

Population-based associations between cannabis use, anxiety and depression in Norwegian adolescents

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Abstract

Objective: The aim of the study was to explore the use of cannabis among Norwegian adolescents and examine associations with self-reported symptoms of anxiety and depression, age and dose/frequency of use.

Methods: 36,714 Norwegian adolescents between the ages of 13 and 17 completed a cross-sectional national survey.

Results: Cannabis users reported significantly more symptoms of anxiety and depression compared to non-users. There were no significant differences on anxiety and depression scores between those who had tried the drug once and those who had tried it six times or more. Both cannabis use and the prevalence of symptoms of anxiety and depression were found to increase with age. Girls reported less use of cannabis and slightly more symptoms of anxiety and depression compared to boys.

Conclusions: The present study contributes to the existing knowledge about important associations between cannabis use and symptoms of anxiety and depression in adolescents. Future research should focus on longitudinal methods in order to better understand the role of environmental and neurobiological explanatory factors.

Keywords: cannabis use, anxiety, depression, adolescents

Several studies have shown that the rates of substance use disorders (SUDs) in adolescents are marginally lower than among adults (Kalaydjian et al., 2009; Swendsen et al., 2012). It is estimated that 11.7% of young Europeans between 15 and 34 years of age have used cannabis in the last year (EMCDDA, 2015). The Norwegian Institute of Public Health cited that 10.2% of Norwegians between 16 and 30 had used cannabis in 2014 (Sandøy, 2015). This prevalence is worrisome since adolescent cannabis use can interfere with normal brain development, leading to deficits in cognitive functioning (Bava & Tapert, 2010).

Mid-adolescence is often marked by an increase in mental health problems such as depression, anxiety and SUDs (Costello et al., 2003; Kessler et al., 2005). Several European epidemiological studies have reported comorbidity between cannabis use and mental health problems (Lieb, 2015). The association between anxiety and cannabis use has been widely examined, where several studies have reported associations between cannabis use and symptoms of anxiety (Agosti et al., 2002; Degenhardt et al., 2013; Kedzior & Laeber, 2014; Merikangas & Kalaydjian, 2007). A meta-analysis drawn from the general population of ten countries found that cohorts with anxiety disorders are more likely to use cannabis (OR=1.24, 95% CI: 1.06–1.45) or to have a cannabis-use disorder (OR=1.68, 95% CI: 1.23–2.31), even after controlling for confounding factors (Kedzior & Laeber, 2014). Furthermore, individuals who are not habitual users report more acute and short-lasting episodes of anxiety compared to long-term users (Crippa et al., 2009).

Whereas cross-sectional studies of the associations between cannabis and depressive symptoms have provided mixed results, longitudinal studies have found a significant association between frequent cannabis use and symptoms of anxiety and depression (Degenhardt et al., 2003; Lev-Ran et al., 2014). Depressive symptoms might be related to frequency of use, as some longitudinal studies have found no association between infrequent cannabis use and symptoms of depression (Degenhardt et al., 2003; Lev-Ran et al., 2014).

This may be different for persons with major depression. Results from a recent longitudinal study showed that individuals with major depression had higher risk of initiating cannabis use (Feingold et al., 2015). Yet determining cause and effect is often challenging, since many mental disorders and substance use frequently begin in late adolescence (Kessler & Wang, 2008). Previous studies are often characterized by small sample sizes, and it appears that few studies have examined early adolescence. To our knowledge, the present work is one of the few major Scandinavian studies examining the association between cannabis use and mental health in a large cohort of youth as young as 13 years of age.

This study aims to explore cannabis use in a cross-sectional national sample of Norwegian adolescents and examine associations with self-reported symptoms of anxiety and depression, age and dose/frequency of use.

Method

Design and sample

Data for the present study was gathered from the national survey “Ungdata”, as conducted by NOVA in cooperation with the regional drug and alcohol competence centres in Norway and financed by the Norwegian Directorate of Health, the Ministry of Children, Equality and Social Inclusion, and the Ministry of Justice and Public Security. This survey was an Internet-based anonymous questionnaire administered to a nationally representative cross-section of adolescents in lower (grade 8th – 10th, age 13-18) and upper secondary school (grade 11th – 13th, age 16-19). The first group follow the structure of national compulsory educational system. Upper secondary school is voluntary in Norway and the pupils can decide between general studies that lead to university admissions certification or vocational qualifications. Almost all pupils choose to continue their education after lower secondary school. Participants completed the questionnaire during school hours, and the time taken to

fill out the questionnaire was estimated to one hour. The survey was conducted in 2014 in 86 Norwegian municipalities. In lower secondary school the response rate was 85% ($n = 30,059$, age 13–16), and in upper secondary school the response rate was 68% ($n = 6655$, age 16–17). 12th and 13th grade were excluded due to a low number of participants. Thus, the sample consisted of 36,714 Norwegian adolescents aged 13 to 17 (see Table 1 for further details).

Table 1 about here

Measures

The questionnaire encompasses a broad range of questions concerning the adolescents' lives, including the following topics: parents and friends (social network, relationship between the parents and child), spare time (hobbies and organizational sports), mental health (symptoms of depression, anxiety, self-worth, self-harm), school and future beliefs (grades, satisfaction in school, future academic dreams), substance use (cigarettes, alcohol and cannabis) and risk behaviour (gambling, violence, traffic offences).

The assessment of cannabis use was based on the question "Have you ever used hash/marihuana/cannabis?". The response categories were "No" (1), "Yes, once" (2), "Yes, 2–5 times" (3), and "Yes, 6 or more times" (4). The categories were later divided into users (tried cannabis) and non-users (never tried). Because the question did not include a time frame, we could not distinguish between regular or casual users.

Symptoms of anxiety were measured with six items from the Hopkins Symptom Checklist (HSCL) (Derogatis et al., 1974, as cited in Derogatis & Spencer, 1982). HSCL is a self-report inventory for detecting mental illness that measures symptomatology of somatization, obsessive-compulsive disorder, interpersonal sensitivity, depression, anxiety, anger hostility, phobic anxiety, psychoticism, paranoid ideation and sleep difficulty (Derogatis et al., 1974, as cited in Derogatis & Spencer, 1982). The six items in this study

addressed how the subject felt during the previous week, e.g., “Suddenly felt scared for no reason”, “Felt tense or keyed up”, with response categories ranging from not bothered at all (1) to very bothered (4). The six items were added together in a total score that ranged from 6 to 24. Even though the HSCL is a well-known and validated instrument, we do not know how the total score of six selected items correlates with scores from the original scale.

Symptoms of depression were measured by using eight items. Of these, three were taken from the HSCL, three were from the Depressive Mood Inventory (Kandel & Davies, 1982, as cited in Kandel et al., 1991), and two items concerning feeling tense or feeling angry were developed for this specific survey. The eight items addressed how the adolescents have felt during the previous week, with responses ranging from “not affected at all” (1) to “affected a great deal” (4). Both the HSCL and Depressive Mood Inventory are proven to be valid instruments (Strand et al., 2009). In this study, the eight items were added together in a total score ranging from 8 to 32. The psychometrics of the eight selected items are not known.

Statistical analysis

Prevalence of mental problems, use and frequency of substance use, were expressed in the number of cases and percentages. Gender differences with respect to frequency of use, were estimated by chi-square tests. Independent t-test and one-way analyses of variance was used to compare age groups with respect to cannabis use, and differences between cannabis user groups and symptoms of anxiety and depression.

Results

Descriptive analyses reveal that cannabis use among Norwegian adolescents is more prevalent among older students than younger students, and that the use increases with age. Among 8th graders, 99% reported having never tried cannabis ($n = 6086$), and 0.2% ($n = 14$)

reported having used cannabis six or more times. In comparison, 84.6% ($n = 3669$) of 11th graders reported having never tried cannabis, and 5.0% ($n = 215$) reported having used cannabis six or more times (see Table 2 for details).

Table 2 about here

Significantly more boys ($n = 706$, 6.3%) than girls ($n = 485$, 4.2%) had used cannabis once or more ($X^2 = 48.45$; $p < 0.001$). The gender difference increases with the frequency of use, as indicated by the number of boys ($n = 232$, 2.1%) who report having tried cannabis six or more times compared with the number of girls ($n = 115$, 1.0%).

There were significant gender and age differences with respect to the prevalence of symptoms of anxiety and depression. Girls in 8th grade ($M = 1.58$, $SD = 0.64$) reported significantly more symptoms of anxiety compared to boys in the same grade ($M = 1.22$, $SD = 0.40$); $t(8137) = -33.2$, $p < 0.001$, two-tailed). Girls in 8th grade ($M = 1.85$, $SD = 0.71$) also reported significantly more symptoms of depression compared to boys in the same grade ($M = 1.58$, $SD = 0.56$); $t(9056) = -25.3$, $p < 0.001$, two-tailed). Girls reported significantly more symptoms of anxiety and depression across grades compared to boys (Table 3). The prevalence of anxiety and depression symptoms increased among those in higher grades.

Table 3 about here

Cannabis use was divided into cannabis users and non-users. An independent samples t-test was conducted to compare cannabis use with anxiety and depression scores. There was a significant difference between cannabis users (total mean score = 10.17; $SD = 4.70$) and non-users (total mean score = 8.93; $SD = 3.76$) in anxiety scores ($t(21781) = -5.883$, $p < 0.001$, two-tailed). Results for depression scores also show a significant difference between

cannabis users (total mean score = 18.72; SD = 6.62) and non-users (total mean score = 15.0; SD = 5.70) ($t(21614) = -11.682, p < 0.001$, two-tailed).

Anxiety and depression scores associated with frequency of cannabis use, is presented in Table 4. A one-way ANOVA was conducted to compare for differences in frequency of use, defined here as the number of times the individual has tried cannabis, on symptoms of anxiety and depression. Frequency was grouped into four categories: “Never tried”, “Tried once”, “Tried 2–5 times” and “Tried 6 or more times”. There were overall significant differences in anxiety ($F(3,22) = 47.47, p < 0.001$) and depression ($F(3,22) = 125.03, p < 0.001$) with respect to frequency of cannabis use. Post-hoc comparisons using Bonferroni corrections showed consistently that the “Never tried” group (total score = 15.0, SD = 5.70) had significantly less symptoms of depression than the “Tried once” group (mean difference - 3.00, $p < 0.001$), “Tried 2–5 times” group (mean difference -3.39, $p < 0.001$), and the “Tried 6 or more times” group (mean difference -3.86, $p < 0.001$). The same was true for symptoms of anxiety. The “Never tried” group (total score = 8.93, SD = 3.76) had significantly less symptoms of anxiety than the “Tried once” group (mean difference -1.12, $p < 0.001$), “Tried 2–5 times” group (mean difference -1.70, $p < 0.001$), and the “Tried 6 or more times” group (mean difference -1.28, $p < 0.001$). There were, however, no significant group differences in anxiety and depression scores between the “Tried once”, “Tried 2–5 times”, or the “Tried 6 or more times” groups.

Table 4 about here

Discussion

The most prominent findings in this study were the weak but significant association between adolescent cannabis use and symptoms of depression and anxiety, and the lack of a significant difference in anxiety and depression scores between those who had tried cannabis once and those who had tried it several times. Cannabis use was found to be more prevalent among older adolescents and the use increased with age. Girls reported slightly less use of cannabis compared to boys. Symptoms of anxiety and depression were furthermore most prevalent among girls. This is consistent with other studies that show small gender differences in adolescent cannabis use (EMCDDA, 2015) and anxiety and depression (Faravelli et al., 2013).

The associations between early cannabis use and symptoms of anxiety and depression have received a lot of research in the last decade. Our finding is in line with a growing body of studies that have reported small but positive associations between adolescent cannabis use and symptoms of anxiety and depression in non-clinical population cohorts of adolescents (Bovasso, 2001; Crippa et al., 2009; Degenhardt et al., 2013; Horwood et al., 2012; Kedzior & Laeber, 2014; Lev-Ran et al., 2014; Stapinski et al., 2016).

The significant but relatively weak association between cannabis use and symptoms of anxiety and depression, and the lack of association between frequency of use and such symptoms, could be explained in several ways. The lack of significant differences between symptoms of anxiety and depression and frequency of cannabis use is somewhat surprising. This might be a result of the crude categorization of cannabis use in this study. Many of the adolescents reporting having used cannabis six times or more, was most likely experimental and low frequency users. It is consequently likely that the assessments in the study did not identify cannabis abuse or dependency and thus did not differentiate between early experimental use and at-risk use. It is unlikely that a few episodes of cannabis use would

increase the prevalence of anxiety and depression symptoms. Although anxiety and depression symptoms are reported as acute negative health effects of cannabis use, long-term and high-frequency use is associated with mental disorders (Crippa et al., 2009). A review by Crippa et al. (2009) concluded that frequent cannabis users consistently had a high prevalence of anxiety disorders, but that it is unclear whether cannabis use increases the risk of developing anxiety disorders. Associations between cannabis use and mental disorders have been shown to cease or change when controlling for confounding variables in cross-sectional and longitudinal studies. Some have found no associations or inverse associations (Fröjd et al., 2011; Kedzior & Laeber, 2014; Myers et al., 2003; Nelemans et al., 2016), and some studies have shown that different mental problems may be differentially associated with cannabis use. Some large longitudinal studies of adolescents or young adults have failed to demonstrate that early cannabis use increases the risk for later development of anxiety and depression (Van Laar et al., 2007; Windle & Wiesner, 2004).

Some cohort studies have shown that the onset of symptoms of depression and anxiety precedes the onset of cannabis use problems (Agosti et al., 2002; Lopez et al., 2005). Hence, one might speculate that individuals with symptoms of depression or anxiety use cannabis to relieve mental problems. Cannabis use could also be understood in relation to the common difficulties among adolescents in the transition from adolescence to adulthood. In this vulnerable period the adolescents begin to develop abstract and differentiated self-concepts (Steinberg & Morris, 2001), and some research suggest that cannabis use might alleviate intolerable feelings caused by individuation problems (Laguerre et al., 2015).

Among adolescents both the prevalence of substance use and anxiety and depression increases with age. Age at onset of cannabis use, dose and quantity used, frequency and duration of use, are also significantly associated with current and future development of anxiety and depression (Crippa et al., 2009). In a recent review and meta-analysis of

longitudinal associations between cannabis use and depression, Lev-Ran et al. (2014) found that the odds ratios (OR) for cannabis users for developing depression was 1.17 (95% CI: 1.05–1.30), and 1.62 (CI 1.21–2.16) for heavy users. There were small or marginal effects of age or length of follow-up. Horwood et al. (2012) found that the strongest association between depression and cannabis use unfolded in mid-adolescence. Identification of regular or daily cannabis consumers in this study could have revealed a stronger association with symptoms of anxiety and depression.

Limitations

The present study has several limitations. The main limitation is the cross-sectional design, which makes the study incapable of determining any inference about causality between cannabis use and symptoms of anxiety and depression in adolescents. The use of self-reports and the crude categorization and assessment of frequency of use, might furthermore lead to inaccurate measures of cannabis use and mental problems. Another limitation concerns the instruments employed to assess mental health or substance use problems. For instance, the HSCL (Derogatis & Spencer, 1982) may not be sensitive enough to identify mental problems among adolescents in a non-clinical population. Different types of anxiety may also be differentially associated with cannabis use. While symptoms of generalized anxiety may increase the risk of cannabis use during adolescence (Stapinski et al., 2016), symptoms of social anxiety may decrease this risk (Fröjd et al., 2011; Myers et al., 2003; Nelemans et al., 2016). Some hypothesize that this could be explained by having a lower risk of cannabis use behaviours due to reduced socializing and reduced peer contact. It is therefore recommended that future studies use more disorder-specific assessments tools in prospective follow-up studies.

Conclusions

The present study presents important information upon the prevalence and co-existence of cannabis use and symptoms of common mental problems in a large and unique national population of adolescents between 13 and 17 years of age. We found that 99% of the adolescents in the 8th grade and 84.6% of those in the 11th grade had never tried cannabis, and that those having tried cannabis reported more symptoms of anxiety and depression than non-users. This association increased with age. These findings contribute to the existing knowledge about important associations between cannabis use and symptoms of anxiety and depression in adolescents. The authors recommend that cannabis use among adolescents should be understood and targeted in prevention programmes in close association with co-occurring mental problems. Future research should also focus on longitudinal methods in order to better understand the role of environmental (for example school performance, alcohol use) and neurobiological explanatory factors.

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Declaration of interest

All authors declare that they have no conflict of interest in this study.

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Tables

Table 1

Characteristics of the sample

Educational level*		Gender		Total
		Boys (%)	Girls (%)	
Lower secondary school	8 th grade	5165 (50.3)	5102 (49.7)	10267
	9 th grade	5183 (50.9)	4998 (49.1)	10181
	10 th grade	4834 (50.3)	4777 (49.7)	9611
Upper secondary school	VG1*	3448 (51.8)	3207 (48.2)	6655
Total		18630 (50.7)	18084 (49.3)	36714

Note. * = grade 8–10 is in Norway for adolescents between 13 and 16 years old. VG1 is an 11th grade for adolescent between 16 and 17 years old

Table 2

Prevalence of cannabis use

“Have you ever tried hashish/marijuana/cannabis?” (Percentages in brackets: boys/girls)

Grade	Never tried	Yes, 1 time	Yes, 2-5 times	Yes, 6 or more times
8 th	6086 (48.6/51.4)	29 (72.4/27.6)	17 (52.9/47.1)	14 (85.7/14.3)
9 th	6024 (50.0/50.0)	76 (64.5/35.5)	46 (63.0/37.0)	30 (83.3/16.7)
10 th	5433 (47.9/52.1)	133 (51.9/48.1)	89 (55.1/44.9)	86 (68.6/31.4)
VG1*	3669 (49.4/50.6)	249 (51.4/48.6)	203 (58.6/41.4)	215 (62.3/37.7)

Note. *=11th grade in the Norwegian school system for adolescents between 16 and 17 years old

Table 3

Prevalence of anxiety and depression symptoms (standard deviations in brackets)

Grade	Anxiety				Depression			
	Boys		Girls		Boys		Girls	
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)
8 th	4785	1.22 (0.4)	4836	1.58 (0.6)*	4742	1.58 (0.5)	4785	1.85 (0.7)*
9 th	4834	1.25 (0.4)	4761	1.70 (0.7)*	4797	1.63 (0.6)	4752	2.08 (0.7)*
10 th	4486	1.26 (0.4)	4543	1.82 (0.7)*	4497	1.73 (0.6)	4528	2.23 (0.7)*
VG1	3027	1.26 (0.4)	2977	1.83 (0.7)*	3013	1.73 (0.6)	2967	2.24 (0.7)*

Note. * = $p < .05$

Table 4

Mean anxiety and depression scores and cannabis use

	Cannabis use	N	Mean (SD)	95% confidence interval for mean	
				Lower bound	Upper bound
Anxiety	Never tried	20909	8.93 (3.8)	8.83	8.93
	Once	472	10.0 (4.5)	9.59	10.41
	2–5 times	347	10.6 (5.0)	10.05	11.11
	≥ 6 times	328	10.2 (4.7)	9.65	10.67
Depression	Never tried	20751	15.0 (5.7)	14.76	14.92
	Once	472	17.9 (6.2)	17.29	18.40
	2–5 times	335	18.2 (6.6)	17.53	18.94
	≥ 6 times	329	18.7 (6.7)	17.97	19.42