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# Drug and Alcohol Dependence

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# Perceived harmfulness of various alcohol- and cannabis use modes: Secular trends, differences, and associations with actual substance use behaviors among Norwegian adolescents, 2007-2015

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## ARTICLE INFO

## ABSTRACT

*Background:* How youth perceive harmfulness of risk behaviors such as substance use relates to their engagement in those behaviors. Yet, little is known about how different substance use modes (i.e., variations in amounts and use frequencies) are perceived. We investigated how adolescent perceptions of harmfulness of various alcohol- and cannabis use modes changed over time, compared to one another, and related to actual substance use behaviors.

*Methods:* We examined nationally-representative repeated cross-sectional samples of 16-year olds in Norway, assessed in 2007, 2011, and 2015 ($N_{Total}$ = 9296) as part of the European School Survey Project on Alcohol and Other Drugs (ESPAD). Adolescents reported their: 1) lifetime alcohol- and cannabis use, and 2) perceived harmfulness of various alcohol- and cannabis use modes.

*Results:* Prevalence estimates for perceived harmfulness: 1) remained high and stable, or increased for alcohol use modes, and 2) declined for all cannabis use modes (i.e., using 1–2 times, occasionally, and regularly) since 2007-cohort. High quantity daily drinking was more commonly perceived as harmful than minimal or occasional cannabis use. Even though culturally-relevant use modes (i.e., weekend heavy drinking and experimental cannabis use) were not most commonly endorsed as harmful, only perceptions of those use modes as harmful were inversely associated with actual substance use.

*Conclusions:* How adolescents from Norway perceived harmfulness of alcohol- and cannabis use depended on the specific substance, its use modes, and secular cohort. Perceived harmfulness was associated with measures of actual substance use predominantly along the culturally- and adolescent-relevant modes of use.

## 1. Introduction

How youth perceive risk behaviors such as substance use is closely related to their engagement in those behaviors (Gerrard et al., 1996; Gibbons and Gerrard, 1995). Complex directionality of this relationship notwithstanding, research has fairly consistently shown that alcohol- and cannabis use is less likely among young people who perceive those substances and/or substance use behaviors as risky for the user (Bachman et al., 1998; Chomynova et al., 2009; Danseco et al., 1999; Grevenstein et al., 2015; Lipari et al., 2017, Sept.; Lopez-Quintero and Neumark, 2010; Miech et al., 2017a; O'Callaghan et al., 2006; Parker and Anthony, 2018b; Pedersen et al., 2016; Piontek et al., 2013; Terry-McElrath et al., 2017; Thornton et al., 2013; Yeomans-Maldonado and Patrick, 2015). This emphasis on individual harmfulness – i.e. on the health, social, legal, and other personal harms and negative consequences potentially incurred by individuals engaging in substance use

(Caulkins et al., 2011; Sjoberg, 1998) – is also arguably central to early prevention strategies (Lopez-Quintero and Neumark, 2010; Parker and Anthony, 2018a, b; Terry-McElrath et al., 2017).

However, previous literature may have examined these questions without major conceptual distinctions. For example, some studies conflate substances (e.g., alcohol) and substance use behaviors (e.g., drinking) by using these terms almost interchangeably when assessing perceptions of harmfulness (Gibbons and Gerrard, 1995; Grevenstein et al., 2015; Pedersen et al., 2016; Pedersen and Von Soest, 2015; Plancherel et al., 2005; Sarvet et al., 2018). Other studies presume substance use to be a uniform construct by not differentiating vastly different use modes – i.e., substantive variations in the amounts and frequencies/duration of use (Kilmer et al., 2007).

This is surprising as we almost intuitively recognize that not only all substances may not be created equal when it comes to their potential harmfulness, but that the same holds for substance use as well – some

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consumption modes may be more harmful than others (Novak et al., 2002). Indeed, both alcohol and cannabis can be consumed in any number of modes, and multiple studies, public health reports, and official guidelines aim to operationalize those modes and effectively gauge their potential harmfulness (Bobashev et al., 2014; Casajuana et al., 2016; European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), 2013; Gunzerath et al., 2004; Kuehn, 2009; Linden-Carmichael et al., 2017; U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015). After all, the most accurate answer to the question of "How harmful is (the use of) substance X for the user?" may be: "It depends". Such answers will not generate simplistic drug harmfulness rankings, (Caulkins et al., 2011), but instead may reflect an understanding of harmfulness as a continuum which is both dependent on and informed by additional drug (use) characteristics. In addition to the drug/substance alone (e.g., alcohol vs. cannabis), we also have opinions on the potencies and amounts consumed (e.g., 1 glass of wine vs. 3 shots of liquor), frequencies, modes, and methods of use (e.g., daily vs. occasional use; "episodic heavy drinking"; inhalation vs. digestion), and user identity (e.g., self vs. others; adults vs. adolescents; pregnant women, etc.) – all framed within cultural, social, and religious understanding of these issues. In short, substance use behaviors vary in nature and degree, and there is no reason to assume that such real-life variations are not reflected in individual appraisal processes and resulting harmfulness perceptions. Yet, the questions of how individuals perceive harmfulness of various substances and substance use modes and to what degree such specific perceptions relate to actual substance use still remain poorly integrated into the harm cognitions literature and related debates on drug harms (Caulkins et al., 2011; Nutt et al., 2007, 2010).

Even though some major monitoring tools such as the USA-based Monitoring the Future (MTF) and the European School Project on Alcohol and Other Drugs (ESPAD) measure harmfulness perceptions of different alcohol and drug use modes, the resulting literature tends to either report selected indicators only (Dzúrová et al., 2016; Johnston et al., 2017; Salloum et al., 2018; Terry-McElrath et al., 2017) or to combine them into a general harmfulness index (Miller et al., 2009; Piontek et al., 2013). Such methodological approaches obscure potentially important differences when it comes to perceptions of distinct use modes, and tell us very little about how such mode-informed perceptions – as opposed to substance-only and use-general – might relate to actual substance use behaviors.

Only a handful of studies examined these questions while considering naturally-occurring variations in substance use patterns and modes: even though some substances were predictably seen as more harmful, the usage modes mattered as well in harmfulness ratings (Bjarnason and Jonsson, 2005; Novak et al., 2002; Thornton et al., 2013). This limited literature also underscores the relevance of use modes and their perceived harmfulness to targeted prevention strategies. For example, communicating that even experimental cannabis use also incurs certain harms may be both more relevant and more important if the primary policy aim is to prevent/delay use initiation among youth (Bjarnason and Jonsson, 2005; Kilmer et al., 2007). Such nuancing may be of particular relevance as certain substances (e.g., cannabis) and use modes (including regular cannabis use) are increasingly being perceived as non-risky or non-harmful by young people (Bachman et al., 1998; Lipari, 2013; Miech et al., 2017a; Sarvet et al., 2018; Terry-McElrath et al., 2017).

Thus, better understanding of the variations in alcohol- and cannabis use modes, their perceived harmfulness, and their associations with actual substance use behaviors – especially among youth in today's changing cultural and legal climate – is needed. This investigation was motivated by these questions.

### 1.1. Aims

We aimed to extend the current research on substance use and associated perceptions of harmfulness by considering not only the specific substance (i.e., alcohol and cannabis) but also the natural variations in their consumption modes. We wanted to know: 1) how were different modes of alcohol- and cannabis use perceived in terms of their harmfulness, 2) whether, and if so, how these perceptions changed over time, 3) how they compared to one another, and 4) how they related to actual alcohol- and cannabis use behaviors among youth in Norway since 2007.

## 2. Methods

### 2.1. Setting: Cultural Context of Underage Alcohol- and Cannabis use in Norway

Even though adolescents in Norway appear to be increasingly refraining from alcohol use, the existent youth drinking culture is characterized by heavier alcohol consumption typically on weekends (Enstad et al., 2017; ESPAD Group, 2016; Fjær et al., 2016) and as distinct from adult drinking (Bakken et al., 2017). For example, the most recent ESPAD results describe adolescent drinking modes in Norway in terms of relatively high consumption on selected occasions, averaging about 3 standard drinks at last drinking occasion, and about 3 drinking occasions per month (ESPAD Group, 2016). In short, if and when they do drink, Norwegian adolescents tend to do so somewhat excessively on weekends.

In contrast, prevalence estimates for lifetime cannabis use among Norwegian adolescents have been consistently below 10% since 2000, and among the lowest in Europe (ESPAD Group, 2016; Sznitman et al., 2015). As regular cannabis use is relatively uncommon in adolescence (Schulenberg et al., 2005; Taylor et al., 2017), Norwegian youth who report cannabis use also tend to be experimental users first and foremost (Sznitman et al., 2015).

### 2.2. Sample and Design (ESPAD Norway)

Our sample included 9296 10th grade Norwegian students who participated in the European School Survey Project on Alcohol and Other Drugs (ESPAD) in 2007 ($n_{2007} = 3554$), 2011 ($n_{2011} = 3045$), and 2015 ($n_{2015} = 2697$); a multi-national project specifically designed to collect nationally-representative and nationally-comparable data on substance use among 15–16 year olds in as many European countries as possible (ESPAD Group, 2016).

ESPAD Norway samples schools/classes through stratified random sampling. Questionnaire completion rates were high among consenting schools: 93% in 2015, 88% in 2011, and 89% in 2007 (ESPAD Group, 2016; Hibell et al., 2009, 2012). As ESPAD primarily aims to provide nationally-representative estimates for the purposes of both within- and across-country comparisons, this analytical sample therefore captured three nationally-representative cohorts of the Norwegian 16-year olds through repeated cross-sectional assessments four years apart. All surveys were administered in accordance with national ethical standards. Detailed ESPAD descriptions are available elsewhere, both for the main study (ESPAD Group, 2016) and for Norwegian samples (Brunborg et al., 2014; Burdzovic Andreas and Bretteville-Jensen, 2017; Bye and Skretting, 2017; Lund and Scheffels, 2018).

**Table 1**

Perceived harmfulness (PH) of various alcohol- and cannabis use modes and lifetime substance use behaviors among 16-year olds in Norway; prevalence estimates ESPAD Norway 2007-2011–2015 ($N$ = 9296).

| Variables | ESPAD (all) | ESPAD-cohort | | | Linear trend (across ESPAD-cohorts) | | |
|---|---|---|---|---|---|---|---|
| | 2007-11-15 $N$ = 9296 | 2007 $n$ = 3554 | 2011 $n$ = 3045 | 2015 $n$ = 2697 | | | |
| | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) | OR (95% CI) | RR (95% CI) | *dir.* |
| **Perceived harmfulness (PH)/Usage mode** | | | | | | | |
| 1. Perceived harmfulness (PH) from: | | | | | | | |
| 1-2 drinks almost every day | 84.0 (83.1 - 84.8) | 83.1 (81.7 - 84.3) | 85.0 (83.6 - 86.5) | 84.1 (82.3 - 85.7) | 1.04 (.96 - 1.13) | 1.01 (.99 - 1.02) | = |
| 4-5 drinks almost every day | 93.9 (93.3 - 94.4) | 93.7 (92.9 - 94.5) | 94.0 (93.0 - 94.9) | 93.9 (92.6 - 94.9) | 1.01 (.89 - 1.15) | 1.00(.99 - 1.01) | = |
| 5 + drinks at once almost every weekend | 79.0 (78.0 - 80.0) | 72.7 (71.1 - 74.3) | 80.4 (78.8 - 81.9) | 85.9(84.2 - 87.4) | 1.51*** (1.40 - 1.63) | 1.09*** (1.07 - 1.10) | ↑ |
| 2. Perceived harmfulness (PH) from: | | | | | | | |
| Using cannabis only 1 or 2 times | 63.0 (61.8 - 64.0) | 64.8 (63.0 - 66.4) | 63.1 (61.2 - 65.0) | 60.3 (58.0 - 62.6) | .91*** (.86 - .97) | .97**(.94 - .99) | ↓ |
| Using cannabis occasionally | 83.2 (82.3 - 84.0) | 84.7 (83.2 - 85.9) | 84.2 (82.7 - 85.5) | 80.1 (78.1 - 81.9) | .86*** (.79 - .93) | .97*** (.96 - .99) | ↓ |
| Using cannabis regularly | 93.1 (92.5 - 93.7) | 94.7 (93.8 - 95.4) | 93.8 (92.7 - 94.6) | 90.4 (88.8 - 91.7) | .72*** (.64 - .81) | .98*** (.96 - .99) | ↓ |
| **Lifetime substance use** | | | | | | | |
| 1. Any alcohol use | 69.1 (29.8 - 31.9) | 77.0 (75.5 - 78.5) | 70.0 (68.5 - 71.9) | 57.5 (55.1 - 59.7) | .63*** (.59 - .67) | .87*** (.85 - .88) | ↓ |
| 2. Any alcohol intoxication | 37.0 (25.9 - 38.1) | 46.2 (44.4 - 47.9) | 36.5 (34.6 - 38.3) | 25.2 (23.2 - 27.2) | .63*** (.59 - .67) | .75***(.72 - .78) | ↓ |
| 3. Any cannabis use | 6.2 (5.7 - 6.8) | 6.4 (5.5 - 7.3) | 5.4 (4.5 - 6.3) | 7.0 (5.9 - 8.3) | 1.05 (.92 - 1.19) | 1.04 (.93 - 1.18) | = |

*Note*: Temporal trends significant at * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$; weighted samples.
ESPAD = European School Survey Project on Alcohol and Other Drugs. PH = Perceived Harmfulness
Linear trends represent average changes in the likelihoods of respective outcomes across the three examined ESPAD cohorts, starting in 2007.

## 2.3. Measures

Standardized paper-and-pencil questionnaires containing basic epidemiological indicators of substance use were completed by student participants during regular class time; the measures and procedures were modeled after the "Monitoring the Future" survey in the US and validated previously (ESPAD Group, 2016; Hibell et al., 2015).

### 2.3.1. Adolescent Characteristics

Based on sampling information, adolescents were classified as *urban residents* (coded "1") if from one of the 5 largest municipalities/settlements in Norway (Statistics Norway, 2015). They also reported their *gender* and evaluated their families' SES in comparison to other families in Norway (recoded into *subjective poverty* and coded "1" if rated "less well off" or lower on the original scale). Those who reported smoking on at least one occasion were classified as *lifetime cigarette users* (coded "1").

### 2.3.2. Perceived Harmfulness of Alcohol- and Cannabis use Modes

Adolescents rated to what degree they think people risk harming themselves (physically or otherwise) if they have: a) 1–2 drinks almost every day, b) 4–5 drinks almost every day, and c) 5 or more drinks at once/single occasion almost every weekend, and if they: d) try cannabis 1–2 times, e) smoke cannabis occasionally, and f) smoke cannabis regularly. The original 5-point Likert-scale responses were recoded such that the explicit statements of perceived "no risk" or "slight risk" were classified into the *perceived no/low harmfulness* category (coded "0"), while all the remaining responses were classified into the *perceived harmfulness* category (coded "1").

### 2.3.3. Lifetime Substance use

Adolescents reported their lifetime a) alcohol use, b) alcohol intoxication, and c) cannabis use, where the original responses of "never", "1–2", "3-5", "6-9", "10-19", "20-39", and "40 times or more" were recoded to reflect any occurrence (coded "1") vs. none (coded "0"). These were the main outcomes of interest in this report, with the understanding that they represent simple proxies for normative usage modes among Norwegian adolescents (i.e., heavier drinking on weekends and minimal cannabis use).

Supplementary categorical outcomes were constructed to probe potential variations in alcohol- and cannabis use in this adolescent sample. Specifically, we differentiated between adolescents who: 1) never used alcohol, 2) used alcohol but were never intoxicated, and 3) were intoxicated at least once during lifetime. For cannabis use, we differentiated between those who: 1) never used cannabis, 2) used cannabis only 1–2 times, 3) used cannabis 3–9 times, and 4) used cannabis 10 times or more during lifetime.

## 2.4. Analyses

Secular trends since 2007 in key indicators were examined with logistic and modified Poisson regression models, with *ESPAD cohort* as the sole, continuous predictor. This approach provided both odds ratio (OR, from logistic models) and more interpretable relative risk estimates (RR, from modified Poisson models) (Zou, 2004). McNemar's tests were used to test for differences in proportions of endorsement across harmfulness indicators; these population-level analyses were based on the weighted sample (Solon et al., 2015). Putative associations between perceived harmfulness and lifetime substance use were examined with multivariable models, including: a) logistic regression (for main binary outcomes of any alcohol use, alcohol intoxication, and cannabis use), and b) multinomial logistic regression (for supplementary categorical outcomes capturing simple variations in alcohol- and cannabis use). These regression models accounted for ESPAD cohort, all remaining adolescent characteristics, and municipal-level clustering but not for sample weights (Solon et al., 2015).

Missing data were not imputed due to the relatively low frequency (i.e., max 5.3% for the *perceived harmfulness from having 5 or more drinks on single occasion almost every weekend*) and to preserve national-level estimates of studied behaviors, even though this resulted in varying analytical $n$'s. Nevertheless, a brief sensitivity analysis was performed involving only those cases with valid information on all covariates. All analyses were conducted in Stata 15 (StataCorp., 2017).

## 3. Results

### 3.1. Sample Characteristics

All participants were 10th grade students in upper secondary schools; 52% were boys. Approximately 1/5 resided in urban areas in 2007 and 2011, while 1/4 did so in 2015. Subjective poverty averaged at 5.2% across three cohorts. These demographics roughly

**Table 2**
Lifetime alcohol use, alcohol intoxication, and cannabis use as a function of perceived harmfulness of alcohol- and cannabis use modes; ESPAD Norway 2007-2011–2015.

| Covariates | 1. Any lifetime alcohol use (n = 7945) | | 2. Any lifetime alcohol intoxication (n = 7898) | | Covariates | 3. Any lifetime cannabis use (n = 7947) | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | OR[a] (95% CI) | aOR[b] (95% CI) | OR[a] (95% CI) | aOR[b] (95% CI) | | OR[a] (95% CI) | aOR[b] (95% CI) |
| ESPAD cohort | .65*** (.60 - .71) | .73*** (.67 - .79) | .65*** (.59 - .72) | .75** (.67 - .82) | ESPAD cohort | 1.00 (.86 - 1.17) | 1.07 (.89 - 1.29) |
| Gender (boy) | .92 (.82 - 1.04) | .83*** (.73 - .94) | .78*** (.70 - .87) | .66** (.58 - .74) | Gender (boy) | 1.81*** (1.54 - 2.12) | 1.59*** (1.29 - 1.05) |
| Urban residence | .82 (.62 - 1.1) | .80 (.60 - 1.06) | .82* (.72 - .94) | .80** (.70 - .91) | Urban residence | 1.93*** (1.53 - 2.44) | 2.15*** (1.64 - 2.80) |
| Subjective poverty | 1.25* (1.02 - 1.52) | 0.97 (.76 - 1.23) | 1.22 (.98 - 1.50) | .93 (.70 - 1.24) | Subjective poverty | 2.39*** (1.69 - 3.40) | 1.77** (1.24 - 2.52) |
| Lifetime cigarette use | 13.40*** (11.2 - 16.0) | 12.21*** (10.2 - 14.7) | 10.70*** (9.5 - 12.0) | 9.99*** (8.74 - 11.4) | Lifetime cigarette use | 33.0*** (23.7 - 45.9) | 25.50*** (18.3 - 35.4) |
| PH (1-2 drinks/every day) | .70** (.63 - .79) | .90 (.76 - 1.06) | .75*** (.67 - .84) | 1.03 (.85 - 1.24) | PH (use cannabis 1-2 times) | .18*** (.15 - .29) | .40*** (.30 - .54) |
| PH (4-5 drinks/every day) | .68*** (.56 - .83) | 1.33 (.98 - 1.80) | .63*** (.54 - .74) | 1.07 (.83 - 1.40) | PH (use cannabis occasionally) | .15*** (.12 - .18) | .37*** (.28 - .49) |
| PH (5+ drinks/weekend) | .37*** (.33 - .42) | .49*** (.42 - .58) | .40*** (.36 - .44) | .49*** (.42 - .57) | PH (use cannabis regularly) | .16*** (.14 - .20) | .77 (.57 - 1.04) |

Note: * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.00$.

PH = Perceived Harmfulness. Intercepts not shown; significant results of substantive interest *italicized*. Models accounted for survey design and municipal-level clustering.

[a] Shown are unadjusted estimates (odds ratios, OR + 95% CI) from univariable logistic regression models estimating the likelihood of any lifetime: 1) alcohol use, 2) alcohol intoxication, and 3) cannabis use among 16-year olds in Norway as a function of each individual covariate alone.

[b] Shown are adjusted estimates (odds ratios, aOR + 95% CI) from the multivariable logistic regression models estimating the likelihood of any lifetime: 1) alcohol use, 2) alcohol intoxication, and 3) cannabis use among 16-year olds in Norway as a function of all covariates; i.e., the three substance-specific harmfulness perceptions and the remaining risk factors. Reference categories in all models were "never". Shown are analytical n's for each model.

corresponded to the official estimates; for example, in 2015 approximately 33.0% of the population lived in the 5 largest urban settlements (Statistics Norway, 2015) and 6.0% of children between the 11 and 17 years of age lived in families marked by persistent poverty (Statistics Norway, 2016). Lifetime prevalence of smoking significantly declined from 46.1% in 2007 to 28.4% in 2015 cohort (OR = 0.68, 95% CI = 0.64 - 0.73; RR = .79, 95% CI = 0.76 - 0.82).

### 3.2. Perceived Harmfulness from Alcohol- and Cannabis use Modes: Secular Trends

Table 1 shows population-level estimates and corresponding 95% CI for all indicators of perceived harmfulness (Table 1, top) and for main substance use outcomes (Table 2, bottom) – both for the entire combined sample and for each of the hereby examined ESPAD cohorts.

Prevalence estimates for the perceived harmfulness of the two "daily" drinking modes – be it lower (1–2 drinks/day) or higher quantity (4–5 drinks/day) – remained both high and stable across ESPAD cohorts (all OR's and RR's *ns*, Table 1). However, prevalence estimates for perceived harmfulness of "weekend heavy drinking" significantly increased since 2007-cohort; OR = 1.51; 95% CI = 1.40–1.63, and RR = 1.09; 95% CI = 1.07–1.10, $p < .001$. In contrast, prevalence estimates for perceived harmfulness of all three examined cannabis use modes significantly decreased since 2007-cohort (Table 1).

In terms of actual substance use, prevalence estimates for both lifetime alcohol use and intoxication significantly declined since 2007-cohort; they remained stably low for lifetime cannabis use (Table 1, bottom).

### 3.3. Perceived Harmfulness of Alcohol- and Cannabis use Modes: Differences within- and Across Substances

Generally, usage modes characterized by greater frequencies were more commonly perceived as harmful (see Table 1). All within-substance prevalence estimates of perceived harmfulness significantly differed from one another in the combined sample (all McNemar's test $p$'s < 0.001). For example, greater proportion of participants saw harmfulness in using cannabis regularly than in using it occasionally (93.4% vs. 83.4%; McNemar $X^2$ (1) = 818.7, $p < 0.001$).

Further, we compared prevalence estimates of perceived harmfulness in having 4–5 drinks nearly every day (i.e., alcohol use mode most commonly seen as harmful) with those for the three cannabis usage modes. Greater proportion of participants saw harmfulness in this drinking mode than in trying cannabis 1–2 times (93.9% vs. 63.4%; McNemar $X^2$ (1) = 2324.6, $p < 0.001$) or in using cannabis occasionally (93.9% vs. 83.4%; McNemar $X^2$ (1) = 627.2, $p < 0.001$), but not from using cannabis regularly (93.9% vs. 93.5%; McNemar $X^2$ (1) = 1.84, $p = 0.18$).

### 3.4. Perceived Harmfulness of Alcohol- and Cannabis use Modes: Associations with Lifetime Alcohol- and Cannabis use

#### 3.4.1. Main Models

Table 2 documents the likelihoods of lifetime a) alcohol use, b) alcohol intoxication, and c) cannabis use among adolescents as a function of perceived harmfulness from all substance-specific usage modes and remaining study variables. Shown are both unadjusted estimates (ORs) from univariable models, and adjusted estimates (aORs) from multivariable models accounting for all covariates simultaneously.

The results from the fully adjusted models indicated that only perceived harmfulness of weekend heavy drinking was associated with significantly lower odds of any lifetime alcohol use and intoxication (aOR = 0.49; 95% CI = 0.42 - 0.58, $p < .001$; aOR = 0.49; 95% CI = 0.42 - 0.57, $p < .001$ respectively, see Table 2). Perceived harmfulness of the two "daily" drinking modes did not add any explanatory value to

**Table 3**

Lifetime alcohol and cannabis use modes as a function of perceived harmfulness of alcohol- and cannabis use modes; ESPAD Norway 2007-2011–2015.

| Covariates | 1. Lifetime alcohol use (n = 7898) | | Covariates | 2. Lifetime cannabis use (n = 7947) | | |
|---|---|---|---|---|---|---|
| | Used alcohol but never intoxicated (vs. *never*) n = 2892 (33.0%) aRRR (95% CI) | Intoxicated at least once (vs. *never*) n = 3274 (37.0%) aRRR (95% CI) | | Used 1-2 times n = 267 (2.9%) aRRR (95% CI) | Used 3-9 times n = 123 (1.3%) aRRR (95% CI) | Used 10 + times n = 154 (1.6%) aRRR (95% CI) |
| ESPAD cohort | .78*** (.72 - .85) | .64*** (.56 - .72) | ESPAD cohort | 1.26* (1.1 - 1.57) | 1.03 (.72 - 1.48) | .79 (.62 - 1.01) |
| Gender (boy) | .97 (.85 - 1.27) | .64*** (.55 - .76) | Gender (boy) | 1.29 (.99 - 1.67) | 1.40 (.98 - 2.01) | 3.01*** (1.82 - 4.98) |
| Urban residence | .87 (.66 - 1.10) | .72* (.55 - .95) | Urban residence | 1.96*** (1.59 - 2.41) | 2.50*** (1.54 - 4.06) | 2.26*** (1.52 - 3.36) |
| Subjective poverty | .99 (.78 - 1.27) | .92 (.65 - 1.31) | Subjective poverty | 1.45 (.89 - 2.35) | 1.45 (.74 - 2.83) | 2.72*** (1.62 - 4.56) |
| Lifetime cigarette use | 5.4*** (4.4 - 6.6) | 30.8*** (24.8 - 38.3) | Lifetime cigarette use | 25.4*** (15.4 - 41.9) | 23.0*** (11.1 - 47.5) | 29.1*** (11.9 - 70.9) |
| PH (1-2 drinks/every day) | .88 (.72 - 1.08) | .94 (.76 - 1.15) | PH (use cannabis 1-2 times) | *.31*** (.22 - .44)* | *.40** (.22 - .73)* | .92 (.52 - 1.60) |
| PH (4-5 drinks/every day) | 1.28 (.92 - 1.8) | 1.31 (.94 - 1.8) | PH (use cannabis occasionally) | *.49*** (.35 - .70)* | *.35*** (.21 - .59)* | *.16*** (.09 - .27)* |
| PH (5 + drinks/weekends) | *.62*** (.51 - .74)* | *.35*** (.29 - .43)* | PH (use cannabis regularly) | 1.44 (.98 - 2.13) | .65 (.39 - 1.07) | *.42*** (.27 - .66)* |

*Note:* * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

PH = Perceived Harmfulness.Shown are adjusted estimates (adjusted relative risk ratios (aRRR) + 95% CI) from multinomial logistic regression models estimating alcohol and cannabis lifetime use categories among 16-year olds in Norway as a function of corresponding harmfulness perceptions and the remaining risk factors. Reference categories in both models were "never" (i.e., no reported use of alcohol/cannabis). Shown are analytical *n*'s for each model.

Intercepts not shown; significant results of substantive interest ***italicized***. All models accounted for survey design and municipal-level clustering.

either of these alcohol use behaviors above and beyond that captured by the perceived harmfulness of weekend heavy drinking.

Perceived harmfulness of both minimal or occasional cannabis use were inversely associated with the odds of actual cannabis use in the fully adjusted model (aOR = 0.40; 95% CI = 0.30 - 0.54, $p < .001$; aOR = 0.37; 95% CI = 0.28 - 0.49, $p < 0.001$, respectively). Perceived harmfulness of regular cannabis use was not significantly associated with actual use above and beyond that of perceived harmfulness of occasional and minimal cannabis use.

### 3.4.2. Supplementary Models

Conceptually identical results were obtained for supplementary categorical substance use indicators (Table 3), where adolescents': a) lifetime alcohol use (where never used alcohol = 33.0%; used alcohol but never intoxicated = 33.0%; and intoxicated at least once = 37.0%), and b) lifetime cannabis use (where never used cannabis = 94.2%; used cannabis only 1–2 times = 2.9%; used cannabis 3–9 times = 1.3%, and used cannabis 10 times or more = 1.6%) were estimated as a function of perceived harmfulness from all relevant substance-specific usage modes and remaining covariates using multinomial regression models.

As in the main models, only the perceived harmfulness of weekend heavy drinking was significantly associated with alcohol-related behaviors (Table 3, col 1). In addition, lifetime cannabis use frequencies aligned with perceived harmfulness of corresponding usage modes (Table 3, col 2). For example, the relative risks of using cannabis 10 times or more were lower for those perceiving harmfulness in using cannabis occasionally (aRRR = 0.16; 95% CI = 0.09 - 0.27, $p < .001$) or regularly (aRRR = 0.42; 95% CI = 0.27 - 0.66, $p < .001$), whereas perceived harmfulness of trying cannabis 1–2 times was not relevant to these no longer exploratory behaviors. Opposite patterns were observed for lower use frequencies, where perceptions of harmfulness from regular use were non-informative (Table 3, col 2).

### 3.5. Sensitivity Check

Main analyses were repeated including only those cases with valid information on all covariates (analytical $n = 7669$ for lifetime alcohol use; $n = 7626$ for lifetime alcohol intoxication, and $n = 7947$ for lifetime cannabis use). Above-reported associations between perceived harmfulness and these substance use indicators remained conceptually unaltered in terms of direction and significance-levels.

## 4. Discussion

Our results revealed diverging trends in and distinctive associations between several alcohol- and cannabis use behaviors and the perceptions of their harmfulness among adolescents in Norway. Even though majority of adolescents saw both alcohol use and cannabis use as generally harmful for the user, those perceptions varied considerably both across secular cohorts and across usage modes. Generally speaking, more recent cohorts appeared to be increasingly perceiving alcohol use as harmful while decreasingly perceiving cannabis use as such, echoing other recent findings from Norway on alcohol- vs. cannabis perceptions (Pedersen et al., 2016; Pedersen and Von Soest, 2015). Consistent with previous literature, we also observed inverse associations between the reported use of alcohol and cannabis and their perceived harmfulness (Andersson et al., 2009; Chomynova et al., 2009; Danseco et al., 1999; Grevenstein et al., 2015; Miller et al., 2009; Pedersen et al., 2016; Pedersen and Von Soest, 2015; Piontek et al., 2013; Plancherel et al., 2005). However, those associations heavily depended on variations in usage modes, such that adolescents who perceived cultural- and age-salient use patterns as harmful were less likely to engage in alcohol and cannabis use – even though those precise usage modes were not most commonly rated as harmful.

Specifically, daily drinking – be it in lower or greater quantities – was consistently and almost uniformly perceived as harmful. It is possible

that daily drinking was seen as incongruent with the dominant alcohol culture characterized by heavier weekend drinking (Enstad et al., 2017; Fjær et al., 2016), or as an "adult" drinking style alien to adolescents (Bakken et al., 2017). Yet, even though heavier drinking on weekends reflects common underage drinking pattern also normative in Norway (ESPAD Group, 2016; Patrick and Schulenberg, 2010), this pattern was nevertheless increasingly perceived as harmful. These results, in combination with marked declines in the reported lifetime alcohol use and intoxication, may suggest tangible secular changes in local alcohol-related norms and perceptions among youth. Finally, adolescents who perceived harms from heavier weekend drinking were less likely to engage in any of the examined drinking behaviors, whereas adolescent perceptions of daily drinking modes were not as relevant.

Almost entirely reverse trends were observed for cannabis. First and foremost, post-2007 ESPAD cohorts in general were less likely to perceive cannabis use as harmful – be it just trying it, using it occasionally, or using it regularly – mirroring similar international developments (Miech et al., 2017b; Pacek et al., 2015). Even though these effects were small statistically speaking (Chen et al., 2010), they nevertheless may have not-so-small real life and policy implications (McCartney and Rosenthal, 2000). And even though we observed no secular changes in lifetime prevalence of cannabis use, these results may warrant closer scrutiny given the known limitations of such estimates and hereby observed shifts in harmfulness perceptions (Burdzovic Andreas and Bretteville-Jensen, 2017; Burns et al., 2013; Caulkins et al., 2015). Finally and not surprisingly, adolescents who perceived even non-regular use as harmful were less likely to report having ever used cannabis.

These results may inform ongoing debates concerning drugs' harmfulness, including subjective perceptions, objective assessment and classification, and individualand aggregate significance (Caulkins et al., 2011; Nutt et al., 2007; Sjoberg, 1998). Without necessarily engaging this debate, we nevertheless believe that delineation of usage modes provided nuanced information not fully captured by generic drug harmfulness indicators. As both alcohol- and cannabis use can encompass indefinite combinations of amounts and frequencies (as well as durations of use, dosages, products, etc.), any appraisals of harmfulness in isolation from usage modes are bound to be inadequate. In this regard, a debate on substance (use) harmfulness – both individual and societal – would perhaps benefit from a clearer acknowledgement that "use" takes vastly varied forms and meanings across user cultures.

In our case, accounting for usage modes was informative in understanding a) how Norwegian adolescents perceived harmfulness of alcohol- and cannabis use over time and in relation to one another, and b) how those perceptions related to corresponding substance use behaviors. When evaluating harmfulness, our participants considered the substance itself, but also the variations in its usage modes. Even though modes characterized by greater frequencies and amounts were more commonly perceived as harmful, those perceptions were not as strongly related to the actual alcohol- and cannabis use behaviors in our multivariate models. Instead, perceived harmfulness of the usage modes which aligned with the local youth cultures emerged as most important predictors, even though such usage modes – being relatively familiar and normative – were not uniformly perceived as harmful.

### 4.1. Limitations

This report was somewhat limited by the original ESPAD design and methodology. For example, the key questions of whether adolescents who engaged in substance use subsequently reduced their perceptions of how harmful these behaviors may be, or were simply more likely to initiate them because they saw them as relatively non-harmful could not be addressed with these repeated cross-sectional data (Grevenstein et al., 2015; Salloum et al., 2018). This design also precluded examination of any within-individual, more complex longitudinal

patterns of alcohol- and cannabis use and associated harmfulness perceptions. Next, the original EASPD items used "risk" and "harms" terminology almost interchangeably – a common issue in the measurement of these constructs (Nutt et al., 2007). Further, "occasional" and "regular" cannabis use were not fully defined, opening these questions to possible conflation of frequency and regularity of use, and to subjective interpretations. Further, some key comparisons were limited both in terms of statistical analyses and interpretation of results: for example, it is not clear what would be the alcohol-equivalent of "trying cannabis once or twice", or how would one appropriately align simple lifetime frequencies of alcohol use with the more complex usage modes examined in the perceptions module (i.e., daily drinking). In that sense, our results interpretation relied rather heavily on prior knowledge and understanding of local use cultures. Finally, we were unable to disentangle various harmfulness dimensions such as health, social, and legal repercussions (Danseco et al., 1999; Nutt et al., 2007; Pedersen and Von Soest, 2015; Plancherel et al., 2005).

Even though we observed secular shifts in perceived harmfulness of alcohol- and cannabis usage modes, we could not examine any underlying mechanisms: these shifts could reflect public health policies, socio-economic and demographic conditions, global declines in underage drinking (Looze et al., 2015), ongoing debates concerning cannabis legalization, its use and related attitudes (Erickson and Hathaway, 2010; Miech et al., 2015), or any combination thereof. Finally, our discussion of age- and cultural salience should be understood primarily within Norwegian context. It is likely that there are variations across religious, cultural, socio-economic, and other groups (Novak et al., 2002). Indeed, we believe that this is an important direction for future research, and that some key issues raised in this report are relevant beyond the local Norwegian context.

## 5. Conclusions

These limitations notwithstanding, these results highlight the importance of accurate mapping of individual risk cognitions and corresponding behaviors along multiple dimensions, both in research and in prevention efforts. How Norwegian adolescents perceived harmfulness of alcohol- and cannabis use depended on the specific usage mode (i.e., frequency/quantity) and time (i.e., secular cohort), while also reflecting age- and culture-specific norms. The observed secular trends also suggest diverging trajectories in harmfulness perceptions and lifetime use of these two substances. Finally, actual engagement in alcohol- and cannabis use behaviors was only associated with the perceived harmfulness of those usage modes with clear cultural and personal relevance to our young participants. That is, adolescents who saw harms *even* in, for them, relatively normative behaviors – i.e., drinking a lot *just* on weekends, or experimenting with cannabis *just* once or twice – were more likely to refrain from any use. Those who cognitively distanced themselves not from the technically-speaking most harmful, but from the most personally familiar/normative usage modes were less likely to report use. Consequently, understanding the role of perceived harmfulness in terms of personal relevance in addition to the objective features such as frequencies and amounts may be an important consideration in future research and related youth prevention strategies based on harms communication.

## Contributors

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## Conflict of Interest

No conflict declared.

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