<sup>27</sup>, increased risk of symptom relapse<sup>28</sup>, increased suicide attempts by older men<sup>29</sup> and poorer outcomes<sup>30,31</sup>. In addition, evidence suggests that women progress from first use to drug dependency more quickly than men<sup>32,33</sup>, are more sensitive to a number of cannabis-induced effects<sup>34</sup> and experience more severe withdrawal symptoms<sup>35</sup>.

The aim of this study was to better understand trends in cannabis use by men and women with a psychotic illness. Using nationally representative data from two cross-sectional Australian national surveys of psychosis (henceforth referred to as the Psychosis Surveys), we examined sex and age differences in rates of past-year cannabis use and investigated whether these have changed over time. We then compared our findings to comparable general population data from the Australian National Drug Strategy Household Survey (NDSHS) collected at the same time periods. Finally, we explored patterns of recent tobacco, alcohol and other illicit drug use across age groups, separately for men and women with a psychotic disorder.

## Methods

### Psychosis Surveys

In 1997, the first national Psychosis Survey was conducted at five sites in three states and one territory across Australia and, in 2010, the second national Psychosis Survey included seven catchment sites in five states. The overarching aims of both Psychosis Surveys were to determine the prevalence of psychotic disorders in Australia and to describe the profile of people living with a psychotic illness and the services they used. Both surveys used a similar two-phase design which has been described in full elsewhere<sup>36,37</sup>. In Phase 1, a one month census took place in public mental health services in each catchment using a psychosis screener to identify individuals aged 18–64 years likely to meet criteria for a formal diagnosis. The 1997 census also included general medical and private psychiatric practices, and marginalized settings (refuges, shelters, soup kitchens) within each catchment, while the 2010 survey screened in non-government organisations providing mental health services. In Phase 2, people who were screened positive for psychosis were randomly selected, stratified by catchment site, for interview. The 2010 survey also stratified by age group (18–34 and 35–64 years) to ensure a good coverage of younger as well as older age groups. All participants gave written informed consent and were interviewed by trained mental health professionals. The Institutional Human Research Ethics Committees at all sites approved the surveys.

To ensure comparability of the two psychosis populations, only people screened positive for psychosis and accessing specialised public mental health services (inpatient, outpatient and community mental health) in the census month in each survey were included in the analysis for this present study. Additionally, all participants who did not provide information on past-year cannabis use were excluded from analysis.

## **National Drug Strategy Household Surveys**

The National Drug Strategy Household Surveys (NDSHS) was first conducted in 1985 and, since then, has been undertaken triennially, including in 1998 and 2010. A multi-stage stratified sample design was used to collect data on awareness, attitudes and behaviour relating to licit and illicit drug use, including alcohol and tobacco. Full details of the sampling and data collection for each survey can be found in the published reports<sup>5,38</sup>. Some methodological differences exist between the 1998 and 2010 surveys. In 1998, two samples were drawn from the same household, whereas only one respondent per household was selected in 2010. The 1998 survey collected data from people aged 14 years and over and used a mixture of interview and self-report questionnaires whereas, in 2010, participants were aged 12 years and over and only self-report questionnaires were used. For this present study, only data from participants aged 18 to 64 years were included, and participants with missing data on past-year cannabis use were excluded, resulting in samples of 8,043 (1998) and 19,289 (2010) people.

## **Outcome variable – Past-year cannabis use**

Similar self-reported data on past-year cannabis use were collected in the Psychosis Survey and NDSHS. The 1997 Psychosis Survey asked participants, How often are you using cannabis? In 2010, the words 'In the last 12 months' were included. Response options were: daily/almost daily, 1–2 days per week, 1–3 times per month, less than monthly, and not used in last 12 months. The 1998 NDSHS participants were asked, Have you used marijuana/cannabis in the past 12 months?' In 2010, the wording changed from 'past' to 'last'. Two response options were provided: no or yes. For our analysis, we created a binary variable (no/yes) and defined past-year cannabis use as any reported use in the 12 months preceding the survey. For past-year users, frequency of use was categorised into three groups: daily/almost daily, weekly, less than weekly.

## **Covariates**

Demographic variables of interest included sex and age. Age was aggregated into four age ranges: 18–29, 30–39, 40–49 and 50–64 years. Information was collected on current use of tobacco, daily use of alcohol, and past-year use of other illicit drugs including amphetamines, heroin, cocaine, ecstasy, LSD/hallucinogens and inhalants/solvents. Responses were coded no, yes or missing.

## **Statistical analysis**

Age and sex profiles were determined for the participant groups from each Psychosis Survey. Chi-squared tests were used to assess differences in the demographic distributions between the 1997 and 2010 surveys. Within each age group, the distribution of frequency of past-year cannabis, other illicit drug,

tobacco and daily alcohol use were determined separately for men and women for each survey. People with missing data on use of other illicit drug, tobacco and daily alcohol use were excluded from this analysis (17, 9 and 20 people in 1997 and 7, 9 and 9 people in 2010, respectively). Chi-squared tests on relevant marginal totals were used to assess differences between proportions. Equivalent distributions of cannabis use by NDSHS participants were calculated using the appropriate sampling weights provided. Analyses were undertaken using SPSS v25.

## Results

A total of 675 and 1205 people from the 1997 and 2010 Psychosis Surveys respectively, were included in the analysis. In both surveys, approximately one quarter of all participants were aged 18–29 years, 40% were women, and the proportion of men and women in each age group did not differ across surveys (Table 1). In 1997, 38.2% of all Psychosis Survey participants had reported using cannabis in the previous 12 months and almost half of these (46.1%) were using every day. In addition, 71.6% of all participants were current tobacco smokers, 19.0% had used other illicit drugs in the past year and 15.9% drank alcohol on a daily basis. By 2010, past-year cannabis use had dropped substantially to 33.7% ( $p = 0.05$ ) and within these users, the proportion using on a daily basis had also dropped significantly to 37.9% ( $p = 0.04$ ). Past-year use of other illicit drugs, tobacco, and daily alcohol had declined to 67.9%, 16.2% and 11.2% respectively; the proportion drinking alcohol daily was significantly lower in 2010 compared to in 1997 ( $p = 0.004$ ).

Table 1  
Psychosis Survey: age profile and use of cannabis in 1997 and 2010, by sex.

	Total		Men				Women					
	1997	2010	1997	2010	1997	2010	1997	2010	1997	2010		
	(n = 675)	(n = 1205)	(n = 409)	(n = 722)	(n = 266)	(n = 483)						
	N	%	N	%	N	%	N	%	N	%	N	%
Age group												
18–29	176	26.1	285	23.7	124	30.3	186	25.8	52	19.5	99	20.5
30–39	197	29.2	402	33.4	121	29.6	256	35.5	76	28.6	146	30.2
40–49	165	24.4	309	25.6	94	23.0	170	23.5	71	26.7	139	28.8
50–64	137	20.3	209	17.3	70	17.1	110	15.2	67	25.2	99	20.5
Cannabis use (past year)												
no	417	61.8	799	66.3	225	55.0	440	60.9	192	72.2	359	74.3
yes	258	38.2	406	33.7	184	45.0	282	39.1	74	27.8	124	25.7
Frequency of cannabis use (n,% within users)												
less than weekly	84	32.6	164	40.4	54	29.3	107	37.9	30	40.5	57	46.0
weekly use	55	21.3	88	21.7	42	22.8	64	22.7	13	17.6	24	19.4
daily use	119	46.1	154	37.9	88	47.8	111	39.4	31	41.9	43	34.7

## Cannabis use by sex and age

Between 1997 and 2010, both sexes showed a decline in prevalence rates of past-year cannabis use. This decline was steeper for men, with rates decreasing significantly from 45.0–39.1% ( $p = 0.05$ ), compared to the less substantial decline for women (from 27.8–25.7%). Our data also showed that, for both men and women, there was a downward trend in daily cannabis use, while the proportion using on a weekly basis remained stable (see Table 1).

Across all age groups in both Psychosis Surveys, the prevalence rates of past-year cannabis use were higher for men than women. Rates were highest among the 18–29 year age group for men and women

alike (Fig. 1). In 1997, in the 18–29 age group, approximately three quarters (70.2%) of all men and half (50.0%) of all women had used cannabis in the previous 12 months. In 2010, this had dropped significantly for men to 47.8% ( $p < 0.001$ ) and less substantially to 37.4% for women ( $p = 0.14$ ). Furthermore, over the same time period, the proportions of men and women in this age group using on a daily basis also declined (52.9 to 43.8% and 46.2 to 35.1% respectively) (see Table 1). Our data show a convergence of past-year cannabis prevalence rates in men and women. In 2010, the gap between the sexes in the 18–29 and 30–39 age groups (10.4% and 13% respectively) had narrowed compared to the equivalent 1997 gaps (20.2% and 16.1%) and this convergence was driven by a greater decline in cannabis use by men than women.

In contrast to our main findings, the proportion of men and women aged 40–49 and 50–64 years who were using cannabis in 2010 had not significantly changed compared to 1997. When we examined the 50–64 year age group in more detail, we observed the trend was not consistent across the whole span. For men aged 50–54 years, we observed a non-significant downward trend from 17.9–11.3% ( $p = 0.4$ ). However, for men aged 55–64 we observed a dramatic increase from 4.8–18.8% ( $p = 0.04$ ). For women aged 50–54 and 55–64 years, rates did not change substantially over time (11.8%-12.5% and 3.0%-3.9% respectively).

## General population comparisons

Using NDSHS data, we observed that overall rates of past-year cannabis use by the general population aged 18–64 years declined, from 17.5% in 1998 to 12.2% in 2010. Past-year use of cannabis decreased in both men and women (Fig. 2), and the pattern of change across age groups was similar to that seen in the Psychosis Surveys: declining rates in the younger ages and increasing rates in the older ages (Fig. 3). As seen in the Psychosis Survey results, the steeper decline in use by men aged 18–29 years contributed most to a narrowing of the sex gap in this age group. Conversely, the prevalence of cannabis use by men aged 55 and over increased only very modestly, from 3.1–4.5%, in contrast to the steep rise in prevalence for the corresponding participants in the Psychosis Surveys.

## Tobacco, alcohol and other illicit drug use

Finally, we examined whether use of other illicit drugs, tobacco or daily alcohol by men and women with a psychotic illness changed over the period between 1997 and 2010. For men, overall and across age groups, the data show a slight decline in the proportion using other illicit drugs, tobacco and, daily alcohol (see Table 2). However, for men in the youngest age group (18–29 years), statistically significant rate reductions were seen in use of other illicit drugs (40.5–28.6%  $p = 0.03$ ) and tobacco (87.6–76.8%  $p = 0.02$ ) while, for men aged 50–64, the proportion using other illicit drugs rose from 2.9–5.5% ( $p = 0.4$ ).

Table 2

Psychosis Survey: use of other illicit drugs<sup>a</sup>, tobacco and daily alcohol in 1997 and 2010, by sex and distribution within each age group (N, % of valid responses).

	Men				Women			
	1997		2010		1997		2010	
Variables	N	%	N	%	N	%	N	%
Other illicit drug use (past year)								
no	301	76.0	578	80.6	232	88.5	426	88.6
yes	95	24.0	139	19.4	30	11.5	55	11.4
Other illicit drug use (n, % within age group <sup>b</sup> )								
18–29	47	40.5	53	28.6	12	24.0	19	19.4
30–39	34	28.8	62	24.4	7	9.3	26	17.8
40–49	12	12.9	18	10.7	5	11.4	9	6.5
50–64	2	2.9	6	5.5	3	4.5	1	1.0
Tobacco use (current)								
no	80	19.9	193	26.9	109	41.4	191	39.9
yes	323	80.1	524	73.1	154	58.6	288	60.1
Tobacco use (n, % within age group <sup>c</sup> )								
18–29	106	87.6	142	76.8	38	76.0	60	61.2
30–39	100	83.3	190	75.1	48	64.0	93	64.1
40–49	68	73.1	123	72.8	41	57.7	88	63.3
50–64	49	71.0	69	62.7	27	40.3	47	48.5

a amphetamines, heroin, cocaine, LSD/hallucinogen, ecstasy or inhalants/solvents

b Data missing: Men - 13 in 1997 and 5 in 2010; Women - 4 in 1997 and 2 in 2010

c Data missing: Men - 6 in 1997 and 5 in 2010; Women - 3 in 1997 and 4 in 2010

d Data missing: Men - 7 in 1997 and 3 in 2010; Women - 13 in 1997 and 6 in 2010

Figure 1: Psychosis Survey: cannabis use in 1997 and 2010, by sex and age group (%).



	Men				Women			
Daily alcohol use								
no	331	82.3	626	87.1	226	86.9	439	91.5
yes	71	17.7	93	12.9	34	13.1	41	8.5
Daily alcohol use (n, % within age group <sup>d</sup> )								
18–29	15	12.3	24	13.0	6	12.2	3	3.0
30–39	20	16.9	30	11.8	9	12.3	11	7.6
40–49	21	22.6	25	14.7	12	16.9	18	12.9
50–64	15	21.7	14	12.7	7	10.4	9	9.3
a amphetamines, heroin, cocaine, LSD/hallucinogen, ecstasy or inhalants/solvents								
b Data missing: Men – 13 in 1997 and 5 in 2010; Women – 4 in 1997 and 2 in 2010								
c Data missing: Men – 6 in 1997 and 5 in 2010; Women – 3 in 1997 and 4 in 2010								
d Data missing: Men – 7 in 1997 and 3 in 2010; Women – 13 in 1997 and 6 in 2010								
Figure 1: Psychosis Survey: cannabis use in 1997 and 2010, by sex and age group (%).								

In comparison, the picture for women was mixed. Decreases in the proportion using alcohol in 2010 were seen across all age groups, but this reduction was only statistically significant in the 18–29 age group (12.2–3.0%,  $p = 0.03$ ). Rates of smoking in this youngest age group also showed a decline (76.0–61.2%  $p = 0.07$ ) but, for all other ages, the proportion of women smoking increased. Decreases in the proportion using other illicit drugs were also seen across all ages except in the 30–39 age group where the proportion using rose from 9.3% in 1997 to 17.8% in 2010 ( $p = 0.09$ ).

## Discussion

Similar to findings for the general population, our data from two large national epidemiological surveys showed that, for men and women with a psychotic illness, rates of past-year cannabis use declined over the 1997–2010 period. Nevertheless, rates remained more than double that of the general population. When the data were examined by age, we found for younger people (18–29 years), past-year cannabis use had declined for both men and women. The significantly greater reduction in use by younger men had resulted in a narrowing of the sex gap, a finding which is in line with what has been reported by other studies<sup>22,25</sup>. Furthermore, within this young group of cannabis users, frequency of use had shifted away from daily use and there was no evidence that other substances were being substituted for cannabis. In fact, for both younger men and women, we found declines in the proportion using tobacco, alcohol and

other illicit drugs, with significant declines in rates of smoking and other illicit drug use by younger men and in daily alcohol use by younger women.

While our data show declining rates of licit and illicit substance use by younger people, a different picture emerged for older Australians living with a psychotic disorder. Since 1997, an increasing proportion of the oldest men and women, aged 55 to 64 years, have persisted in using cannabis, a finding also noted in the Australian and American general population<sup>13,14</sup>. In addition, in the 55 to 64 age group, the proportion of men using other illicit drug rose as did the proportion of women smoking. These findings are of particular concern as the use of illicit substances by older people with severe mental illness adds to the complexity of their medical treatment. Use of these substances has been associated with an increased risk of chronic physical health conditions<sup>39</sup>, drug-induced neurotoxicity and altered drug metabolism<sup>40</sup>. Importantly, increasing use of cannabis by older people places additional demands on drug and alcohol services, particularly as the aging population grows.

The declining rates of substance use in younger people are positive given the impact ongoing cannabis use has been shown to have on the health of people with severe mental illness, including increased severity of positive and negative symptoms, increased rates of psychotic relapse and poorer psychosocial functioning<sup>41,42</sup>. Why rates of cannabis use may be declining in younger people with a psychotic disorder is unclear. Changes in affordability or availability do not appear to be factors, as prices have remained stable and availability has not changed over this period<sup>43</sup>. The impact of anti-smoking advertising over the last 20 years may extend beyond contributing to reducing rates of smoking in younger people<sup>44</sup>. It is possible that younger people who do not take up smoking are also less likely to use other substances including cannabis, commonly co-consumed with tobacco. It has been suggested<sup>45</sup> that the rise in social media and screen time may be a factor in the decline in cannabis use by younger people: less time spent in face to face interactions with friends may reduce exposure to cannabis and other substances. However, a recent report suggests otherwise<sup>46</sup>.

Our study has a number of strengths as well as limitations. Similar data on cannabis use were collected from large randomly selected, representative samples of people with and without a psychotic disorder enabling direct comparison. In addition, women who are often under-represented in cannabis studies were well represented here. However, we only had data on cannabis use by people with a psychotic disorder from two points in time. Therefore, we have assumed that the trend we observed between 1997 and 2010 had a consistent downward trajectory. General population data covering this same period showed a small but significant overall increase in cannabis use between 2007 and 2010 after decreasing steadily since 1998<sup>5</sup>. Despite our large sample sizes, the number of men and women in older age groups who reported using cannabis was relatively small, making inferences about this group less robust than for other age groups. A third national psychosis survey collecting comparable data on cannabis use would help to determine whether the differing trends in cannabis use by younger and older people persist beyond 2010.

# Conclusions

Our data suggests that the 'typical' cannabis user is changing. Between 1997 and 2010, in the general and psychosis populations, rates of past-year cannabis use in younger men and women declined, while the percentage of older people who continued to use cannabis increased. These findings highlight the need for public health campaigns and mental health treatment programs to ensure they include age-appropriate drug reduction strategies to meet the needs of all ages. At the same time, research is needed to examine why fewer younger people, with and without a psychotic disorder, are no longer choosing to use cannabis.

# Abbreviations

NDSHS: National Drug Strategy Household Survey

# Declarations

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## Ethics approval and consent to participate

All participants provided written informed consent. The following Human Research Ethics Committees approved the Psychosis Survey: University of Western Australia (RA/4/1/2478), South Australia Health (2009179), Queensland Health (52-09), Melbourne Health (2010.011), St. Vincent's Hospital Melbourne (119/09), Hunter New England (09/11/18/5.10) and Greater Western Area Health Service (SSA/10/GWAHS/2).

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## Authors' contributions

*AW prepared the original manuscript and undertook the analyses. PD undertook and oversaw the analyses. VM was the 2010 Psychosis Survey project director from which the data was obtained and*

provided oversight on all aspects of the study. JB and MM contributed to the manuscript preparation. All authors contributed to and have approved the final manuscript.

## Consent for publication

Not applicable

## Availability of data and materials

The psychosis data that support the findings of this study contains personal sensitive information and release of this data could compromise research participant consent. The data are not publicly available, please contact the corresponding author (AW).

## Competing interests

The authors declare that they have no competing interests.

## References

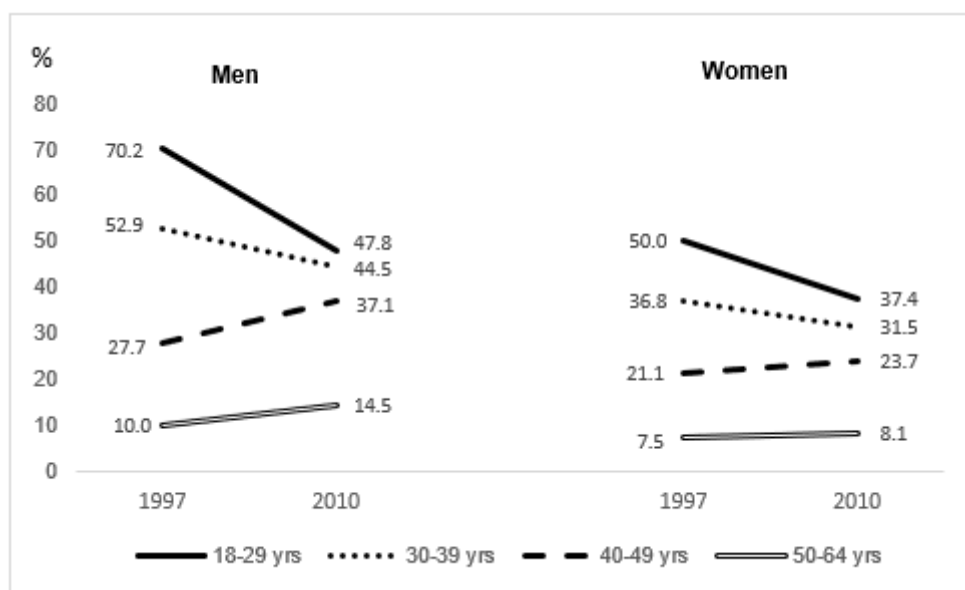
1. United Nations Office on Drugs and Crime. World Drug Report 2016. 2016.
2. Degenhardt L, Chiu W-T, Sampson N, et al. Toward a global view of alcohol, tobacco, cannabis, and cocaine use: findings from the WHO World Mental Health Surveys. *PLoS Med.* 2008;5(7):e141.
3. von Sydow K, Lieb R, Pfister H, et al. The natural course of cannabis use, abuse and dependence over four years: a longitudinal community study of adolescents and young adults. *Drug Alcohol Depend.* 2001;64(3):347-61.
4. Ministry of Health. Cannabis Use 2012/13: New Zealand Health Survey. Wellington: Ministry of Health; 2015.
5. Australian Institute of Health and Welfare. 2010 National Drug Strategy Household Survey report. Drug statistics series no. 25. Cat. no. PHE 145. Canberra: AIHW; 2011.
6. Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2016: detailed findings. Drug Statistics series no. 31. Cat. no. PHE 214. Canberra: AIHW.; 2017.
7. Broadfield D. Drug misuse: findings from the 2016/17 Crime Survey for England and Wales: Home Office; 2017.
8. Chawla D, Yang YC, Desrosiers TA, et al. Past-month cannabis use among US individuals from 2002–2015: An age-period-cohort analysis. *Drug Alcohol Depend.* 2018;193:177-82.
9. Hasin DS, Saha TD, Kerridge BT, et al. Prevalence of marijuana use disorders in the United States between 2001-2002 and 2012-2013. *JAMA psychiatry.* 2015;72(12):1235-42.
10. Kerr WC, Lui C, Ye Y. Trends and age, period and cohort effects for marijuana use prevalence in the 1984–2015 US National Alcohol Surveys. *Addiction.* 2018;113(3):473-81.

11. Roxburgh A, Hall WD, Degenhardt L, et al. The epidemiology of cannabis use and cannabis-related harm in Australia 1993–2007. *Addiction*. 2010;105(6):1071-9.
12. Ter Bogt TFM, De Looze M, Molcho M, et al. Do societal wealth, family affluence and gender account for trends in adolescent cannabis use? A 30 country cross-national study. *Addiction*. 2014;109(2):273-83.
13. Kostadinov V, Roche A. Bongs and baby boomers: Trends in cannabis use among older Australians. *Australas J Ageing*. 2017;36(1):56-9.
14. Han BH, Sherman S, Mauro PM, et al. Demographic trends among older cannabis users in the United States, 2006–13. *Addiction*. 2017;112(3):516-25.
15. Brooks-Russell A, Farhat T, Haynie D, et al. Trends in substance use among 6th-to 10th-grade students from 1998 to 2010: findings from a national probability study. *J Early Adolesc*. 2014;34(5):667-80.
16. Reitsma MB, Fullman N, Ng M, et al. Smoking prevalence and attributable disease burden in 195 countries and territories, 1990–2015: a systematic analysis from the Global Burden of Disease Study 2015. *Lancet*. 2017;389(10082):1885-906.
17. Pape H, Rossow I, Storvoll EE. Under double influence: Assessment of simultaneous alcohol and cannabis use in general youth populations. *Drug Alcohol Depend*. 2009;101(1-2):69-73.
18. Tzilos GK, Reddy MK, Caviness CM, et al. Getting higher: co-occurring drug use among marijuana-using emerging adults. *J Addict Dis*. 2014;33(3):202-9.
19. Ritter A, Sotade O. Explaining the declining rates of past year cannabis use in Australia: A first pass. *Drug Alcohol Rev*. 2017;36(5):602-8.
20. Monshouwer K, Smit F, De Graaf R, et al. First cannabis use: does onset shift to younger ages? Findings from 1988 to 2003 from the Dutch National School Survey on Substance Use. *Addiction*. 2005;100(7):963-70.
21. Chapman C, Slade T, Swift W, et al. Evidence for sex convergence in prevalence of cannabis use: a systematic review and meta-regression. *J Stud Alcohol Drugs*. 2017;78(3):344-52.
22. Kerr WC, Greenfield TK, Bond J, et al. Age–period–cohort influences on trends in past year marijuana use in the US from the 1984, 1990, 1995 and 2000 National Alcohol Surveys. *Drug Alcohol Depend*. 2007;86(2-3):132-8.
23. Piontek D, Kraus L, Pabst A, et al. An age–period–cohort analysis of cannabis use prevalence and frequency in Germany, 1990–2009. *J Epidemiol Community Health*. 2012;66(10):908-13.
24. Carliner H, Mauro PM, Brown QL, et al. The widening gender gap in marijuana use prevalence in the US during a period of economic change, 2002–2014. *Drug Alcohol Depend*. 2017;170:51-8.
25. Johnson RM, Fairman B, Gilreath T, et al. Past 15-year trends in adolescent marijuana use: Differences by race/ethnicity and sex. *Drug Alcohol Depend*. 2015;155:8-15.
26. Degenhardt L, Hall W. The association between psychosis and problematical drug use among Australian adults: findings from the National Survey of Mental Health and Well-Being. *Psychol Med*.

- 2001;31(4):659-68.
27. Ouellet-Plamondon C, Abdel-Baki A, Salvat É, et al. Specific impact of stimulant, alcohol and cannabis use disorders on first-episode psychosis: 2-year functional and symptomatic outcomes. *Psychol Med*. 2017;47(14):2461-71.
  28. Crocker CE, Tibbo PG. The interaction of gender and cannabis in early phase psychosis. *Schizophr Res*. 2018;194:18-25.
  29. Waterreus A, Di Prinzio P, Badcock JC, et al. Is cannabis a risk factor for suicide attempts in men and women with psychotic illness? *Psychopharmacology (Berl)*. 2018;235(8):2275-85.
  30. Burns JK. Pathways from cannabis to psychosis: a review of the evidence. *Front Psychiatry*. 2013;4:128.
  31. Van der Meer FJ, Velthorst E, Outcome of Psychosis I. Course of cannabis use and clinical outcome in patients with non-affective psychosis: a 3-year follow-up study. *Psychol Med*. 2015;45(9):1977-88.
  32. Hernandez-Avila CA, Rounsaville BJ, Kranzler HR. Opioid-, cannabis-and alcohol-dependent women show more rapid progression to substance abuse treatment. *Drug Alcohol Depend*. 2004;74(3):265-72.
  33. Kerridge BT, Pickering R, Chou P, et al. DSM-5 cannabis use disorder in the National Epidemiologic Survey on Alcohol and Related Conditions-III: gender-specific profiles. *Addict Behav*. 2018;76:52-60.
  34. Cooper ZD, Haney M. Investigation of sex-dependent effects of cannabis in daily cannabis smokers. *Drug Alcohol Depend*. 2014;136:85-91.
  35. Sherman BJ, McRae-Clark AL, Baker NL, et al. Gender differences among treatment-seeking adults with cannabis use disorder: Clinical profiles of women and men enrolled in the achieving cannabis cessation—evaluating N-acetylcysteine treatment (ACCENT) study. *Am J Addict*. 2017;26(2):136-44.
  36. Jablensky A, McGrath J, Herrman H, et al. Psychotic disorders in urban areas: an overview of the Study on Low Prevalence Disorders. *Aust N Z J Psychiatry*. 2000;34(2):221-36.
  37. Morgan VA, Waterreus A, Jablensky A, et al. People living with psychotic illness in 2010: the second Australian national survey of psychosis. *Aust N Z J Psychiatry*. 2012;46(8):735-52.
  38. Adhikari P, Summerill A. 1998 National Drug Strategy Household Survey: Detailed findings. Drug Statistics Series No. 6. AIHW cat. no. PHE 27. Canberra: AIHW; 2000.
  39. Lin WC, Zhang J, Leung GY, et al. Chronic physical conditions in older adults with mental illness and/or substance use disorders. *J Am Geriatr Soc*. 2011;59(10):1913-21.
  40. Dowling GJ, Weiss SRB, Condon TP. Drugs of abuse and the aging brain. *Neuropsychopharmacology*. 2008;33(2):209.
  41. Seddon JL, Birchwood M, Copello A, et al. Cannabis use is associated with increased psychotic symptoms and poorer psychosocial functioning in first-episode psychosis: a report from the UK national EDEN study. *Schizophr Bull*. 2015;42(3):619-25.
  42. Schoeler T, Monk A, Sami MB, et al. Continued versus discontinued cannabis use in patients with psychosis: a systematic review and meta-analysis. *Lancet Psychiat*. 2016;3(3):215-25.

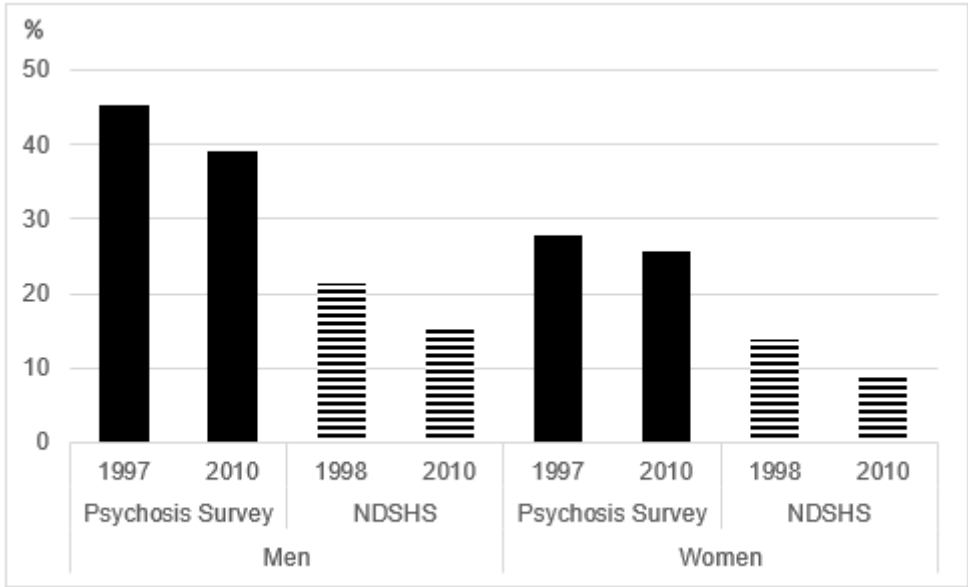
43. Roxburgh A, Ritter A, Grech K, et al. Trends in drug use and related harms in Australia, 2001 to 2011. *Sydney: Drug Policy Modelling Program, National Drug and Alcohol Research Centre, University of New South Wales*. 2011.
44. White VM, Durkin SJ, Coomber K, et al. What is the role of tobacco control advertising intensity and duration in reducing adolescent smoking prevalence? Findings from 16 years of tobacco control mass media advertising in Australia. *Tob Control*. 2015;24(2):198-204.
45. Livingston M. Trends in non-drinking among Australian adolescents. *Addiction*. 2014;109(6):922-9.
46. De Looze M, van Dorsselaer S, Stevens G, et al. The decline in adolescent substance use across Europe and North America in the early twenty-first century: A result of the digital revolution? *Int J Public Health*. 2019;64(2):229-40.

## Figures



**Figure 1**

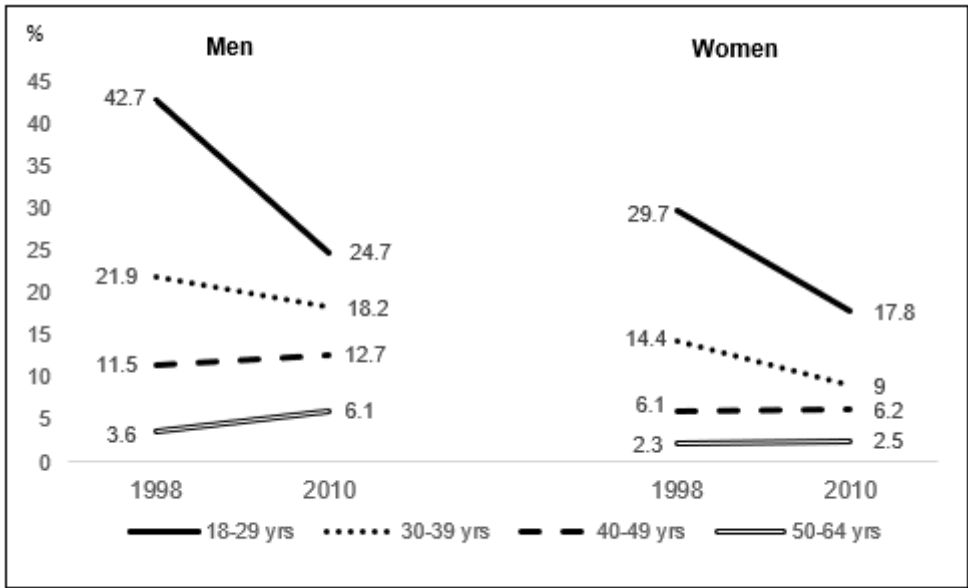
Psychosis Survey: cannabis use in 1997 and 2010, by sex and age group (%).



\*weighted data

**Figure 2**

Psychosis Survey and National Drug Strategy Household Survey \*:Overall prevalence of past-year cannabis use in 1997 and 2010, by sex (%).



\*weighted data

**Figure 3**

National Drug Strategy Household Survey\*: cannabis use in 1998 and 2010, by sex and age group (%).