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A SOCIAL ECOLOGICAL PERSPECTIVE ON CANNABIS USE AMONG NORWEGIAN ADOLESCENTS

A multilevel study

Acknowledgements

Abstract

Aim of the study: The main aim of this study is to explore the impact of the school-class on individual cannabis use, and the following research questions have been formulated; To what extent does the school-class influences individual cannabis use? Is the gender proportion in the school-class influencing individual cannabis use? Is the socioeconomic composition in a school-class influencing individual cannabis use?

Theoretical perspective: The study applies the social ecological framework of Bronfenbrenner (1979) to conceptualise and structure the study to identify and discuss different levels of influence, and to empirically demonstrate the impact of school-class contextual factors on adolescent's cannabis use.

Methods: Quantitative multilevel analyses are employed to investigate the research questions. Data used in this study stem from the cross-sectional study *Young in Oslo* 2018, with an analytical sample of 5109 students at upper secondary school in Oslo, nested within 278 classrooms.

Results: The use of cannabis is more widespread among boys, students at higher grade-levels and with a higher socioeconomic status. The intraclass correlation shows that 13.7 % of the variance in cannabis may be ascribed to the school-class. Moreover, the median odds ratio shows that if a student moves from a lower risk school-class to a higher risk school-class the probability of using cannabis almost doubles (MOR=1.99). A higher proportion of boys (OR=1.05), and students with a higher socioeconomic status (OR=1.11) at the school-class level increase the risk of individual cannabis use.

Conclusion: A substantial part of the variance in cannabis use may be ascribed to the school-class level. A higher proportion of male students, and students with a higher socioeconomic status increase the risk of individual cannabis use. Results of the study support Bronfenbrenner's (1979) theory that the individual is influenced by its context. Consequently, this study suggests preventative efforts should target the classroom-environment.

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1. Introduction

This master's thesis takes outset in the presumptions that the adolescent's cannabis use is influenced by contextual factors and will explore the influence of the imposed classroom setting on adolescent's cannabis use in Oslo, Norway. Any findings will be discussed in Bronfenbrenner's (1979) social ecological framework. The master's thesis consists of two separate sections. First, in the introductory chapter, elaborations on methodological and theoretical aspects are emphasised. Lastly, an article written for the interdisciplinary youth research journal YOUNG will be presented.

1.1 Background

Earlier research and theory indicate that the school is an important arena for young people's development that may influence the use of cannabis (Bronfenbrenner, 1979; Babor et al., 2010; Hoff, Andersen, & Holstein, 2010; Kuntsche, 2010; Araos, Cea, Fernández, & Valenzuela, 2014). However, evidence regarding the importance of the school-context in the Norwegian setting is limited. Abebe, Hafstad, Brunborg, Kumar, and Lien (2015, p. 1000) found only a small variance between schools in Oslo but encouraged further examination of variations within and between schools utilising multilevel analysis. After performing a literature review, no studies adopting multilevel methods to explore variations in cannabis within the Norwegian school-setting are identified, and this thesis addresses this gap. In addition, socioeconomic status and gender seem to be associated to cannabis use (Legleye, Janssen, Beck, Chau, & Khlat, 2011, pp. 1520–1531; European Monitoring Centre for Drugs and Drug Addiction, 2015, pp. 2-3; Hemsing & Greaves, 2020). Thus, the following research questions have been formulated:

- To what extent does the school-class influences individual cannabis use?
- Is the gender proportion in the school-class influencing individual cannabis use?
- Is the socioeconomic composition in a school-class influencing individual cannabis use?

1.2 Use of cannabis in a global perspective

The number of people using illicit drugs has increased significantly over the last ten years. The United Nations Office on Drugs and Crime [UNODC] estimates that 5.5 % of the global population between 15-64 years old used an illicit drug in 2017 (United Nations publication, 2019, booklet 1, pp. 7-20). Availability influences the prevalence of substance use, and illicit

drugs keep on expanding in range and availability. Use of illicit drugs may result in infectious and chronic diseases, increased criminality rates, accidents, disrupted families, workplace problems, and fuel the illegal economy. Thereby, the use of illicit drugs cause threats to security and sustainable development (Babor et al., 2010, pp. 18-80; United Nations Publication, 2018, pp. 1-43). Thus, the use of illicit drugs is a complex problem at both individual and societal level and research on the topic is of interest from both a social welfare and a health policy perspective.

188 million people are estimated to have used cannabis in 2018, leaving this to be the most widely used illegal drug globally (albeit, cannabis has been legalised in some countries). Moreover, there is an increase in the proportions of people entering drug treatment programs with cannabis as their primary substance of concern (United Nations publication, 2019, booklet 1, p. 7-20). Cannabis is a psychoactive substance which acutely impairs learning capability and psychomotor performance, and in the long-term effects there is a risk of a deterioration in both mental and physical health (World Health Organization, n.d.). People who try cannabis once are in risk of developing dependency syndrome, and this risk incline from 9 % to 17 % if the onset is during adolescence (United Nations publication, 2019, booklet 2, p. 14). Hence, the wide-ranging effects and the complex nature of cannabis use may have severe health implications for young people, which is why increased knowledge on cannabis use among adolescents is of importance.

1.3 Drug policy and the Norwegian setting

Narcotics is one of the main causes in the national burden of diseases among young Norwegians (Folkehelseinstituttet, 2018, p. 3). Today, there is an ongoing debate on what is considered as best practice and several countries have legalised or decriminalised the drug (NOU, 2019, p. 116). Although cannabis may causes a deterioration in social and health status, studies have found positive effects of therapeutic use, for example in treatment of nausea during cancer and AIDS treatment (World Health Organization, n.d.). Portugal is one of the countries which has decriminalised drugs, and the International Narcotics Control Board consider the Portugal-model as best practice (Sipp, 2015, p. 5). Norway works towards a change in their drug policy, moving closer to the Portugal-model, whereby the responsibility of reactions is moved from the justice department to the health sector. The Norwegian Health Minister states that the government wants people with substance use disorders to be met with health care and respect, not punishment and condemnation (Regjeringen Helse- og omsorgsdepartementet, 2018). An empirical review of the Portugal-model in the light of the

Norwegian setting concludes that a policy change is not likely to have a great impact on death rates or imprisonments related to narcotics (K. Johansen, Johansen, & Johannessen, 2018, p. 22).

Undoubtedly, people suffering from substance use disorders should be treated with respect and receive health care according to their needs. However, it is also desirable to prevent young people from initiating a substance use. Preventative programmes addressing the classroom and the school environment are seemingly effective than those addressing individuals (Babor et al., 2010, pp. 104-114), which implies that some aspects of school are of importance when it comes to adolescent cannabis use. Moreover, K. Johansen et al. (2018, p. 22) emphasise the importance of knowledge-based measures taking outset in the local arena. Thus, as the use of cannabis is more common among adolescents living in Oslo than in the rest of Norway (Bakken, 2018a, p. 61), this study will examine adolescents attending upper secondary school in Oslo and their imposed school-class context. Possible findings from this study may give grounds to policy implications and inform the ongoing policy debate.

2. Empirical review

To identify relevant literature on the topic a literature review was performed in the database SocIndex, which contains references to articles within the research fields of anthropology, criminology, welfare, demography, policy, social psychology and more. Relevant text words by different combinations (see appendix 1) were employed, and reference searches within the most relevant articles were conducted.

2.1 Cannabis use in Oslo

First, previous research exploring the use of cannabis with data from the survey series *Young in Oslo*, which contains information about students' health and wellbeing (Bakken, 2018a, p. 8), were identified.

Bakken and Pedersen (2016) examine substance use (tobacco, alcohol, and cannabis) among adolescents within different city-districts in Oslo, showing that the use of cannabis is more prevalent in the more affluent districts of Oslo, and display a socio-geographic pattern of substance use. The more affluent areas have a higher level of recreational smoking, snus, and alcohol use, while the poorer areas show higher levels of daily cannabis use, smoking, and alcohol problems. Results indicate youth from more affluent districts develop a less harmful pattern of substance use than those from less affluent districts. While poor school grades, poor parental monitoring and higher levels of parental control were associated with

cannabis use, no association between neighbourhood area and cannabis use was established after controlling for risk factors.

Due to an increase in cannabis use between 2015 and 2018, Pedersen, Bakken, and von Soest (2019) examine the hypothesis that when cannabis is more widely used a normalisation-process occurs and the users will be less social marginalised. They compare characteristics of cannabis users in Oslo's middle- and upper secondary school from 2015 and 2018 using bivariate and multiple logistic regression analysis. The researchers conclude there is no definitive support for the hypothesis, as the users were not characterised by more psychosocial risk factors in 2015 than in 2018. Factors associated with cannabis use were male gender, low parental control, little time spent on schoolwork, alcohol intoxication, conduct problems, being a victim of violence and being an ethnic minority. Nonetheless, the associations between cannabis and these factors are stronger for middle-school students than high-school students. Also, in contrast from middle-school students, students at upper secondary school who use cannabis report to have more friends and more socio-material resources (Pedersen et al., 2019). Thus, cannabis use may be more normalised among older students than younger students.

As cannabis is associated to alcohol intoxication (Pedersen et al., 2019), a study by Pedersen, Bakken, and von Soest (2017) was found to be relevant. They use a multilevel method to analyse data from the Young in Oslo 2015 survey to investigate neighbourhood and school influences on the alcohol socialisation process among 16 to 18-year-olds. Furthermore, the study assesses if variations may be ascribed to sociodemographic factors of school and neighbourhood and aims to identify sociocultural aspects of the school environment that may be of importance. Results show that schools accounted for a little more of the variance than the neighbourhood through an aspect of youth culture, while effects of the neighbourhood were in a higher degree associated with family characteristics. Additionally, school-level characteristics of having a large proportion of students with high socioeconomic status, and who are committed to Norwegian celebration traditions were associated with a higher frequency of alcohol consumption (Pedersen et al., 2017). Thus, it is of interest to further explore the school processes and their influence on cannabis use. Also, the studies presented in these sections give rise to the assumption that socioeconomic status at school level matters to cannabis use in Oslo.

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2.2 Cannabis use and the school-context

Fletcher, Bonell, and Hargreaves (2008) provide a systematic review to examine whether school institutional factors influence adolescent's substance use. They found longitudinal observational studies at individual- and school level, which were indicating that a variance between secondary schools in drug prevalence was remaining after controlling for a wide range of factors, such as student's health behaviour prior to starting secondary school, suggesting school level effects are of importance. Moreover, Hoff et al. (2010) show that affiliation to a school-class with more than two cannabis users, as well as poor school satisfaction were associated with individual cannabis use among Danish adolescents after controlling for many known risk factors. Holm, Sandberg, Kolind, and Hesse (2014) found that the cannabis culture among school friends is of importance for individual use in Denmark. Araos et al. (2014) suggest that the imposed classroom environment give rise to a normative context that are associated with cannabis use in Chile, while Kuntsche (2010) found the frequency of Swiss students' cannabis use was higher in school-classes where perceived availability of cannabis is higher and where students observed classmates being cannabis intoxicated. Lastly, a multilevel study of Finnish 15 to 16-year-old students' cannabis use in 2011 at both individual level and school-class level also concludes there is a between school variation in cannabis use (Hakkarainen, Karjalainen, Raitasalo, & Sorvala, 2015). This literature highlights the importance of the school-context when it comes to cannabis use among adolescents. As employing multilevel models is encouraged to explore behaviour within a context (Duncan, Jones, & Moon, 1996, pp. 817-828), other Nordic studies adopting this method to investigate the school-context and cannabis use were identified, and studies found relevant will be accounted for in the next sections.

Karlsson, Ekendahl, Gripe, and Raninen (2018) explore the relationship between individual and classroom factors and cannabis use among Swedish adolescents in 9th and 11th grade. The study applies multilevel logistic regression analysis on nationally representative cross-sectional data from 2012-2015. Results indicate that individual factors increasing the odds of cannabis use were male gender, an early debut of binge drinking and tobacco use, a low risk perception, and parents accepting binge drinking and smoking. At the classroom level, higher proportions of students in the school-class with early substance use debut, binge drinking, truancy, keeping lower risk perceptions, and female students were related to cannabis use. Moreover, the study suggests that the school-class is an important factor of

social influences on adolescent's substance use, and that the influence of imposed peers is stronger than that of selected peers (Karlsson et al., 2018).

A. Johansen, Rasmussen, Madsen, and Johansen (2006) employ multilevel modelling to examine the relative influence of the school-class, family's socioeconomic status and individual risk factors on health behaviours among Danish adolescents between 14 and 16 years old. Results suggest the school-class had the strongest impact on risky health behaviour, such as smoking and consumption of alcohol and cannabis, while family had stronger impact on nutritional habits. They did not find a significant relationship between socioeconomic status and cannabis, however the school-class varied to a great extent in cannabis use and other euphoriants.

Multilevel logistic regression models were also utilised to analyse data from the 2009 cross-sectional survey *Youth in Iceland*. While school variance in cannabis use were estimated to be 5 %, the relationship between school level peer cannabis use and individual odds of cannabis use was not significant. Moreover, family affluence was not significantly associated to cannabis use (Kristjansson, Sigfusdottir, & Allegrante, 2013).

After performing an extensive literature review, no studies adopting multilevel methods to explore the effects of individual factors and school-class factors on cannabis use among Norwegian adolescents were identified. Thus, this thesis aiming to contribute with literature on the field.

3. Theoretical framework

Bronfenbrenner (1979, pp. 3-57) presents a theoretical perspective on a nested model for the ecological environment of development and how individuals interact within different settings at different levels, acknowledging development occurs within a context and that all contexts interact with individuals and have an impact on personal development. The nested model (figure 1) presents different levels of influence, as a conceptual framework for understanding children's development.

At the first level we find the microsystem. This is the immediate settings and the interrelations within these settings, in example personal characteristics, family and friends, whereby people's activities influence each other when they are in a relation. The next level is the mesosystem, that is the interrelations and connections between two or more immediate settings, whereby the developing person is an active participant. This level also represents

influences of a specific group, in example schools. Next, the exosystem is an indirect environment and the setting in which the individual is not an active participant, but in which events occur that affect the individual (in example urban environments). Last, the macrosystem is the abstract setting of cultural and societal aspects (in example social and cultural values, and policies) (Bronfenbrenner, 1979, pp. 3-57; Byrne & Lander, 2013, p. 63).
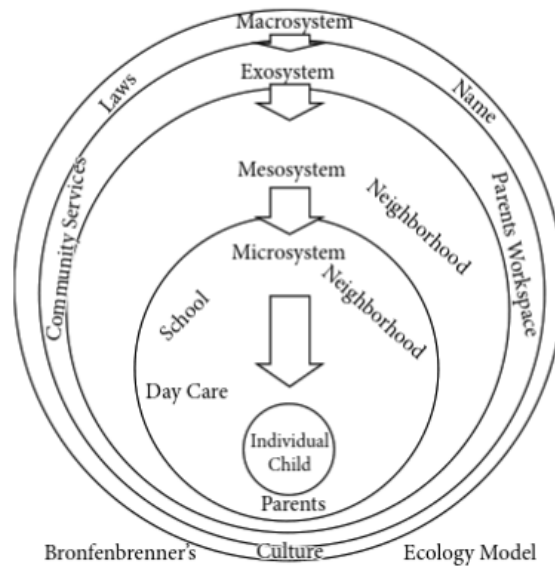
Figure 1. Bronfenbrenner's nested model. Extracted from Byrne & Lander (2013, p. 65)

Exploring interactions within contexts can extend our knowledge of adolescent's substance use (Shekhtmeyster, Sharkey, & You, 2011, p. 387). Mayberry, Espelage, and Koenig (2009, p. 1047) conclude Bronfenbrenner's framework enhances our understanding of social contexts influence on substance use, while Byrne and Lander (2013, pp. 64-66) argue that the different levels affect substance use and contain information about treatment measures. Thus, by adopting the nested model of Bronfenbrenner (1979) this study seeks to explore the influence of the micro- (individual characteristics), meso-(school-class) and exosystem (socioeconomic status and gender of classmates), and discuss possible influences of the exo- and macrosystem (Oslo, Norway), in order to gain a more comprehensive understanding of adolescent's cannabis use and hopefully contribute with new information on preventative measures. The theory has been criticised for being difficult to test, and that scholars refer to the theory without leaning on Bronfenbrenner's complete work (Tudge, Mokrova, Hatfield, & Karnik, 2009, pp. 198-208). Therefore, it is emphasised that this thesis merely applies the early work of Bronfenbrenner's framework for conceptualising and structuring the thesis.

4. Method

4.1 Data

The data used in this study stem from the *Young in Oslo 2018* survey where 25 348 students within 84 schools in Oslo participated, and is purposed to give a comprehensive picture of adolescents living in Oslo's health and wellbeing, and how they administer their time outside of school. The survey is initiated by the regional Drug and Alcohol Competence Centres and carried out by the Norwegian Social Research Institute [NOVA] in collaboration with Oslo Municipality (Bakken, 2018a, pp. 1-11), and made accessible for the current study by NOVA. Data was collected in 2018, and students who participated in the survey were between the 8th grade of middle school and 3rd grade of upper secondary school and have a total response rate at 74 %, whereas the response rate was 65 % at upper secondary school. The quality of the data is estimated to be high and considered as representative for Oslo city (Bakken, 2018a, pp. 1-11). Only data from students attending upper secondary school is selected for this study. NOVA is not responsible for any inferences or analyses presented in this thesis.

4.2 Scope and limitations

The scope of the thesis is on contextual items that the students do not have any impact on but are nonetheless assumed to be influenced by. Albeit, factors at the macrolevel are not directly assessed, plausible influences of this system will be discussed. Drawing upon the theoretical framework, the following analytical model has been produced and will be explored in the discussion section:
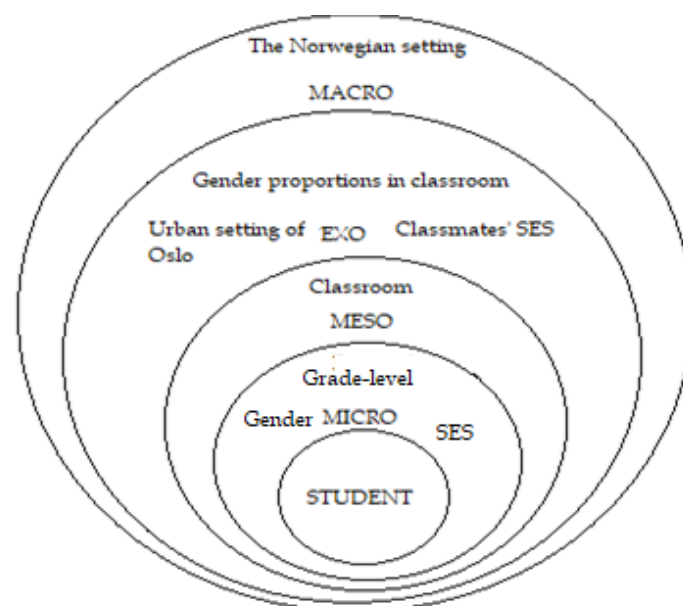

Figure 2. Analytical model

Self-reporting questionnaires do have some advantages; they do not have any interviewer bias, and it is easier to reach out to many respondents. A total response rate of 74 % is evaluated as very good (Bryman, 2012, pp. 233-235). However, 60 % of the students report that they experienced the survey to take too much time, and 18 % of the students did not finish the questions, implying the questionnaire may be too long (Bakken, 2018b, p. 11).

Moreover, analyses of the *Young in Oslo 2006* survey show that respondents who use cigarettes and have parents with lower education have lower capacity to complete the survey (Elstad, 2010, p. 28). Furthermore, as the questionnaire is completed during school hours and the use of illicit drugs can be associated with problem behaviour such as truancy (Karlsson et al., 2018), the representativeness of this study may be questionable. Additionally, the analyses of Young in Oslo 2006 suggest there is an underreporting on sensitive issues, for instance criminal offences (Elstad, 2010, p. 36). Similar analyses are not performed on data used in this study, nonetheless there is a chance of an issue regarding the reliability of the study. However, these issues are not perceived as affecting the results to a remarkably degree, and the data is evaluated as suitable to the study.

4.3 Variables included

Questions in a survey may be interpreted differently by the respondents and the method is therefore criticised for given a false sense of accuracy. Reliability refers to the consistency of a measure and validity refers to whether the indicator actually measures what it is supposed to measure (Bryman, 2012, pp. 169-179). Additional information and deliberations about included variables are therefore presented in the following sections, to give the reader further grounds to evaluate the quality of the study.

4.3.1 Dependent variable

Use of cannabis

Cannabis use is captured by a question of how many times the student report to have used cannabis the last 12 months and is measured by a six-point scale ranging from never to 11 times or more. The variable is recoded to a dummy variable measured by never (0) and one time or more (1). Thereby, this study does not distinguish between experimental and problematic use and risks not capturing existing nuances in the scaled variable. However, most adolescent cannabis consumption is limited to experimental use (NOU, 2019, p. 75) and the risk of developing dependency increase if there is an onset during adolescence (United Nations publication, 2019, booklet 2, p. 14), which is why a dichotomous variable is of

interest. Also, there is a risk of the respondents do not capture the timeframe established in the question (Elstad, 2010, pp. 15-17) and may report lifetime cannabis use rather than usage during the last 12 months. This is not evaluated as affecting the results, as the study does not distinguish between experimental and regular use.

4.3.2 Independent variables

Gender

Gender is a dichotomous variable measured by the question "are you a boy or a girl?". This question may be experienced as provoking to people who consider themselves neither a boy nor a girl, and perhaps an alternative of gender definitions should be added in future surveys to capture this group as well. Furthermore, 49 % boys and 51 % girls responded to the original survey (Bakken, 2018a, p. 11). In comparison, response rates are 45 % for boys and 55 % for girls after defining the analytical sample. Albeit, self-completed questionnaires assumedly keep lower levels of social desirability bias and may be a good alternative to a personal interview when asking sensitive questions, a risk of under-reporting is always present in sensitive questions (Bryman, 2012, p. 234). Hence, it is possible to assume there is an underreporting because of boys (who report higher levels of cannabis use) dodge this question in a higher degree than girls. Nevertheless, this study focuses upon the gender proportions within the classroom and the skewed distribution of gender should not impact these results in a great manner.

Grade-level

As cannabis use seems to be more normalised among older students (Pedersen et al., 2019), it is chosen to control for grade-level. Grade-level is a categorical variable measured by the question "Which grade-level do you attend?" and response options are upper secondary school grade-level 1, 2, and 3. Response rates decrease by grade-level, and students who participate in an apprentice programme or who have dropped out of school are not represented (Bakken, 2018a, pp. 9-10). This may cause issues of representativeness, as the prevalence of cannabis use may be differently distributed among these groups. Thus, the results of this study may not be generalised to these types of school-classes. Moreover, the survey has not been distributed to students following a vocational field of study in the same degree as those undergoing the general study programme (Bakken, 2018a, pp. 9-10). However, after defining the analytical sample a higher proportion of students attending vocational fields of studies are found.

Socioeconomic status

Socioeconomic status [SES] is measured by a multiple-indicator measurement and consists of one average score composed by several variables to capture at which level the student have access to economic, cultural, and social resources. The measurement have been described and evaluated in detail in a NOVA-report by Bakken, Frøyland, and Sletten (2016, pp. 21-33). The variable is based on the parent's level of education, number of books in student's home and family affluence. Family affluence is measured by a revised version of the Family Affluence Scale, including four questions about access to material resources (whether the student's family own a car, computer, have its own bedroom and whether the family went on vacation the last year) (Bakken et al., 2016, pp. 21-28). The variable is a five-point scale ranging from 1-5, where 5 is the highest SES category. In this study, a dichotomous version of the variable is used to capture the students with the highest SES. Thus, the reference category is the students who keep the three lowest scores on the SES-scale and the target group is the students who keep the two highest scores.

4.4 Ethical considerations

Research in Norway is required by law to be conducted in accordance with existing ethical norms (Forskningsetikkloven, 2017). This study follows the ethical guidelines established by the National Committee for Research Ethics in the Social Sciences and the Humanities (NESH, 2016). Some aspects of the guidelines are also highlighted by Bryman (2012, pp. 135-140), who emphasises that research shall protect personal integrity, autonomy and avoid any harm, participants shall be informed, and confidentiality shall be secured. The current study uses data which is already collected, processed, and anonymised and does not contain all data from the original survey, which is why an application of approval from NSD is not filed. However, the *Young in Oslo 2018*-report informs ethical considerations according to these principles were adhered to (Bakken, 2018b, pp. 8-10).

4.5 Data analysis

When the outcome variable is a measurement of an event that is zero inflated (as in this study), logistic regression is preferable. Multilevel logistic regression is a method for estimating the odds of a binary outcome variable by lower-level and higher-level variables and cross-level interactions, while taking into the account the nested structure of the data. Thereby, the method allows one to estimate within-clusters and between-clusters effects and predict if the odds of the event occurring may be attributed to lower-level characteristics or higher-level characteristics. Multilevel modelling requires 50 or more higher-level units in

order to correctly estimate the standard errors and lessen the risk of Type 1 errors (Sommet & Morselli, 2017, pp. 203-207). Respondents in this study are nested within 32 schools and 278 school-classes, which is another argument for choosing the school-class as the higher-level. IBM SPSS Statistics 26 was used to perform the analysis in the current study, while intraclass correlation coefficient [ICC] and median odds ratio [MOR] were calculated by the formulas presented in the article's appendix (1). The software has some limitations when it comes to multilevel modelling, as the program has troubles calculating random slopes. This is a common problem of SPSS, and the algorithms most often will fail to estimate random slope parameters (Sommet & Morselli, 2017, p. 211). This does not affect the current study, as only a random intercept is included in the models.

5. Findings

The descriptive statistics (table 1 in the article) show that more boys than girls report to have used cannabis the last 12 months. Students in the second and third grade-level report to have used cannabis more than the students attending the first grade-level. Students with high socioeconomic statuses report a higher level of cannabis use than those with low socioeconomic statuses. Results of the multilevel regression (table 2 in the article) show that when calculating the null model 13.7 % of the variance (ICC) in cannabis may be attributed to the school-class level, and if a student moving from a low-risk class to a high-risk class the odds of using cannabis almost doubles (MOR=1.99). Model 1 suggests that individual factors increasing the risk of cannabis use are male-gender, affiliation to a higher grade-level, and a higher socioeconomic status. Results are significant at the 1 % level. Model 2 includes school-class factors, and the results show that that an increase in 10 percentage points of boys in the school-class increase the risk of using cannabis by 5 % over and above the individual level. Also, an increase by 10 percentage points in students with high socioeconomic statuses in the school-class increases the risk of using cannabis by 11 % over and above the individual level. Having a high socioeconomic status is not statistically significant in model 2, while other results are significant at the 5 % level. After adjusting for the demographic factors included, there is a remaining between school-class variance of 10.9 %.

6. Discussion and conclusion
The main aim of the study was to investigate if the school-class, and gender proportion and socioeconomic composition in the school-class, influence cannabis use among students attending upper secondary school in Oslo, Norway. This study indicates that the school-class,

and the gender proportions and the socioeconomic composition of the school-class are associated with the use of cannabis at the individual level to a significant degree. A larger proportion of male students, and a larger proportion of students with a higher socioeconomic status increase the risk of using cannabis. Although, Bronfenbrenner's theory (1979) is not tested (through e.g. structural modelling), the findings of this study support that the individual is influenced by different contexts at different levels.

In the microsystem we find that gender, grade-level and socioeconomic status are associated with the use of cannabis. In the mesosystem, an influence of the school-class is found, and the individual's risk of using cannabis is associated with which school-class the student is assigned to. The exosystem represents a setting in which the individual is not an active participant, and the results suggest that both the socioeconomic status of the classmates and gender proportions in the school-class are influencing individual cannabis use at this level. Laws and culture are contextual influences at the macrolevel. The setting of Oslo (exosystem) and Norway (macrosystem) is not directly assessed in this study. To thoroughly examine this level of influence a comparative study or a qualitative study would assumedly be more appropriate, and the results of this study do not allow for any conclusions at this level. However, there is reported an increase in cannabis use during the last years (Bakken, 2018b, pp. 102-103) , and it seems to be a change in the prevalence and the attitudes towards cannabis. Students in Oslo report to use cannabis in a higher degree than students living in other parts of the country (Bakken, 2018a, p. 61). Therefore, the influence of an urban environment, as well as norms and culture seem to be of importance when it comes to adolescent cannabis use.

Findings from the current study align with existing literature which suggest a higher socioeconomic status is associated to cannabis use in Oslo (Bakken & Pedersen, 2016; Pedersen et al., 2019). In comparison, Kristjansson et al. (2013) and A. Johansen et al. (2006) did not find any significant association between cannabis and family affluence, and Karlsson et al. (2018) found that adhering to a classroom with a higher proportion of females increased the risk of individual cannabis use. Also, findings from this study indicate the school-class account for some of the variance in cannabis use and align with studies from other Nordic countries (A. Johansen et al., 2006; Hakkarainen et al., 2015; Karlsson et al., 2018). In addition, international literature on the topic adds to the evidence that the school-context is of importance when it comes to cannabis (A. Johansen et al., 2006; Fletcher et al., 2008; Hoff et al., 2010; Kuntsche, 2010; Araos et al., 2014; Holm et al., 2014; Karlsson et al., 2018).

Consequently, this study suggests preventative efforts should focus upon the school-class environment.

The contextual influence of all levels presumably varies between settings. Therefore, findings from this study may not be generalised outside of Oslo. Thus, testing the model presented in the article in other contexts is suggested. Further research is also suggested to investigate whether these findings apply to the school-level as well.

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Appendix 1. Text words

P	(Adolescen* OR High school OR Teen* OR Student OR Young*) AND (Norw* OR Oslo)
I	
C	(School-class* OR School* OR Classroom*)
O	(Cannabis OR Marijuana OR Substance misbuse OR Drug abuse OR Substance use OR Drug use OR Substance addiction OR Substance abuse)
SD	Multilevel

A SOCIAL ECOLOGICAL PERSPECTIVE ON CANNABIS USE AMONG NORWEGIAN ADOLESCENTS - a multilevel study

Introduction

Previous research and theory indicate that the school is an important arena for young people's development that may influence the use of cannabis (Bronfenbrenner, 1979; Fletcher, Bonell, & Hargreaves, 2008; Babor et al., 2010; Hoff, Andersen, & Holstein, 2010; Kuntsche, 2010), and the Norwegian Government Committee for Drug Policy Reform calls for increased knowledge on preventative measures in the school-setting (NOU, 2019, p. 236). However, evidence regarding the school-context and cannabis use in Norway is limited. A study on substance use among adolescents living in Oslo in 2006 concluded there is only a small variation between schools relating to substance use behaviour (Abebe, Hafstad, Brunborg, Kumar, & Lien, 2015, pp. 992-1001). Nevertheless, the sociodemographic composition of Oslo's inhabitants has changed since 2006 (Ljunggren, 2017), and in recent years it seems to be a change in the prevalence and the attitudes towards cannabis, primarily among older students in Oslo (Bakken, 2018a, p. 61). Thus, the importance of the social context might have altered. Another reason for examining the school-context is the lack of focus on variations *within* schools. As individuals are assumed to be influenced by the groups in which they belong (Hox, Moerbeek, & van de Schoot, 2010, p. 1), cannabis use is likely to vary between school-classes. Abebe et al. (2015, p. 1000) encouraged further examination of variations within and between schools utilising multilevel analysis. After carrying out a literature review, no studies employing multilevel methods to explore variations within the school-context in the Norwegian setting are identified. Thus, this article addresses this gap.

Specifically, this study examines the impact of the composition in the school-class, by gender and socioeconomic status. This is based on the evidences that suggest young people with a higher socioeconomic status are more likely to experiment with cannabis, than adolescents with a lower socioeconomic status, and that cannabis is more prevalent among males (Legleye, Janssen, Beck, Chau, & Khlat, 2011, pp. 1520–1531; European Monitoring Centre for Drugs and Drug Addiction, 2015, pp. 2-3), and in the more affluent city districts in Oslo (Bakken & Pedersen, 2016). By applying the social ecological framework of Bronfenbrenner (1979), this article seeks to discuss different levels of influence, and to empirically demonstrate the impact of school-class contextual factors on adolescent's cannabis use in Oslo, Norway.

Cannabis use among adolescents

In the *World Drug Report 2019,* the United Nations Office on Drugs and Crime [UNODC] estimates around 4.7 % of the world's youth between 15-16 years have tried cannabis at least once during 2017, and that cannabis is the most widely used drug among adolescents (United Nations publication, 2019, booklet 2, p 13-14). Furthermore, data from the *Global Burden of Disease Study* show that mental health and substance use disorders were the main cause of disability-adjusted life years [DALYs] among young people aged under 24 in high-income countries in 2010 (Erskine et al., 2015, p. 1551). Harms associated with substance use are at greatest risk among adolescents, and youth between 12-17 years are in a critical period when it comes to the initiation of substance abuse. Results of harmful use can be a deterioration in both physical and mental health as well as unsettled futures. The pleasure learning reinforcement (repeating an action which provides pleasure) combined with young people's social contexts enhance the risks of adolescents, which are undergoing growth and maturing, using psychoactive substances. Thus, the risk of initiating a problem drug use in this phase of life is highly present (Babor et al., 2010, p. 18; United Nations publication, 2019, booklet 2, p. 13-14). Several studies suggest that people who have ever tried cannabis have a 9 % risk of developing dependency, and that this rate inclines to 17 % among those who start using cannabis during adolescence (United Nations publication, 2019, booklet 2, p. 14). Consequently, it is of importance from a social welfare and health perspective to obtain further knowledge about cannabis use among adolescents.

Factors influencing adolescent cannabis use

UNODC informs that the presence of risk factors (and the combinations of these) and the absence of protective factors makes certain adolescents more susceptive to drug use than others (United Nations publication, 2019, booklet 2, p. 13). However, illicit drug use cannot be separated from other aspects of the adolescent's life and factors predicting a drug problem coincide with factors predictive of in example school failure, social isolation and aggression (Babor et al., 2010, pp. 113-114). Additionally, an increase in the use of illicit drugs also causes an increase in the illicit economy, and cannabis may be a gateway for adolescents to enter other criminal environments (Bakken, 2018a, pp. 60-61). A comprehensive systematic review highlights that both individual, family, and environmental factors are of importance when it comes to the onset of cannabis use among teenagers (Guxensa, Nebot, Ariza, & Ochoa, 2007). Factors presented by UNODC that are well known to be associated with adolescent's initiation of drug use are genetic predisposition, personality traits, mental and

behavioural disorders, poor school- and community attachment, social norms, and growing up in marginalized and deprived communities. Protective factors presented are mental wellbeing, personal and social competence, and an attachment to parents, schools and communities (United Nations publication, 2019, booklet 2, p. 13). Albeit, a lot of factors are evident to influence substance use among adolescents, substance use cannot be isolated from other attributes of the adolescent's lives, and further examination of individual factors and the interaction within contexts may contribute to a more extensive understanding of the adolescent's substance use (Shekhtmeyster, Sharkey, & You, 2011, p. 387).

Bronfenbrenner's social ecological framework suggests individuals interact within different settings at different levels, and that different contexts have an impact on the individual's development. The different levels of influence range from the most proximate and intermediate settings to the most distal settings, and is referred to as the micro, meso-, exo- and macrosystem (Bronfenbrenner, 1979). Byrne and Lander (2013, pp. 64-66) argue that each level contains information about factors influencing substance use, and thereby holds the opportunity to inform appropriate treatment interventions at different levels. By employing a social ecological framework, it is feasible to identify influential contextual factors within different systems, and thereby inform policy measures. Thus, this article applies Bronfenbrenner's (1979) framework to conceptualise and structure the study to discuss different levels of influence, and.to empirically demonstrate the impact of school-class contextual factors on adolescent's cannabis use.

The Norwegian context

Laws and culture are factors presented as influencing the individual in the macrosystem (Bronfenbrenner, 1979, p. 26). Substance use disorders are the main cause of DALYs among young people in high-income countries (Erskine et al., 2015, p. 1551). Norway is one of the most affluent countries in the world (Thuesen, Thorsnæs, & Røvik, 2020) and narcotics is one of the main causes in the national burden of diseases among young Norwegians (Folkehelseinstituttet, 2018, p. 3).

The use of cannabis among young Norwegians has declined significantly since the 1990's, and the prevalence of cannabis use among Norwegian adolescents is reported as lower than in most other countries (Bakken, 2018b, p. 102). However, it seems to be a change in the trend as the numbers of Norwegian students reporting to have used cannabis have increased from 2015 to 2017, especially in upper secondary school (Bakken, 2018b, p. 103). Albeit, the

negative consequences of cannabis have been debated, e.g. in comparison to alcohol, and it has been legalised in several countries (NOU, 2019, p. 116), it is still an illegal drug in Norway and young people who use cannabis have crossed a line (Bakken, 2018b, p. 102). However, the government of Norway is working for a change in the drug policy, leaning closer towards the Portugal-model which decriminalised drugs in 2001 with seemingly good results (NOU, 2019, pp. 131-142). The responsibility for reactions on use and possession of illicit drugs will be transferred from the justice department to the health sector. The Norwegian Health Minister express that the government want people with substance use disorders to be met with health care and respect, not punishment and condemnation (Regjeringen Helse- og omsorgsdepartementet, 2018). This implies there are some ongoing changes in the macrosystem which possibly will influence the adolescents.

The exosystem represents an indirect environment of influence (Bronfenbrenner, 1979, p. 25), and the urban setting of Oslo city may be regarded as an influence at this level. This setting seems to be of importance, as the use of cannabis is far more common in Oslo than in the rest of Norway. Almost 15 % of the students report to have used cannabis in 2018, and almost 4 out of 10 boys in the 3rd level of upper secondary school report to have used cannabis during the last year (Bakken, 2018a, p. 61). Moreover, the student-survey *Young in Oslo 2018* implies that there is a change in the cannabis culture, as cannabis use seem to be more acceptable among the students (Bakken, 2018a, p. 61). According to data from the European School Survey Project on Alcohol and Other Drugs (ESPAD), the risk perception of cannabis decreased between 2007-2015. In the same period, exposure to cannabis use opportunities decreased, while the use among those holding such opportunities increased (Burdzovic Andreas & Bretteville-Jensen, 2017). As it seems to be a change in the cannabis culture among young Norwegians, primarily among older students in Oslo, it is of interest to gain knowledge about cannabis use per se among adolescents attending upper secondary school in Oslo.

The school-context

In Bronfenbrenner's mesosystem we find influences of a specific group in which the developing person is an active participant, in example schools (Bronfenbrenner, 1979, p. 25). Several studies suggest that preventative programmes addressing the classroom and school environment are more effective than those targeting individual behaviour (Babor et al., 2010, pp. 104-114), which indicates the school-context is of importance when it comes to adolescent's substance use. Additionally, longitudinal observational studies at the individual-

and the school level found that the variance between secondary school in drug prevalence were remaining after controlling for a wide range of other factors, such as student's health behaviour prior to starting secondary school, suggesting school level effects are of significance (Fletcher et al., 2008).

In Norway, the students who are studying general studies in upper secondary school will spend around 840 hours at school each year during 3 years (Fylkenes informasjonstjeneste for søkere til videregående opplæring, n.d.), leaving the school-context to be an important aspect of Norwegian adolescents' life (NOU, 2019, p. 236). Students may choose their field of studies but are randomly assigned to school-classes. Gender distributions are unequal across different fields of studies, and there is for example an overrepresentation of males in construction subjects, while females are overrepresented in health subjects (Bufdir, 2019). Due to the selection process, a school tend to attract students with similar characteristics (for instance, high socioeconomic status or low socioeconomic status) (Hox et al., 2010, p. 4). In Oslo's upper secondary school, there is a citywide admission model and the student's grade points determine which school they will get access to. Today, students with the lowest grade points are primarily clustered in Oslo's east district, while those with higher grade points mainly adhere to schools in central and western city-districts. A free school-choice model based on grade points may stimulate segregation and there is an ongoing debate on which school-admission models that are the most opportune (Oslo Kommune, 2019; Serediak & Helland, 2020, pp. 6-8). Thus, knowledge on the school-class' influence on adverse health outcomes, such as cannabis use, is of relevance.

Personal characteristics

At the most proximate level of influence in Bronfenbrenner's framework we find the microsystem. This is the immediate setting and the interrelations within these settings (Bronfenbrenner, 1979, p. 22). Most adolescent cannabis consumption is limited to experimental use (NOU, 2019, p. 75). Although evidence is dispersed (European Monitoring Centre for Drugs and Drug Addiction, 2015, pp. 2-3), it is suggested that young people who come from families with high socioeconomic statuses are more likely to experiment with drugs and less likely to have a daily use of drugs compared to youth with lower socioeconomic statuses (Legleye et al., 2011, pp. 1520–1531). Furthermore, males are highly overrepresented among those who seek treatment for cannabis use. 84 % of those seeking treatment for cannabis as their primary problem drug, and 78 % of daily users are males (European Monitoring Centre for Drugs and Drug Addiction, 2015, pp. 2-3). Hemsing and

Greaves (2020, pp. 19-20) find that substance use are associated to traditional gender roles and that cannabis use can be an expression of masculine norms. Additionally, they argue that women of higher social classes are in a better position to challenge traditional gender roles. Thus, a more male-dominant milieu with a larger proportion of students from higher social classes may drive cannabis use within a given setting. Therefore, it is of interest to further examine the influence of gender and socioeconomic status at the school-class level on cannabis use.

Previous research
Cannabis use among adolescents in Oslo
Pedersen, Bakken, and von Soest (2019) compare characteristics of cannabis users in Oslo's middle- and upper secondary school from 2015 and 2018 to explore a normalisation hypothesis. They found that cannabis users were not characterized by more psychosocial risk factors in 2015 than in 2018. In contrast from middle school students, students at upper secondary school who use cannabis report to have more friends and more socio-material resources (Pedersen et al., 2019). These results align with the results from a study by Bakken and Pedersen (2016) who find that the use of cannabis is more prevalent in the more affluent western districts of Oslo. The study examines substance use (tobacco, alcohol, and cannabis) among adolescents within different city-districts in Oslo, and the analyses show how substance use vary between districts and follow a socio-geographic pattern. The more affluent areas have a higher level of recreational smoking, snus, and alcohol use, while the poorer areas show higher levels of daily smoking, alcohol problems and cannabis use. The results indicate youth from more affluent districts develop a less harmful pattern of substance use than those from districts with lower socioeconomic statuses.

As earlier mentioned, factors predicting drug use coincide with factors predicting other problematic behaviour (Babor et al., 2010, pp. 113-114). Therefore, a study by Pedersen, Bakken, and von Soest (2017) were found to be relevant. They utilise multilevel methods to analyse neighbourhood and school influences on the alcohol socialisation process among Norwegian students between 16-18 years living in Oslo in 2015. The study assesses if variations may be ascribed to sociodemographic factors of school and neighbourhood, and aims to identify sociocultural aspects of the school environment that may be of importance. Results show that schools accounted for a little more of the variance than the neighbourhood through an aspect of youth culture, while effects of the neighbourhood were in a higher degree associated with family characteristics. Additionally, school level characteristics as a

large proportion of fellow students with high socioeconomic status and who are committed to Norwegian celebration traditions (*russ*) were associated with a higher frequency of alcohol consumption (Pedersen et al., 2017).

Influences of the school-context on adolescent cannabis use

Multilevel modelling is suggested for exploring individual behaviour within a context (Duncan, Jones, & Moon, 1996, pp. 817-828). Although the literature is limited, a few studies which employ the multilevel approach on data from other Nordic countries have been identified. A study from Sweden found that individual factors increasing the odds of cannabis use were male gender, an early debut of binge drinking and tobacco use, a low risk perception, and parents accepting binge drinking and smoking. At school-class level, higher proportions of students in the school-class with early substance use debut, binge drinking, truancy, keeping lower risk perceptions, and female students was related to cannabis use. The study suggests that the classroom is an important factor of social influences on adolescent's substance use, and that the influence of imposed peers is stronger than that of selected peers (Karlsson, Ekendahl, Gripe, & Raninen, 2018). A. Johansen, Rasmussen, Madsen, and Johansen (2006) use multilevel modelling to examine the relative influence of the school-class, family's socioeconomic status, and individual risk factors on health behaviours among Danish adolescents between 14 and 16 years old. Results suggest the school-class had the strongest impact on risky health behaviour, such as smoking and consumption of alcohol and cannabis, while family affluence were not associated to cannabis use. Lastly, a multilevel study of Finnish 15 and 16 years old students' cannabis use in 2011 at individual level and school-class level also concludes there is a between school variation in cannabis use (Hakkarainen, Karjalainen, Raitasalo, & Sorvala, 2015). There has not been identified any studies exploring the relationship between cannabis use and the school-class context in Norway utilising multilevel modelling, which is why this article aims to contribute to the literature on this field.

Aim of the study

Previous research and theory indicate that the school is an important context to further examine, and gender and socioeconomic status seem to influence adolescent cannabis use. Thus, the main aim of the study is to investigate to what extent the school-class influence cannabis use, and whether gender proportions and the social composition of the school-class influence cannabis use at the individual level when controlling for individual characteristics (gender, grade-level and socioeconomic status) among students attending upper secondary

school in Oslo, Norway. Any findings will be discussed in Bronfenbrenner's (1979) socioecological framework. The following research questions have been formulated;

To what extent does the school-class influences individual cannabis use? Is the gender proportion in the school-class influencing individual cannabis use? Is the socioeconomic composition in a school-class influencing individual cannabis use?

Method

By drawing upon Bronfenbrenner's (1979) nested model, this study will explore the different levels of influence on the adolescent's cannabis use, focusing upon the micro- (individual characteristics), meso-(school-class) and exosystem (socioeconomic status and gender of classmates), and discuss other possible influences of the exo- and macrosystem (Oslo, Norway). As suggested by Abebe et al. (2015), this study will utilise multilevel analysis to study the effects of factors within school on cannabis use among Norwegian adolescents in Oslo's upper secondary school. When employing multilevel modelling it is possible to examine the importance of the school-context while controlling for individual factors (Kristjansson, Sigfusdottir, & Allegrante, 2013, p. 8). Due to the selection process, a school tend to attract students with similar characteristics (for instance, high socioeconomic status or low socioeconomic status) (Hox et al., 2010, p. 4). To avoid the problem of separating self-selection from actual effects and spurious estimates (due to e.g. parents choosing where to live/students choosing school) this study will apply the school-class as the second level and explore the effect of demographic variables that the students cannot affect themselves. As the data is nested within clusters (i.e. school-classes), there is an assumption that individuals clustered within the same group have a higher probability of functioning in the same way (Sommet & Morselli, 2017, p. 206).

Data

To investigate cannabis use among adolescents in Oslo per se, a dataset stemming from the cross-sectional study *Young in Oslo 2018* will be used. The data are produced by self-reported questionnaires answered to during school-hours and contains information about students' health and wellbeing. 10 825 students from 28 upper secondary schools in Oslo participated in the survey, with a response rate at 65 %. Data were collected between week 3 and 12 in 2018. The survey is initiated by the regional Drug and Alcohol Competence Centres (KoRus) and carried out by the Norwegian Social Research Institute [NOVA] in collaboration with Oslo

Municipality, and is financed by the Norwegian Directorate of Health (Bakken, 2018a, pp. 1-11). Data is made accessible to the current study by NOVA.

Respondents

This study includes students attending upper secondary school in Oslo. Students who have dropped out of school, have special needs, doing an apprentice programme, or answered less than 30 questions (429 respondents in total) are not included. Moreover, additionally 191 respondents were excluded due to presumably unserious answers (Bakken, 2018a, p. 10). Which school-class the respondent is assigned to is not directly measured in the survey. However, by identifying and clustering the respondents who answered the survey within the same hour of the same day, and who attended the same school, grade-level, and study programme, a school-class variable was computed. Thus, the school-class variable is an indirect measurement containing clusters of students who are assumed to cohere to the same school-class. Respondents nested within a school-class with less than 10 students are excluded, as they probably do not affiliate to an intact school-class. In cases where more than 35 students were nested within the same school-class it is presumed the survey was completed simultaneously with other school-classes. Respondents adhering to these large clusters are therefore excluded, as it is not possible to identify a school-class affiliation. Furthermore, only individuals with valid information on all the variables in the study are included, excluding additionally 147 respondents. As a result, the analytical sample contains 5 109 students within 278 classrooms.

Ethical considerations

Electronic questionnaires are responded to during school-hours and students were provided with information about the survey in advance, either orally by their teacher or through an information video. Participants were informed about the purpose of the study, that participation is voluntary, the possibility to withdraw or skip questions during the completion, and contact information to health personal at school if the students needed someone to talk to after the completion of the questionnaire. Moreover, parents were informed in advance of the study and had the opportunity to reserve their children under the age of 18 against participation. Students gave their consent by participating, and a separate written consent is therefore not collected. Students who did not participate were provided with an alternative activity. The questionnaire distributed to students attending upper secondary school obtains detailed information about their background, thus the data contains indirectly personal information. Norwegian Centre for Research Data [NSD] and the Norwegian Data Protection

Authority evaluated the survey as licensable with criteria of data storage and access to raw material (Bakken, 2018a, pp. 8-10). The current study uses data which is processed and anonymised and does not contain all data from the original survey, nor does the data contain person identifiable data, which is why an application of approval from NSD is not filed.

Strengths and limitations of data

Data are estimated to be of high quality and is collected from almost every school in Oslo which means all city-districts are well represented. Additionally, response rates are high (65 %) (Bakken, 2018a, p. 10). Moreover, as students cannot choose their gender, age, socioeconomic status, or which school-classes they are assigned to, issues of selection effects may be excluded. Furthermore, exposure to cannabis presumably varies between cities and more peripheral districts, and it is reasonable to assume students living in the same city are more equally exposed to cannabis than if the data were stemming from a national survey. As questionnaires are responded to during school-hours, there is a risk of underrepresentation by students skipping school. Also, questions about substance use are highly sensitive, and there is a risk of social bias and underreporting being present in this study (Elstad, 2010, p. 36) which potentially could decrease the reliability and validity of the study. Albeit, socioeconomic composition and gender proportion can affect cannabis use, and not the other way around, cross-sectional data cannot establish causality (Bryman, 2012, p. 175). Unobserved factors (e.g. liberal teachers at school-class level) may generate correlated effects (Manski, 1993, p. 31), as they influence the group simultaneously. Hence, it is emphasised that the results of this study only give rise to inferences.

Measurements
Use of cannabis

The use of cannabis is the dependent variable in this study and is measured by the item of how many times the respondents have used cannabis/hashish/marijuana the past 12 months. The measurement is scored by a six-point scale ranging from "never" to "11 times or more". Due to the pleasure learning reinforcement, people trying cannabis one time are in enhanced risk of repeating the action (Babor et al., 2010, p. 20; United Nations publication, 2019, booklet 2, p. 14). Hence, it was found suitable to establish a categorical variable with 2 exclusive groups containing those who report to never have used cannabis and those who report to have used cannabis. A dichotomous variable (no/yes) on the use of cannabis was computed, and those who report to have used cannabis during the last 12 months serve as the target group.

Gender

Gender is measured by the question "Are you a boy or a girl?" (boy/girl) and coded to a dummy variable where girls being the reference category.

Grade-level

Grade-level is measured by the question "Which grade-level do you attend?" and response options are upper secondary school grade-level 1, 2 and 3. As most students start level 1 at the age of 15-16 this variable can be treated as approximate to age, however students may attend different grade-levels at different ages. The variable is recoded to a dummy variable, where grade-level 1 is the reference category.

Socioeconomic status

Socioeconomic status [SES] is measured by a multiple-indicator measurement and consists of one average score composed by several variables; if parents' had university education (none/one/both), how many books the respondents have at home (ranging from 0 to 1000 or more on a six-point scale), the number of cars (none/one/two or more), vacations and computers in the respondent's family (none/one/two/more than two), and whether the respondents report to have their own bedroom (yes/no). Due to the student's age, the measurement takes outset in the socioeconomic status of their parents. These items are combined and divided on the number of questions asked in order to establish a valid approximately linear scaled variable to capture at which level the student have access to economic, cultural and social resources (Bakken, Frøyland, & Sletten, 2016, pp. 21-28) (an extended evaluation of the measurement can be found in a NOVA-report by Bakken et al. (2016)). First, the variable is a 5-point scale ranging from 1-5, where 5 is the highest SES. Second, the variable is recoded into a dummy variable, where the reference category is the three lowest computed scores, and the target category is those who keep the two highest scores on the SES-scale.

Data analyses

When you have data at different levels (as in this case; individual level and school-class level), the data form a hierarchical structure where one observation is nested within another one at a higher level (Hox et al., 2010, p. 1). Multilevel logistic regression is a method to estimate the effect of predictors at several levels, allowing the estimates to take into the account the hierarchical structure of the data (Sommet & Morselli, 2017, pp. 203-206). Moreover, by using multilevel modelling it is possible to avoid the ecological fallacy, which

is to falsely interpret and draw conclusions on aggregated data at the lower level (Hox et al., 2010, p. 3).

Descriptive statistics on level 1 will be reported on the independent variables' (gender, grade-level, and SES) distribution by the dependent variable (use of cannabis). Also, a stepwise multilevel logistic regression model will be performed. First, a null model containing the cluster intercept is defined in order to assess the variation of log-odds from one cluster to another (Sommet & Morselli, 2017, p. 210). To test whether data is interdependent and estimate the variance in cannabis use between school-classes, the intraclass correlation coefficient [ICC] and the median odds ratio [MOR] were calculated for the dependent variable. Next, an intermediate model containing lower-level variables in their raw-form is estimated to assess lower-level effects. When adding explanatory variables deviance is expected to decrease, indicating a better fit (Hox et al., 2010, p. 18). The intercept is kept random, other variables included are fixed. Finally, to investigate the gender proportions and the socioeconomic composition in the school-class' relationship to cannabis use at the individual level, a full model is constructed in order to test within- and between cluster associations with the outcome variable (Sommet & Morselli, 2017, p. 210). Estimating the mean of a lower-level variable as an explanatory higher-level variable is a common procedure in multilevel modelling (Hox et al., 2010, p. 2). Lower-level variables may vary within clusters, while higher-level variables are constant within the cluster (Sommet & Morselli, 2017, pp. 203-207). Aggregated variables added in the full model contain school-class means on the independent variables (gender and SES) and is computed so that an increase in 10 percentage points of the proportion in the school-class will show the effects on the individual by odds ratio [OR]. The command for generalized linear mixed models in the statistical software IBM SPSS Statistics 26 was used to perform the analysis, except from ICC and MOR which are calculated by the equations presented in the appendix (1).

Results

Table 1 shows descriptive statistics, and the distribution of the independent variables on the dependent variable. The cross-tabulation shows that more girls than boys have answered the questionnaire, while more boys than girls report to have used cannabis. The response-rate decreases by grade-level, and more students at the second grade-level report to have used cannabis than the students attending first and third grade-level. Those with a higher socioeconomic status more often report to have used cannabis than students with a lower socioeconomic status.

Table 1. Descriptive statistics

	USE OF CANNABIS		
	No	**Yes**	**N**
Total	75 %	25 %	5109
Girl	81 %	19 %	2822
Boy	67 %	33 %	2287
Grade-level 1	79 %	21 %	1919
Grade-level 2	72 %	29 %	1649
Grade-level 3	73 %	27 %	1541
Lower SES	77 %	23 %	3170
High SES	71 %	29 %	1939

N = number of respondents

Next, the multilevel regression (table 2) is assessed. To answer the research question to which extent the school-class influences individual cannabis use, the ICC and MOR is assessed. The ICC calculated in the null model shows that 13.7 % of the variance in cannabis use can be attributed to factors at the school-class level. Moreover, the MOR shows that if a student moves from a school-class with lower risk to a school-class with higher risk the probability of using cannabis almost doubles (MOR=1.99). The ICC decreases from model 0 (13.7 %) to model 2 (10.9 %), which implies that after adjusting for the demographic factors, there is a remaining unexplained variance between school-classes in the use of cannabis of 10.9 %. Also, the decrease in the ICC indicates aggregated variables included in model 2 are improving the model fit. Given the complex nature of substance use, an ICC of 13.7 % is evaluated as quite high. Thus, the results indicate that the school-class is of importance and has a considerable influence on individual cannabis use.

In model 1, factors at the individual level are included. The results show that boys are in a higher risk of using cannabis than girls (OR=2.1). In addition, students attending grade-level 2 (OR=1.54) and 3 (OR=1.50) have a higher probability to have used cannabis than students attending grade-level 1. Furthermore, students with a higher socioeconomic status are

more likely to use cannabis (OR=1.26), than students with a lower socioeconomic status. All associations in model 1 are statistically significant at the 1 % level.

Table 2. Results from multilevel logistic regression

	MODEL 0***	MODEL 1***		MODEL 2***	
		OR	95 % CI	OR	95 % CI
Individual level					
Boys		2.10***	1.83-2.42	2.03***	1.75-2.34
Grade-level 2		1.54**	1.19-1.98	1.48**	1.16-1.89
Grade-level 3		1.50**	1.15-1.95	1.48**	1.15-1.90
High SES		1.26**	1.09-1.45	1.13	0.97-1.31
School-class level					
Boys				1.05*	1.00-1.11
High SES				1.11***	1.06-1.16
ICC	13.7 %	12.0 %		10.9 %	
MOR	1.99	1.89		1.83	

Significant at the 5 %*, 1 %**, 0,1 %*** level. CI 95 %= 95 % confidence intervals for odds ratio.

To answer the research questions about whether the gender proportion and the socioeconomic composition in a school-class are influencing individual cannabis use, model 2 is assessed. Aggregated factors (gender and socioeconomic status at the school-class level) are included in model 2 and controlled for by individual level factors. School-class level factors are computed so that an increase in 10 percentage points of the proportion in the school-class will show the effects on the individual by odds ratio over and above the individual-level factor. The results show that an increase in 10 percentage points of boys in the school-class increase the risk of using cannabis by additionally 5 % over and above gender at the individual level (OR=1.05). The effect of being a boy also decreases at individual level. Consequently, the more male students there are in the school-class, the higher are the risk of using cannabis. Similarly, an increase by 10 percentage points in students with high

socioeconomic statuses in the school-class increases the risk of using cannabis by 11 % over and above socioeconomic status at the individual level (OR=1.11). Furthermore, having a higher socioeconomic status is not significant at the individual level in model 2, and the confidence interval crosses 1 (CI=0.97-1.31). The associations between cannabis use and a higher socioeconomic status at the school-class level, and male gender at the school-class level, are statistically significant at the 5 % level. The results indicate that both gender and socioeconomic status at the school-class level predicts cannabis use over and above their equivalent individual-level variables, whereby a greater proportion of students with a higher socioeconomic status seems to have a stronger effect on cannabis use, than the effect of being more male students in the school-class.

Discussion

The main aim of the study was to investigate to what extent the school-class influences cannabis use, and whether gender proportions and the socioeconomic composition of the school-class affect cannabis use. The main findings of this study are that the school-class influence cannabis use to a substantial degree, as the variance that may be attributed to the school-class level is noteworthy 13.7 %. Furthermore, findings show that a higher proportion of male students in the school-class increases the risk of using cannabis. In addition, a larger proportion of students with a higher socioeconomic status increases the risk of using cannabis. School-class effects predicted cannabis use over and above the individual effects, which also highlights the importance of the school-class context. There is not identified any other studies exploring the school-class effect on cannabis use in Norway, which is why findings of the current study contribute to a more comprehensive understanding of adolescent cannabis use. In the following sections, the results of the analyses will be discussed in Bronfenbrenner's (1979) social ecological framework.

Influences of the school-class and individual characteristics

In the mesosystem an influence of groups may be presented (Bronfenbrenner, 1979), and the results of this study indicate an impact of the school-class. The ICC and MOR presented in table 2 shows that the individual student's risk of using cannabis is associated to which school-class the student is assigned to, and that the school-class influences cannabis use to a notable degree. These results align with other Nordic literature on the subject (A. Johansen et al., 2006; Hakkarainen et al., 2015; Karlsson et al., 2018) were findings suggest that the school-class have an influence on cannabis use and risky health behaviours.

The exosystem represents an indirect environment and the setting in which the individual is not an active participant (Bronfenbrenner, 1979, pp. 23-25). The gender of classmates was found to influence cannabis use in this system. Whereas Karlsson et al. (2018) unexpectedly found that a higher proportion of female students was related to cannabis use, this study found that a larger proportion of boys in the school-class increases the risk of the student using cannabis. As earlier presented, cannabis use can be an expression of masculine norms, and women of higher social classes might be in a better position to challenge traditional gender roles (Hemsing & Greaves, 2020, p. 20). Thus, results of this study support findings by Hemsing and Greaves (2020, p. 20), as a more male-dominated environment with a larger proportion of students with higher socioeconomic status increase the risk of cannabis use. However, the individual's reaction to a male-dominant milieu may vary, and the interaction effect between gender and socioeconomic status on the use of cannabis is not addressed in this study and results only give rise to conjectures.

The results that a high socioeconomic status increase the risk of cannabis use align with those of Bakken and Pedersen (2016) who found that cannabis is more prevalent in the more affluent areas of Oslo City, and Pedersen et al. (2017) who show that a large proportion of fellow students with high socioeconomic status was associated to alcohol consumption. However, when school-class variables are added, high socioeconomic status at the individual level turns insignificant. This imply that socioeconomic status might not matter at the individual level when the student adheres to a school-class were a higher proportion of fellow students keep a high socioeconomic status. Thus, students with low socioeconomic statuses are equally exposed to the risk of using cannabis as students with high socioeconomic statuses, when attending a school-class with a larger proportion of students with high socioeconomic statuses. However, future studies should investigate whether the school-class effect is varying between students with low socioeconomic status and high socioeconomic status at the individual level.

Also, it is earlier presented that young people who come from families with high socioeconomic statuses are more likely to experiment with drugs and less likely to have a daily use of the drug compared to youth with lower socioeconomic statuses (Legleye et al., 2011, pp. 1520–1531). Findings by Bakken and Pedersen (2016) also suggest youth from more affluent districts develop a less harmful pattern of substance use than those from less affluent districts. Most adolescent substance use are restricted to experimental use (NOU, 2019, p. 75), however 17 % of those initiating cannabis use during adolescence are estimated

to develop a problematic usage (United Nations publication, 2019, booklet 2, p. 14). As both cannabis and alcohol are associated with high socioeconomic status in Oslo, this may imply an experimental culture among adolescents belonging to this group. Therefore, the results of this study can suggest a problem of social inequality in health, whereby adolescents with a higher socioeconomic status have tendencies to a more experimental relationship to cannabis, which may result in a more harmful use among their classmates with lower socioeconomic statuses. However, studies taking outset in Oslo to explore whether adolescents with a lower socioeconomic status are more susceptible to develop a more harmful pattern of substance use if they adhere to an environment with higher proportions of peers with high socioeconomic statuses are encouraged. In addition, a free school-choice model may stimulate segregation (Oslo Kommune, 2019; Serediak & Helland, 2020, pp. 6-8), and results of this study may imply segregation in schools are unfortunate for healthy development. Furthermore, previous research imply the variance in cannabis also applies to schools (Kristjansson et al., 2013; Pedersen et al., 2017), and further research is encouraged to explore whether the results of this study apply to the school level in Norway as well.

Lastly, in Bronfenbrenner's (1979) microsystem we find that immediate settings such as personal characteristics influence the use of cannabis. The results indicate that being a boy, a student in a higher grade-level, or a student with a higher socioeconomic status increase the risk of cannabis use.

To summarise, the social context at the school-class level is demonstrated to affect cannabis use. The adolescents have no possibilities to affect the factors shown to influence cannabis use in the meso- and macrosystem (school-class, and gender proportion and socioeconomic composition in the classroom). Several studies indicate that preventative programmes addressing the classroom and school environment are more effective than those targeting individual behaviour (Babor et al., 2010, pp. 104-114), and the results of this study support these findings, as both gender proportions and socioeconomic composition predicts cannabis use over and above the individual level. Thus, results suggest the meso- and exosystem are of greater importance when it comes to adolescent cannabis use, and that preventative measures could benefit from focusing upon these systems. In conclusion, preventative strategies targeting the school-class environment, especially focusing upon boys and students with higher socioeconomic status, are suggested.

The influence of Oslo city and the Norwegian setting

As earlier described, laws and culture are contextual factors presented as influencing the individual at the macrolevel, and the exosystem represents an indirect environment (Bronfenbrenner, 1979, pp. 23-25). Albeit, factors attributed to the influence of Oslo city and the Norwegian setting are not directly assessed in this article, and findings of this study do not allow for any conclusions at this level. However, the results give rise to some implications.

Although, cannabis is considered an illegal drug in Norway, 25 % of the students attending upper secondary school in Oslo report to have used cannabis. This implies that the law does not keep all adolescents from using cannabis, and that there is possibly a greater influence of the exo- and macrosystem. Moreover, the Norwegian government is moving towards a new approach as they want people with a substance use disorder to be met with care and respect instead of punishment (Regjeringen Helse- og omsorgsdepartementet, 2018). One can quickly assume policy changes as decriminalisation may contribute to a lower risk perspective and that the ongoing policy-debate may influence the adolescent in their attitudes towards illicit drugs. However, the press release by the Norwegian government (Regjeringen Helse- og omsorgsdepartementet, 2018) were announced after the data were collected. Moreover, the Norwegian Government Committee for the Drug Policy Reform state that it is rather doubtful a decriminalization of narcotics will influence individual attitudes (NOU, 2019, p. 261). Thus, one can assume that the influence of the cultural setting is of higher importance than the law itself (although, laws may also form norms). Moreover, the incline in the use of cannabis during the last years, and a higher prevalence of self-reported cannabis use in Oslo than in the rest of the country (Bakken, 2018a, p. 61; 2018b, pp. 102-103) adds weight to this argument, as the law has not changed. Nonetheless, access to cannabis may vary between different districts in Norway, and whether the effect applies to the exosystem (availability in Oslo) or macrosystem (culture and laws) is nor addressed or assessable in this study. However, to thoroughly investigate the influence by laws and policies, a comparative study investigating cannabis in the Norwegian setting and e.g. the Sweden setting before and after the policy change announced in Norway (Regjeringen Helse- og omsorgsdepartementet, 2018) is encouraged.

Furthermore, having a high socioeconomic status is not typically associated to cannabis use, and UNODC presents growing up in a marginalised and deprived community as a well-known risk factor for the initiation of drug use (United Nations publication, 2019, booklet 2, p. 13). Studies from Denmark and Iceland find no associations between family

affluence and cannabis use (A. Johansen et al., 2006; Kristjansson et al., 2013). Nonetheless, the results that a high socioeconomic status increase the risk of cannabis use align with other studies from Oslo (Bakken & Pedersen, 2016; Pedersen et al., 2017), which also imply an effect of the exo- and macrosystem. The importance of a cannabis culture is further supported by the findings of Pedersen et al. (2017) who conclude that schools accounted for some of the variance in alcohol through an aspect of youth culture. However, further research is suggested to examine the influence of culture on cannabis use among adolescents.

Finally, the contextual influence at all levels is assumed to differentiate between cities, and results from the multilevel logistic regression model will presumably therefore vary between settings. It is therefore reasonable to assume that the findings from this study may not be generalised outside of Oslo. Moreover, K. Johansen, Johansen, and Johannessen (2018, p. 22) emphasise knowledge-based measures should take outset in the local arena, and findings from this study support this. It is evaluated that Bronfenbrenner's (1979) social ecological perspective has provided a beneficial framework for structuring and conceptualising the study. In addition, the method applied allowed for an empirical demonstration of the social context's interactions and influences on individual behaviour, and to identify school-class level factors that can be addressed in preventative efforts.

Conclusion

The main aim of the study was to investigate whether the school-class, and gender proportions and the socioeconomic composition of the school-class, are influencing cannabis use among students attending upper secondary school in Oslo, Norway. First, the school-class is found to influence adolescent cannabis use to a significant degree. Next, a higher proportion of male students increases the risk of cannabis use. Last, a larger proportion of students with a higher socioeconomic status also, and in addition, increases the odds of adolescent's cannabis use. Thus, results of the analyses show that the school-class context does matter when it comes to adolescent cannabis use. Also, the findings support Bronfenbrenner's (1979) theory that the individual is influenced by different contexts at different levels.

First, in the microsystem, gender, grade-level, and socioeconomic status are associated to the use of cannabis. Being a boy in a higher grade-level with a higher socioeconomic status increases the odds of the student reporting to have used cannabis the last twelve months. The result that having a high socioeconomic status increases the risk of substance use is also found in other studies based on data from the *Young in Oslo* survey (Bakken & Pedersen, 2016;

Pedersen et al., 2017). Next, in the mesosystem the school-class is demonstrated to be of importance for cannabis use. School-class variance in cannabis use is found to be noteworthy, and a student almost doubles its probability of reporting to have used cannabis when moving from a low-risk school-class to a high-risk school-class. These results align with other Nordic literature on the field (A. Johansen et al., 2006; Hakkarainen et al., 2015; Karlsson et al., 2018). In the exosystem, the results show that being in a school-class with a larger proportion of boys and a larger proportion of students with higher socioeconomic statuses increase the risk of cannabis use at the individual level. In contrast, Karlsson et al. (2018) found a higher proportion of girls in the school-class were increasing the risk of individual cannabis use. Lastly, the results imply that some greater, however unassessed, influence of the cultural setting (the macrosystem) and the urban setting in Oslo (the exosystem).

By adopting Bronfenbrenner's (1979) social ecological framework factors at several levels of influence are identified. Thus, this study allows for a more substantial understanding of adolescent's cannabis use and to inform interventions at different levels. Factors at the school-class level are estimated to moderate individual factors, and to influence cannabis use over and above their equivalent individual level factor. Therefore, preventative strategies targeting the school-class level are presumably more effective than those targeting the individual level. Consequently, this study suggests that preventative efforts should address the school-class environment, primarily focusing upon boys and students with a higher socioeconomic status. Further research is suggested to investigate whether the results of this study apply to schools as well. Moreover, studies exploring more distal influences on adolescent cannabis use, i.e. urban setting, culture, and laws in Oslo and Norway, seem to be of importance from a social welfare and a health policy perspective.

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Appendix 1. ICC & MOR

Intraclass correlation coefficient (ICC) is calculated using the following formula,

$$\text{ICC} = \frac{\text{var}\left(u_{0j}\right)}{\text{var}\left(u_{0j}\right) + \text{var}\left(\pi^2 \,/\, 3\right)}$$

where U_{0j} represents the random intercept variance and estimates the between-cluster variation proportion of the total variation (Sommet & Morselli, 2017, p. 212), and can be expressed as the amount of dependency (Hox et.al., 2010, p. 14). Median odds ratio (MOR) represents variance on the log-odds scale and is calculated by

$$\text{MOR} = \exp\left(\sqrt{2\sigma_u^2}\,\Phi^{-1}\left(0.75\right)\right)$$

where $\phi^{-1}(\cdot)$ represents the inverse cumulative standard normal distribution function (Merlo, Wagner, Ghith, & Leckie, 2016, p. 7).