Urban landscapes of adolescent substance use

Willy Pedersen, Department of Sociology and Human Geography, University of Oslo,

P.O. Box 1096, Blindern 0317, Oslo, Norway; and Norwegian Social Research, Oslo and
Akershus University College of Applied Sciences
Phone ++ 47 90268644, Fax ++ 47 22855253, E-mail: willy.pedersen@sosgeo.uio.no

Anders Bakken
Norwegian Social Research, Oslo and Akershus University College of Applied Sciences,
Stensberggata 26, 0170 Oslo, Norway
Phone ++ 47 46502076, Email: anders.bakken@nova.hioa.no

Willy Pedersen is professor of Sociology at University of Oslo. He has been doing research
on crime, alcohol and substance use and social marginalization.

Anders Bakken is senior researcher at the Section for youth research at Norwegian Social
Research (NOVA), Oslo and Akershus University College of Applied Sciences. He has been
doing research regarding social inequality in school achievement and living conditions among
young people in Norway.

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Abstract

Cities are increasingly organized according to socio-spatial divisions in which groups with similar characteristics live in the same areas. This social polarization is associated with differences in living conditions, health, morbidity and mortality. Traditionally, 'areas of disadvantage' have also been associated with increased risk of harmful substance use. However, some recent studies suggest that 'areas of affluence' may socialize adolescents into high levels of alcohol consumption. Using a combination of city district-level socio-economic data and surveys of adolescents, we investigated patterns of substance use in different city districts of Oslo, Norway, with the aim to shed more light on these conflicting previous findings. We found that adolescents in the affluent parts of Oslo West reported the highest levels of recreational smoking, snus use and alcohol use. Those in the poorer Oslo Central East reported the highest levels of daily smoking, alcohol problems and cannabis use. After controlling for individual- and family-based risk factors, significant area differences remained, except with regard to alcohol problems and cannabis use. We conclude that adolescents living in affluent areas report the highest use of several psychoactive substances, but in a manner that is usually compatible with a rather health-oriented lifestyle. By contrast, those from socio-economically disadvantaged districts near the city centre use substances in a manner that may have greater potential for social marginalization, morbidity and mortality.

Introduction

Two decades ago, Douglas Massey characterized our times as 'an age of extremes', where poverty and affluence increasingly are concentrated in different geographic areas (Massey, 1996). Now, new evidence suggests that income inequalities have increased from the 1980s in advanced capitalist countries (Piketty, 2013). In Europe, these inequalities increasingly seem to cluster in urban space (Malmberg et al., 2013). It has been suggested that, as a result, the traditional social class divisions of cities may shift to broader socio-spatial divisions in which groups with similar education, income and lifestyle are living in the same neighbourhoods, and groups who do not share such characteristics live elsewhere (Kesteloot, 2005). To some degree, this social polarization reflects the increasing concentration of multinational corporations in large cities, with a group of highly competent and well-paid employees on the one hand, and many low-skilled workers on the other hand (Sassen, 1991). Another force behind socio-economic segregation is related to the decreasing role of the public and social housing sector, which has occurred all over Europe (Jones and Murie, 2006) and led those who remain in public housing to be increasingly poor and concentrated in disadvantaged areas of the cities (Manley et al., 2013). A third factor is increasing ethno-racial segregation, which often works in tandem with traditional socio-economically based segregation (Preteceille, 2011).

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This emerging pattern is important not least because numerous studies indicate that socio-economic areas characterized by inhabitants with low levels of education and income have high levels of illness and mortality, and that such associations remain significant after controlling for individual characteristics (Bosma et al., 2001, Winkleby and Cubbin, 2003). However, there seem to be exceptions to this general rule, as some areas display unexpected forms of 'area resilience' (Cairns-Nagi and Bambra, 2013, van Hooijdonk et al., 2007). Actually, few studies address living conditions and socio-cultural aspects of lifestyles in areas inhabited by those with middle and high levels of education and income (Sampson, 2011, Sampson et al., 2015), and some studies even suggest that adolescents in such areas may have specific risk factors for maladaptive outcomes (Luthar, 2003). Moreover, all psychosocial problems may not necessarily follow the typical pattern of a concentration in areas of disadvantage, and there is increasing evidence that this may be true for the use of psychoactive substances (Galea et al., 2007, Karriker-Jaffe, 2011, Karriker-Jaffe, 2013). Here we ask: To what degree does the use of such substances reflect the socio-economic characteristics of a certain area? May adolescents in areas of affluence be at risk for certain patterns of tobacco, alcohol and drug use? If such associations exist, do they reflect genuine neighbourhood differences over and above the characteristics of the individuals living there?

Two emerging traditions of area-based substance use studies

The majority of studies on the spatial dimensions of substance use have addressed what we can label the 'disadvantage hypothesis'. The main finding is that inhabitants of socio-economically disadvantaged areas have increased risks for daily smoking, heavy alcohol use and the use of hard illegal drugs (Blomgren et al., 2004, Cerda et al., 2010, Karriker-Jaffe, 2013, Martikainen et al., 2003). Theories of social marginalization and deprivation (for a summary, see Sampson, 2011) suggest that socio-economically poor areas may suffer from a lack of 'collective efficacy', poor policing and schools that fail to maintain social order. Other studies suggest that exposure to such stressors may lead to substance use as a stress-coping behaviour. Under such circumstances, users may easily lose control over their substance use and become dependent (Cooper et al., 1992). Disadvantaged areas, particularly those in the inner city, may also have other factors that increase substance abuse, such as numerous alcohol outlets and open illegal drug scenes (Bluthenthal et al., 2008).

A large number of studies have investigated the socio-geographical distribution of smoking habits, and a coherent picture has emerged in countries such as the UK (Duncan et al., 1999) and Sweden (Ohlander et al., 2006): A poor socio-economic environment is associated with individual-level smoking. People in socio-economically disadvantaged neighbourhoods also experience increased morbidity and mortality from smoking-related diseases (Diez Roux et al., 2003). However, although many researchers

have investigated area patterns of daily and nicotine-dependent smoking, no one has

highlighted the distribution of non-daily or recreational smoking. There are also no

published studies on the association between neighbourhoods and the use of snus (low-

nitrosamine smokeless tobacco), which has become prevalent in Nordic countries

during the past couple of decades (Lund and McNeill, 2013). These two latter patterns

of nicotine intake account for an increasing share of the total (author citation removed).

Most studies also point to more alcohol problems and heavier drinking in

disadvantaged areas (Cerda et al., 2010, Stimpson et al., 2007). Inhabitants of such areas

tend to drink beverages with higher alcohol content (Jones-Webb and Karriker-Jaffe,

2013), which may be a factor behind the higher alcohol-related mortality rate in these

areas (Conolly et al., 2010). However, an early study from a Midwestern US sample

revealed that adolescents from high socio-economic areas reported the highest levels of

alcohol use (Ennett et al., 1997). Another US study showed that adolescents in high

income areas had the greatest likelihood of alcohol use (Song et al., 2009). A third study,

from New York, revealed that living in a high median income neighbourhood was

associated with the highest frequency of drinking (Galea et al., 2007). A Dutch study in

a similar vein reported that use of alcohol was less prevalent in poor neighbourhoods.

However, this finding was largely explained by the inhabitants' backgrounds from

Muslim countries, such as Turkey and Morocco (Kuipers et al., 2013). Generally, this

latter group of studies suggests that some areas of affluence seem to have a greater

prevalence of alcohol users and sometimes a higher consumption level, whereas they do

not report higher levels of alcohol problems or alcohol-related mortality.

Results are mixed among the few studies of neighbourhoods and the use of

cannabis. A study from New York revealed that inhabitants of high income

neighbourhoods reported the highest level of cannabis use (Galea et al., 2007). However,

another US study, using national data, found that marijuana initiation was more likely in

neighbourhoods with high unemployment (Tucker et al., 2013). A third US study

showed that adolescents' *perception* of a high level of disorder in their neighbourhood

was associated with cannabis initiation (Wilson et al., 2005).

Why should those living in affluent areas have certain patterns of increased

substance use? Sociologists Matza and Sykes (1961) coined the term 'subterranean

values' for juvenile delinquents who seek out excitement. However, when they analysed

their data in more detail, they found that similar experiences (albeit with more control)

were valued in more conventional groups as well. Expanding on this framework, Lyng

(1990) also found that sensation-seeking and risk-taking are typically valued and exist

side-by-side with security values in conventional society, but only when this 'edgework'

is controlled. This line of research may be relevant in our context: One may hypothesize

that adolescents in areas with different socio-economic compositions all use substances

(reflecting a need for excitement, for example), but that substance use patterns

associated with greater health risks and little individual control may be most prevalent

in 'areas of disadvantage'. People in 'areas of affluence' may display the opposite pattern, and there is some evidence that subterranean values in such groups may be linked to an awareness of the potential costs as well as the benefits associated with the use of psychoactive substances, which could lead to a tendency to avoid more harmful substances and emphasize moderation (Shiner and Winstock, 2015). In this study, we will investigate such questions in more detail.

Our social context: Oslo

The data for this study come from Norway's capital, Oslo, which has 650,000 inhabitants. Oslo has one of the most rapid rates of population growth in Europe and a tight housing market (Brattbakk and Wessel, 2013). Norway is a Nordic-type welfare state, similar to Sweden, Finland and Denmark (Esping-Andersen, 1990). This group of countries is typically seen as having small socio-economic inequalities (Fritzell and Lundberg, 2005) and small health inequalities (Richter et al., 2012). However, recent research has presented a more nuanced picture and documented that there are also some differences between the capitals Stockholm and Oslo, for example, with the housing sector in Oslo being more market-based than in Stockholm (Wessel, 2015). Another disturbing aspect of the Nordic region is the lack of spatial integration of the increasing proportion of non-Western immigrants. Oslo has high levels of immigration, but a majority of the inhabitants with immigrant backgrounds are concentrated in some of the

eastern city districts, and in three of these districts the proportion of immigrants is now more than 50% (Wiggen et al., 2015). Welfare generosity may be assumed to reduce the speed of spatial integration (Arbaci, 2007). This seems to be the case in Oslo, where the spatial integration of immigrants proceeds at an extremely slow pace (Wessel et al., 2015). Nevertheless, in a recent comparison between different European cities, and contrary to expectations, Oslo was found to be less socio-economically segregated than Stockholm. In fact, Oslo was ranked among the least segregated of the European cities studied (Tammaru et al., 2015). However, a number of other studies have provided evidence that Oslo's residential pattern *is* highly class structured, with upper-class residents increasingly concentrated in the west of the city and those in the working class in the central eastern, eastern and southern parts of the city (Ljunggren and Andersen, 2015). Thus, previous studies provide a rather mixed picture regarding the degree of socio-economic segregation in Oslo.

The aims of this study were to:

1. Investigate possible differences in: (i) daily and (ii) non-daily smoking; (iii) use of snus; (iv) alcohol consumption; (v) alcohol problems and (vi) use of cannabis among adolescents in different areas of Oslo that are characterized by varying levels of affluence, ethnic composition and social problems.

2. Determine the extent to which possible differences between areas remain significant after controlling for respondent and family characteristics.

Methods

City districts in Oslo

Studies of the importance of neighbourhoods in the substance use context have typically

used a single or a very few socio-economic indicators (Karriker-Jaffe, 2011). However,

there is increasing evidence that a number of neighbourhood dimensions may be

important for health and risk behaviours. Income, education and unemployment are the

variables most often assessed (Kim et al., 2010, Roux et al., 2001). Other dimensions of

importance may be the proportion of single parent households and measures of illness

and mortality (Halonen et al., 2012, Pickett and Pearl, 2001).

Oslo has 15 city districts, and in the present study we collected register-based

information from the municipality of Oslo in seven domains: (i) median income, (ii)

proportion in paid work, (iii) proportion with primary school as their highest education

level, (iv) proportion unemployed, (v) proportion of single parent households, (vi)

proportion who are immigrants, and (vii) death rate. These seven indicators of the

district-level socio-economic index (DLSI) were selected to represent the socio-

economic position of the age group that typically would be parents of the adolescents

included in the study sample. Factor analyses with direct quartimin rotation showed that

all of the indicators loaded strongly on one factor (all factor loadings > .40). Moreover,

the correlations between the indicators were high and consistent (mean Pearson's r =

0.79, Cronbach's Alpha = 0.95). All of the sociodemographic data for the city districts were transformed into standardized scores, and the DLSI was constructed as an average of Z-scores across all items, ranging from –1.08 to +1.31.

Participants and procedure

Individual-level data were taken from the 'Young in Oslo' study (Øia, 2012). In 2012, public and private schools with students in grades 9–11 were invited to participate in an anonymous study. Parents were informed in advance and both they and the students could choose whether the student would participate. The response rate was 72% and attrition analyses revealed that the sample was representative of immigrant status, sex and age. The sample makes up 65% of the Oslo population in these three age cohorts. An electronic questionnaire was administered during a school lesson under the supervision of teachers. Because substance use was not prevalent among ninth graders, the analyses reported here only include 6,508 tenth and eleventh graders (age 15–17 years; 49.5% boys, 50.5% girls). Because the participants were assured anonymity, no information on which schools they attended was collected.

Parental characteristics. To measure socio-economic background, we asked about parental education, parental employment and the family's income during the past two years (on a 5-point scale from 'We have been well-off all the time' to 'We have had poor means all the time'). There is some evidence that so-called 'cultural capital' may

be associated with substance use (Lunnay et al., 2011), and thus we included a measure

of how many books respondents had in their homes (on a 6-point scale from 0 to 1000+).

Based on the average scores of these four variables, we constructed a single socio-

economic score and each respondent was placed in a ranked decile (1–10). We know

that non-Western immigrants in Norway have a low level of alcohol consumption

(Amundsen, 2012); thus, we asked whether the parents had immigrated to Norway.

Because parents' alcohol consumption may have an impact on their offspring (author

citation removed), we also asked about the mother's and the father's use of alcohol (on

a 5-point scale from 'Never' to 'Daily'). Based on Olweus (1989), we measured

parental monitoring by asking the adolescents whether their parents usually know where

they are during leisure time, with whom they spend time and whether their parents

know their friends' parents. A mean score was constructed based on a 4-point scale (0–3)

for each item ranging from 'fits very well' to 'does not fit very well'.

    Tobacco. We asked, 'Do you smoke?' The response options 'Less than once a

week' and 'Smoke each week, but not daily' were categorized as non-daily smoking.

We also asked about 'daily smoking'. Use of snus was assessed similarly, and here

'regular snus use' includes those who reported using the substance weekly or daily.

    Alcohol. To measure the frequency of alcohol consumption, we asked, 'Do you

drink any form of alcohol?' Response options were: 'Never; have only tasted it a few

times'; 'Sometimes, but not as often as monthly'; 'Quite regularly, around 1–3 times a

month'; and 'Use alcohol each week'. Answers were dichotomized, with the last two categories classified as 'alcohol users'. We measured alcohol problems with a shortened version of the Rutgers Alcohol Problem Index (RAPI) (White and Labouvie, 1989), which covers a number of potential problems related to the use of alcohol and is particularly suited to adolescents. We used these items: 'Suddenly found yourself in a place that you could not remember getting to'; 'Missed a day of school'; 'Had a sad period'; 'Got into a fight, acted bad or did mean things'; and 'Was told by a friend or neighbour to stop or cut down drinking'. The response scale for these items ranged from 0 (never) to 4 (more than 10 times). A RAPI score was constructed by computing the average of the five items, and those respondents with a score of 1.0 or higher on the index were categorized as having an alcohol problem. For the analyses of alcohol problems, we restricted the sample to those who used alcohol at least 'quite regularly', as only they were considered at risk for such problems.

Cannabis. We asked about cannabis use during the previous 12 months on a 5-point scale and dichotomized the answers as no/yes.

Other factors. School grades may predict substance use (Barnes and Welte, 1986), and we asked about school grades in the following subjects: Norwegian, mathematics and English (average grade points, scale 1–6). Religious involvement is also associated with substance use (Borynski, 2003). We asked about religious

affiliation, including 'Islam' as one option, and we also asked whether participants

believed in God, with values 0–3 (see: Cotton, 2010).

Table 1 shows descriptive statistics for all of the variables included in the

analyses. Due to the relatively large sample size, the significance level was set at $p <$

0.01. Most correlations were statistically significant and thus relevant to include in the

multivariate models.

Statistical analyses

To get an overall picture of the socio-geographical pattern of substance use, we first

present the prevalence of substance use for each of the 15 city districts. We compared

each district with the rest of the city using Chi-square tests. To examine the association

between substance use and the DLSI, we conducted a stepwise series of multi-level

logistic regression analyses using the XTLOGIT model (random intercepts only) in

Stata (version 13.1). In the first model, we only included the DLSI variable. In the

second model, we included all individual and family background variables to examine

whether these explain the differences between the areas. When comparing the two

models, the OR- or B-coefficients in logistic regression can be problematic to interpret,

because they can reflect the degree of unobserved heterogeneity in the models (Mood,

2010). One way to overcome this problem is to rescale the results of the XTLOGIT

model to the same scale as those in the intercept-only model, using the 'meresc'

command in Stata (see: Hox, 2010, Chapter 6.5). For snus use, alcohol use, alcohol

problems and cannabis use, we used ordinary binomial logistic regression. For smoking,

we first conducted a logistic regression by coding daily smokers 1 and all others 0.

Second, we compared non-daily smokers with non-smokers (thereby excluding a small

group of daily smokers).

Results

Table 2 shows the prevalence of substance use and alcohol problems among drinkers for

each of the 15 city districts. All areas were sorted according to their aggregated socio-

economic level (DLSI scores) and marked with their geographical location in the city

(according to the inner–outer and eastern–western dimensions). The table shows a great

deal of variation in the index, with the eastern–western dimension accounting for much

of it. For example, all of the western areas are well above the mean on the socio-

economic index, and most of the outer eastern districts are well below mean. Three out

of four inner eastern city districts are also well below the mean. These latter districts

have many pubs and bars, as well as one of the largest cannabis distribution scenes in

Scandinavia, and some of these areas have a high level of alcohol-related violence

(Rossow and Norstrom, 2012). To visualize the socio-spatial divisions of Oslo, we

present the DLSI scores on a map of Oslo in Figure 1. Darker grey denotes poorer

socio-economic conditions, and we observe that some of the central eastern, eastern and southern districts have the lowest DLSI scores.

From Table 2 we see that the districts with the highest share of daily smokers are located in the least affluent parts of the city, whereas recreational smoking, snus use and alcohol use in particular are more prevalent in the most affluent city districts. Cannabis use is more prevalent in the affluent western districts as well compared with the poorest eastern districts, but here the distinction between the inner and outer districts is more pronounced than that along the east–west distinction, with more cannabis use in inner city districts. Alcohol problems are most prevalent in some of the eastern districts, but only two districts showed statistically significantly higher problems than the rest of the city; both of these districts are among the least affluent eastern districts. The district with the lowest level of alcohol problems is in the most affluent western part of Oslo.

In Table 3 we study these patterns more systematically; we present the results from the logistic regression models, which have substance uses as the dependent variables. For the Model 1 substance use models, only the DLSI was included as a continuous variable. For the Model 2 substance use models, we also controlled for family and individual variables that may help explain the district-level differences. The results from Model 1 partly confirm the findings in Table 1. Except for cannabis use, there are clear relationships between the aggregated socio-economic status of the city districts and all of the indicators of substance use. Although daily smoking and alcohol

problems are negatively related, non-daily smoking, regular snus use and alcohol use are positively related.

Comparing Models 1 and 2, we observe that the relationship between substance use and the DLSI are weaker after controlling for individual background variables. Nevertheless, there are still significant relationships between DLSI and four of the six substance use variables.

Daily smoking was least prevalent in the more affluent parts of the city. Comparing Models 1 and 2, we see that around half of these area differences were explained by the background variables. For non-daily smoking, we observed the opposite pattern, with the highest level occurring in the most affluent areas. After control, a significant association between DLSI and non-daily smoking remained, and the family and individual variables only explained one third of the bivariate association. We observed a similar pattern for snus use.

With regard to regular alcohol use, we note that the differences between city districts were halved after control. Nevertheless, a significant association remains between the DLSI score and the use of alcohol. Finally, with regard to alcohol problems and cannabis use, no area differences remained after controlling for family and individual characteristics.[1]

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[1] Because the number of level-two units is relatively low, we performed additional analyses to check for the robustness of the results. Following suggestions from CAMERON, A. & TRIVEDI, P. 2010. *Microeconometrics using Stata,* College Station, Texas, Stata Press., we estimated bootstrap errors using

A more detailed inspection of the results revealed that a number of family and individual factors played a role in the different models. Specifically, parental alcohol use and parental monitoring had large impacts in all of the models. There was a negative association between immigrant background and snus and alcohol use; variables related to religion seem to play a role for alcohol and cannabis use; and the variable grade points were significant in all models.

Discussion

Substance use among adolescents in Oslo follows distinct socio-geographic patterns. Adolescents from the affluent western areas reported the most recreational smoking, snus use and the highest frequency of alcohol consumption. Those from the urban central-eastern areas with low socio-economic index scores and proximity to the city centre reported the highest prevalence of daily smoking, alcohol problems and (though less pronounced) cannabis use. Those in the outer eastern suburban districts with low socio-economic index scores and a high proportion of immigrants reported mid- to low-level use of all substances. Thus, the critical issue here does not seem to be disadvantaged areas *per se*; rather, it seems as if the combination of social disadvantage and proximity to the city centre may constitute a risk factor for the most harmful patterns of substance use.

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400 replications. Basically, we obtained the same results, but for daily smoking the z-values for the DLSI were slightly changed (from to $z = -2.35$ to $z = -1.82$).

In his landmark study 'The age of extremes', Douglas Massey (1996) argued that in the social ecology that was being created around the globe, the worlds of the rich and the poor increasingly would diverge. He concluded that, 'the advantages and disadvantages of one's class position in society will be compounded and reinforced by a systematic process of geographic concentration' (p. 409). Our study points to some aspects of this process that have not been much emphasized, namely that both the pleasures and the health-damaging costs associated with the use of psychoactive substances seem to cluster in space in a manner that is structured by social class as well as more subtle socio-economic dimensions. One should note that Oslo, the city where this study was conducted, increasingly is becoming a multi-cultural city, as there have been large waves of immigration over the past couple of decades. This trend, combined with the globalization of culture and travel, could have pointed in another direction, such as the possible 'placelessness' of new generations of adolescents, or the declining importance of traditional forms of community. Our findings point in the opposite direction, towards the idea that the social lives of teenagers may largely be shaped by local communities, which would suggest the importance of 'identities of place', even in a world of globalization, technological change and urbanization (see also: Sampson, 2013: 2-3).

A handful of previous studies, mainly from the US, point to higher alcohol use in some affluent areas, and our results echo these findings. We have not found previous

studies of area differences in recreational smoking and the use of snus. Thus, our study

extends the research on such affluence-related patterns of substance use. The larger

rates of daily smoking and alcohol problems in the central eastern areas of Oslo are

consistent with a more well-established line of findings. Generally, inhabitants of

disadvantaged areas report more harmful substance use than others. After controlling for

family and individual backgrounds, daily smoking data still indicated area-based

influences. However, for alcohol problems, family and individual risk factors acted as

confounding variables for the observed area-based differences.

The design of the present study does not allow us to identify causal mechanisms

for the observed area differences. However, Galster (2012) recently described a number

of potential mechanisms. In particular, those he labelled 'social-interactive mechanisms'

may be pertinent to our findings. Behaviours and attitudes may be influenced through

the social contagion of contact with peers (see also: Chuang et al., 2005). Over time,

individuals may be encouraged by local role models to conform to area-specific norms

and rituals. Particularly in the affluent western areas, such influences may be important

for alcohol consumption, recreational smoking and snus use. In some of the eastern

inner-city districts, daily smoking may spread in this manner. Previous studies have

revealed that alcohol outlets and open illegal drug markets may also play a role in the

development of alcohol problems and illegal substance use in disadvantaged areas

(Bernstein et al., 2007). The central eastern parts of Oslo have a number of these

characteristics. However, after controlling for family and individual risk factors, our data show no area effects associated with alcohol problems and cannabis use.

This study has several strengths. We had at our disposal almost two complete cohorts of adolescents in Oslo. We had access to socio-demographic data at the city district level, in addition to a variety of individual-level data regarding parental background and individual characteristics. This study also has limitations. Even though the city districts show a clear pattern of socio-demographic differences, they were created for administrative purposes and do not necessarily reflect integrated local networks and processes of social contact. Moreover, some districts are rather heterogeneous with regard to socio-economic composition, dwellings, school enrolment and types of youth organizations. Thus, we may have underestimated the true level of social area influences that occur in smaller and more homogeneous city districts. On the other hand, even if we had access to a large number of family- and individual-level control variables, we obviously do not have data regarding *all* such factors that may influence adolescents' substance use. This may have led us to overestimate the importance of area associations.

Another potential methodological problem concerns the issue of spatial dependence, such that young people living in one area might be influenced by the

substance use patterns in neighbouring city districts.[2] Note as well that, in addition to

the geographical area in question, adolescents' school peers may influence their

substance use (Bonell et al., 2013). Unfortunately, we did not have information about

which schools the adolescents in this study attended (to preserve their anonymity). This

is a limitation, and the statistical effects we attributed to neighbourhoods and

geographical areas may have been reduced if we had information about school context.

Subsequent studies should investigate the importance of spatial dependence and school

contexts as well as area context.

Substance use in areas of affluence

Why do we find this increased use of certain substances in affluent areas? Previous

research shows that residents in such areas typically embrace health-related lifestyles

(Cockerham et al., 1997, Karriker-Jaffe, 2013). One explanation may be that the

patterns of substance use observed in Oslo West are perceived as compatible with the

values and accepted behaviours in such 'subcultures of health'. In fact, several

researchers suggest that non-daily or recreational smoking seems to be associated with

limited health risk (Schane et al., 2010), which is not true for daily smoking. This may

be one reason why recreational and daily smoking display opposite area patterns in our

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[2] We performed additional analyses to measure whether the residuals in our logistic models were spatially autocorrelated. Using the mean residuals for each city district, we estimated Moran's I and found non-significant results for four of the six dependent variables. Although this might imply a problem with spatial dependence, it is still not clear how it affects our analysis.

study. Adolescents in affluent Oslo West clearly had the highest levels of recreational smoking, whereas there were few daily smokers in this wealthy part of the city. The socio-cultural contours of recreational smokers seem to be associated with rather high education and high income (Hassmiller, 2003, Husten, 1998). A previous Norwegian study even placed recreational smoking in a symbolic landscape of social and cultural resources and 'hipster-hipness' (see author citation removed). In our study, there were no associations between parental socio-economic status and recreational smoking, whereas adolescents of parents with low socio-economic status had a greater risk of daily smoking. Thus, recreational smoking seems to lack the socio-economic dimensions of daily smoking.

Snus use was clearly most prevalent in the more affluent districts. Whereas daily smoking is rapidly decreasing in Norway, use of snus has increased at approximately the same rate (see: author citation removed). A recent study suggested that snus users are characterized by a more middle-class-oriented lifestyle than are smokers (Sæbø, 2013). In a study investigating smokers' and snus users' perceptions of their own tobacco use, smokers reported more social disapproval of their habit than did snus users (Lund et al., 2014). Our findings suggest that, as with recreational smoking, snus use seems to be situated in a social landscape where the inhabitants generally endorse health-compatible behaviours, and there is little doubt that snus use is far less dangerous than daily smoking (Levy et al., 2004). There is also an increased use of snus among

students in elite sport high schools in Norway (Martinsen and Sundgot-Borgen, 2014),

which may strengthen the positive subcultural connotations of snus use (Kahma, 2012).

However, the most striking dimension of substance use in the affluent parts of

Oslo was the high level of alcohol consumption. After controlling for background

variables, we found large area differences. We also found a strong positive association

with parental socio-economic status. This may be because adolescents often perceive

the 'ordinary' use of alcohol to have limited risks, especially among those who report

high levels of self-esteem (see also: Hampson et al., 2001). This finding should be

interpreted in the context of the socio-demographic patterns of alcohol use in Norway.

First, the most highly educated people clearly drink the most (Nordfjærn and Brunborg,

2015). Parents who live in Oslo West are probably among the most highly educated

people and among the heaviest drinkers in the nation. We also found a strong

association between adolescent and parental alcohol use (Table 2), indicating that

adolescents mimic their parents' alcohol use. In addition, we could hypothesize that

parental norms (Wood et al., 2004) and ease of access to alcohol in the parental home

(Gilligan et al., 2012) vary between different socio-economic areas. Note also that new

work by Norwegian researchers (Magnus et al., 2011) on the possible protective

cardiovascular effects of alcohol has received much attention in the media, not least

among those who are generally well informed about new research results. All of these

factors may have contributed to the positive image of alcohol. In this respect, alcohol

plays the opposite role to daily smoking, as the latter is uniformly condemned because of its great health risks. Purchasing power may be a final factor affecting the higher level of alcohol use in Oslo West, as adolescents in these neighbourhoods are typically from higher socio-economic backgrounds and thus may be better able to afford alcohol, which is expensive in Norway (Galea et al., 2007, Rossow, 2010).

One possible explanation for the discrepancy between the higher frequency of drinking in Oslo West and the higher level of alcohol problems in some of the eastern districts could be that, although the adolescents in Oslo West drink more frequently, they consume smaller amounts when they drink. Unfortunately, we have no information in this study about the amount of alcohol the adolescents typically consume when they drink. However, we did collect information about how frequently they became intoxicated, and those data show a slightly higher frequency of such episodes among the adolescents in the affluent west relative to adolescents in the other areas. This might indicate that it is not only the *amount* of alcohol consumed that accounts for the divergent patterns in alcohol problems across areas that are reported here.

A pattern of substance use with some similarities to that observed in the affluent areas of Oslo has been described as 'pick 'n' mix' by UK researchers. Adolescents from the middle and upper classes pragmatically combine alcohol with a variety of other psychoactive substances with the goal of becoming intoxicated but remaining in control (Parker and Measham, 1994). As previously mentioned, Lyng's (1990) framework takes

a similar perspective, suggesting that people value risk-taking (including experiences associated with psychoactive substances) along with security values in conventional society, but only when this 'edgework' is controlled. Despite such framing of substance use in areas of affluence, there are obviously social and health risks here as well. At the population level, these 'wet' environments may have a number of adverse consequences (Rossow and Romelsjo, 2006). For example, Norway belongs to 'the binge drinking belt of Europe', where the use of alcohol is more likely to be related to violence and aggression than in the Mediterranean countries (Bye and Rossow, 2010). In addition, per capita alcohol consumption is correlated strongly with homicides in the Nordic countries (Graham, 2011).

The main impression from our own findings is that adolescents in more affluent areas of Oslo typically develop patterns of substance use that they are able to frame and symbolize as less harmful compared with what we observe in the eastern inner-city areas. Indeed, adolescents in affluent areas use many psychoactive substances, but typically in a manner that is not particularly unhealthy. Moreover, the normative pattern of such substance use seems to imply competent handling of the kind of 'edgework' described above. The fact that adolescents in affluent areas have a high level of alcohol consumption but a rather low level of alcohol problems indicates that they are often able to handle such complex expectations fairly well.

Substance use in disadvantaged inner-city areas

The substance use patterns in some of the eastern inner-city districts are characterized by daily smoking and a large number of alcohol problems. After controlling for family and individual variables, we found that area socio-economic disadvantage was still associated with an increased rate of daily smoking. In addition, higher daily smoking rates were associated with low parental socio-economic status. A large body of studies indicate that neighbourhood effects are important with respect to daily smoking (Duncan et al., 1999, Ohlander et al., 2006). Thus, our findings echo previous studies, suggesting that daily smoking is a marker of low social class. Area and individual risk factors both seem to play a role in this picture. The other distinguishing characteristic of inner-city Oslo East was the high level of alcohol problems among those who use alcohol, but this association disappeared when the control variables were included. Hence, we suggest that family and individual risk factors are more important than neighbourhood influences for the development of alcohol problems among adolescents. Previous studies suggest that heavy alcohol consumption and alcohol problems seem to be more prevalent among groups low on the socio-economic ladder (Huckle et al., 2010, Kuntsche et al., 2004). Alcohol-related illness and mortality are also highest in these groups (Harrison and Gardiner, 1999, Hemstrom, 2002, Mäkelä, 1999). However, our data indicate that parental socio-economic status does not play an independent role in predicting alcohol problems among adolescents in Oslo.

With the exception of daily smoking, our data suggest that low parental socio-economic status plays a limited role with regard to adolescents' substance use. Regarding other variables, we note that poor school grades were robust predictors of all types of substance use. This may indicate that other aspects of parental socio-economic status are mediated through school grades (Hassandra et al., 2011). However, school grades and choice of educational track may be early indicators of adolescents' future social class. This is consistent with studies suggesting that the importance of parental social class is gradually declining as a predictor of substance use patterns, whereas markers of the adolescents' own future social class are gradually increasing in importance (Casswell et al., 2003).

After controlling for background variables, there were no associations between neighbourhood area and cannabis use. However, with respect to cannabis use, we see that poor school grades, poor parental monitoring and high level of parental alcohol use play a role. Based on studies from the UK, patterns of cannabis use have been conceptualized as 'normalized', implying that ordinary middle-class youth have become users (Measham et al., 1994). However, these studies have also been questioned (Measham and Shiner, 2009, Sandberg, 2012). Previous Norwegian studies suggest that there are small socio-economic differences between adolescent cannabis users and other adolescents, whereas cannabis users in their late 20s are more frequently recruited from the social margins of society (see: author citation removed). A study from France

suggests that adolescents from high socio-economic backgrounds are at risk for cannabis initiation, but less prone to daily use (Legleye et al., 2011). Our data also confirm that it seems difficult to draw firm conclusions about the importance of geographic area and socio-economic background for the use of cannabis among ordinary adolescents.

Conclusions

Substance use among adolescents in Oslo exists in a social and symbolic landscape with a distinct socio-demographic profile. Health- and social-risk perceptions, especially in areas of affluence, may be a key to the findings in our study. Indeed, adolescents in the affluent western districts use a variety of psychoactive substances, but much of this use has limited risks. In disadvantaged areas, we see the opposite pattern. Tobacco is the key example: it remains the leading preventable risk factor for disease and death in Western Europe (Lim et al., 2012). Thus, the high level of daily smoking in the eastern areas and the fact that this seems to reflect both neighbourhood- and family-based influences is the clearest sign of how those in disadvantaged areas are still socialized into substance use patterns with poor health outcomes.

Even though Norway is a welfare state with low inequality, our study provides additional support to previous research showing that, for centuries, Oslo has been a city divided between the prosperous west and the poorer east (Andersen, 2014). Moreover,

there is a great coherence between this spatial structure and the distribution of

advantage and disadvantage regarding income, employment, welfare assistance, health

and illness, and the living conditions for adolescents (Ljungren and Toft, 2014). The

findings reported in this study provide additional evidence for such a conclusion.

Politically, our findings may suggest that a complex prevention strategy may be

necessary: On the one hand, one should obviously target the high level of alcohol use

and the use of recreational tobacco products in the wealthy western areas. At the same

time, it seems wise to address those family- and individual risk factors that predispose

for the development of e.g. alcohol problems and nicotine dependence in the poorer

eastern areas of the city.

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Table 1. Descriptive statistics and correlations between substance use and the district-level socio-economic index (DLSI).

	Mean	SD	Daily smoker	Non–daily smoker	Regular snus user	Regular alcohol user	Alcohol problems among drinkers	Cannabis user	DLSI
						Correlations			
Gender (girl=1)	.50	.50	–.01 NS	–.02 NS	–.09 *	.01 NS	–.03 NS	–.08 *	.00 NS
School grade (11th grade=1)	.50	.50	.08 *	.10 *	.10 *	.19 *	.01 NS	.10 *	.02 NS
Immigrant background (yes=1)	.31	.46	.05 *	–.12 *	–.13 *	–.25 *	.09 *	–.08 *	–.46 *
Religious affiliation (Islam=1)	.17	.38	.03 NS	–.10 *	–.09 *	–.20 *	.13 *	–.09 *	–.34 *
Religious belief in God (0–3)	1.58	1.23	.01 NS	–.10 *	–.09 *	–.18 *	.02 NS	–.11 *	–.26 *
Socio-economic background (1–10)	5.52	2.90	–.09 *	.08 *	.05 *	.22 *	–.10 *	.02 NS	.45 *
Grade points (1–6)	3.88	.86	–.10 *	–.03 NS	–.09 *	.05 *	–.13 *	–.04 *	.21 *
Parental monitoring (0–3)	2.12	.62	–.11 *	–.10 *	–.06 *	–.08 *	–.20 *	–.14 *	.07 *
Parental use of alcohol (0–4)	1.23	.99	.02 NS	.14 *	.12 *	.24 *	.01 NS	.11 *	.34 *
N =			6.330	6.151	6.321	6.338	1.428	6.380	

Note: NS = non-significant (p>0.01). * p < 0.01.

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Table 2. District-level socio-economic index (DLSI) and per cent of substance use in Oslo areas.

Geog. area	City districts	DLSI	Substance use (%)						
			Daily smoker	Non-daily smoker	Regular snus user	Regular alcohol user	Alcohol problems#	Cannabis user	N =
Central east	Gamle Oslo	−1.08	5.1 *	11.1	8.3 *	12.7 ***	39.4 **	9.9	280 [33]
Outer east	Grorud	−0.76	2.1	7.6 ***	7.5 ***	11.9 ***	16.4	6.4 **	451 [55]
Outer east	Alna	−0.68	4.5 *	9.3 ***	9.3 **	9.1 ***	33.3 *	7.9	544 [54]
Outer east	Stovner	−0.66	3.9	7.8 ***	9.3 **	7.8 ***	23.7	7.5 *	531 [38]
Central east	Grünerløkka	−0.63	6.8 **	18.1	12.6	19.9	27.0	12.6	196 [37]
Outer east	Søndre Nordstrand	−0.59	3.4	10.8 **	7.9 ***	10.9 ***	28.1	8.9	619 [64]
Outer east	Bjerke	−0.54	2.5	10.4 *	8.2 **	12.6 ***	21.7	7.5	368 [46]
Central east	Sagene	−0.48	5.5	15.8	11.9	14.2 **	15.8	19.4 **	133 [19]
Central east	St. Hanshaugen	0.03	6.3 *	17.3	17.3	33.6 **	17.1	20.0 **	113 [35]
Outer east	Østensjø	0.33	2.4	9.4 ***	18.0	18.7 **	18.9	7.3 **	451 [106]
Central west	Frogner	0.40	2.5	24.8 ***	21.5 ***	40.1 ***	13.7	19.2 ***	242 [95]
Outer west	Nordstrand	0.93	1.3 **	18.5 **	15.5	30.2 ***	14.0	8.6	634 [186]
Outer west	Ullern	1.17	2.7	20.4 ***	20.4 ***	45.9 ***	19.2	13.9 *	376 [167]
Outer west	Nordre Aker	1.25	1.5 *	18.0 **	14.5	28.8 ***	11.9 *	9.6	625 [176]
Outer west	Vestre Aker	1.31	1.1 ***	21.7 ***	19.6 ***	41.1 ***	19.4	13.7 **	800 [317]
	Total	0.16	2.8	14.5	13.0	22.7	18.8	10.2	6508 [1428]

Among those who use alcohol regularly (the number of respondents is presented in brackets in the last column).

Significance tests comparing each district against all others (Chi-square test): * p < 0.05, ** p < 0.01, *** p < 0.001.

Table 3. Results from multilevel logistic regression analysis predicting use of substances. rescaled logistic regression coefficients.

	Daily smoking			Non-daily smoking			Regular snus use			Regular alcohol use			Alcohol problems among drinkers			Cannabis use		
	b	SE b	p	b	SE b	p	b	SE b	p	b	SE b	p	b	SE b	p	b	SE b	p
Model 1																		
City district-level socio-economic index (DLSI)	−.500	.105	***	.395	.095	***	.418	.066	***	.786	.121	***	−.315	.100	**	.149	.123	NS
Model 2																		
City district-level socio-economic index (DLSI)	−.259	.110	*	.234	.076	**	.272	.052	***	.421	.085	***	−.132	.102	NS	.031	.103	NS
Gender (girl=1)	.132	.148	NS	.018	.075	NS	−.406	.077	***	.169	.062	**	.081	.140	NS	−.356	.085	***
School grade (11th grade=1)	.971	.168	***	.465	.075	***	.491	.077	***	.869	.063	***	.047	.148	NS	.568	.086	***
Immigrant background (yes=1)	.034	.207	NS	−.316	.132	*	−.867	.145	***	−.694	.118	***	−.034	.275	NS	−.217	.138	NS
Religious affiliation (Islam=1)	.184	.236	NS	−.200	.168	NS	.021	.171	NS	−.559	.168	***	1.161	.342	***	−.454	.185	*
Religious belief in God (0–3)	−.071	.074	NS	−.055	.036	NS	−.029	.036	NS	−.064	.029	*	−.004	.065	NS	−.151	.040	***
Socio-economic background (1–10)	−.116	.035	***	.032	.016	NS	−.006	.017	NS	.074	.013	***	−.004	.030	NS	−.012	.018	NS
Grade points (1–6)	−.520	.093	***	−.302	.050	***	−.470	.051	***	−.216	.042	***	−.314	.090	***	−.256	.055	***
Parental monitoring (0–3)	−.561	.105	***	−.483	.061	***	−.247	.062	***	−.408	.052	***	−.684	.106	***	−.571	.066	***
Parental use of alcohol (0–4)	.310	.079	***	.236	.043	***	.179	.043	***	.207	.035	***	.149	.077	NS	.192	.047	***
Constant	−3.67	.818		−1.25	.415		.18	.421		−2.59	.355		.669	.773		−1.01	.462	

Note: b: rescaled logistic regression coefficients using the 'meresc' command in Stata. SE: standard error. p: significance level: * p<.05, ** p<.01, *** p<.001, NS = non-significant.

Figure 1. Scores on the district-level socioeconomic index (DLSI) for the city districts of Oslo.

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