

## Immigration and the decline in adolescent binge drinking

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### ARTICLE INFO

#### Keywords:

Immigration  
Alcohol  
Binge drinking  
Youth  
Trends  
Decomposition

### ABSTRACT

**Background:** Adolescent alcohol consumption has fallen in most Western countries over the past two decades, while immigrants and children of immigrants from low-consumption countries constitute a growing proportion of teenagers in many Western nations. We investigate the extent to which immigrants and children of immigrants have contributed to the decline in adolescent heavy episodic drinking in Oslo, the capital of Norway.

**Methods:** We use repeated cross-sectional survey data on adolescents in grades 9–11 in Oslo (aged around 14–16, N = 54,474) from 1996 to 2018. We use data on heavy episodic drinking/intoxication in the past 12 months (dichotomized), immigrant background, sex and grade. We decompose the trend into components attributable to changes in the demographic composition of the adolescent population (by immigrant background, grade and sex), and to changes in drinking patterns within different groups. Confidence intervals (CIs) are obtained by bootstrap resampling.

**Results:** The proportion of adolescents with immigrant backgrounds increased from 21% to 35% over the time span. The proportion reporting having been intoxicated fell from 42% to 25%. Most of the decline stems from reduced heavy episodic drinking in the majority population, accounting for 70.8% of the reduction (95% CI: 67.5–74.2). The increased proportion of adolescents with an immigrant background accounts for 21.4% of the decline (95% CI: 19.2–23.8).

**Conclusions:** An increasing proportion of immigrants and children of immigrants with low alcohol consumption explains one-fifth of the decline in the prevalence of adolescent heavy episodic drinking in Oslo.

### 1. Introduction

Since peaking around the turn of the millennium, adolescents' alcohol use has fallen markedly in many Western countries. This decline in teenagers' drinking has been observed in diverse contexts such as Australia (Livingston et al., 2018), Canada (Elgar et al., 2011), Denmark (Andersen et al., 2014), Germany (Richter et al., 2013), Italy (Siciliano et al., 2016), the Netherlands (Garretsen et al., 2008), Norway (Brunborg et al., 2014; Pedersen and von Soest, 2015), Sweden (Norström and Svensson, 2014; Raninen et al., 2014), the USA (Jang et al., 2017), and several other countries (see for instance Jackson et al., 2017; Osaki et al., 2009; Peltzer and Pengpid, 2015; Sanchez et al., 2015; Sznitman et al., 2016; Tantirangsee et al., 2014).

Studies drawing on cross-national data sets have typically reported overall reductions in drinking, although the magnitude of the reduction varies between countries (de Looze et al., 2015; Kraus et al., 2016; Kuntsche et al., 2011; Simons-Morton et al., 2009). Moreover, these studies suggest a reduction in most indicators of alcohol consumption, including reduced frequency of drinking, lower rates of heavy episodic

intoxication and higher abstention rates, although the decline in heavy episodic (hereafter: "HE") drinking is less consistent across countries (Pape et al., 2018). The largest decline in adolescent HE drinking appears to have taken place in Iceland, where it dropped by a remarkable 70% between 2003 and 2015 (Kraus et al., 2016; Kristjansson et al., 2016). A notable exception is found in some Eastern European countries, where adolescent drinking has increased, fluctuated or remained stable (de Looze et al., 2015; Kuntsche et al., 2011; Ostaszewski and Pisarska, 2008). The decline has primarily been found among young adolescents, particularly boys (Pape et al., 2018).

Because these trends in adolescent drinking occur across national contexts, they may have some common underlying drivers. Policy changes and preventive efforts may have accelerated the trend in some countries – particularly in Iceland, where an extensive preventive program has been implemented (Kristjansson et al., 2010; Sigfúsdóttir et al., 2008) – but cannot explain trends in other countries (Pape et al., 2018). Broader cultural shifts may also be of importance. Younger cohorts seem to be more disapproving of alcohol use and drunkenness than older cohorts (Keyes et al., 2012), possibly reflecting general

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<https://doi.org/10.1016/j.drugalcdep.2019.05.031>

Received 27 March 2019; Received in revised form 28 May 2019; Accepted 28 May 2019

Available online 01 August 2019

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normative changes or greater awareness of potential alcohol-related harm (Livingston and Callinan, 2017). Moreover, declining drinking trends among adolescents coincide with improvements in parent-child relationships, increased parental monitoring, and less parental approval of adolescent drinking (de Looze et al., 2014; Raitasalo and Holmila, 2017). The role of social media and computer games has also been emphasized as a potential driver, although the evidence for this explanation is limited (Pape et al., 2018).

Several researchers have also pointed to the potential importance of immigration. With an increasing proportion of immigrants and children of immigrants from low-consumption countries in the adolescent population, immigration may play a key role in many national contexts. However, only one study, by Svensson and Andersson (2015), seems to have assessed this empirically. Their time-series analysis revealed that trends in adolescent drinking and proportions of adolescents with immigrant backgrounds were unrelated. However, only aggregate trends were investigated. Here, we contribute to the literature by utilizing individual-level data on immigrant background and drinking when assessing to what extent immigration has contributed to the decline in adolescent HE drinking.

### 1.1. Migration and alcohol use

In many countries and cultures, per capita alcohol consumption is low compared with the high-consumption cultures in Europe and North America. For instance, alcohol consumption is relatively low in much of Asia, Africa and the Middle East (World Health Organization (WHO), 2014). The reasons for consumption differences vary, but generally, people drink more in richer than in poorer countries and the lowest levels are found in countries with a predominantly Muslim population (Babor et al., 2010). In addition, cultural norms may limit alcohol consumption in general, or by some specific groups. For instance, men usually drink more than women, but this difference is larger in some countries than in others, and quite extreme in countries such as India and Sri Lanka (Wilsnack et al., 2009).

In recent decades, many Western countries have experienced increased immigration from countries with relatively low alcohol consumption (see for instance McAuliffe and Ruhs, 2017). For instance, people originating from low-consumption countries constitute a sizeable proportion of the immigrant population in European countries such as Belgium, Denmark, the Netherlands, Sweden, and the UK (Eurostat, 2018; World Health Organization (WHO), 2014). Thus, immigration from low-consumption countries may have a substantial effect on aggregate alcohol consumption among adolescents in Europe.

Immigrants from predominantly Muslim countries stand out with regards to alcohol use, as Islam prohibits the use of alcohol. Alcohol consumption is generally low in Muslim majority countries and, notably, among Muslim immigrants and minorities elsewhere (Balabanova and Mckee, 1999; Denscombe, 1995; Michalak and Trocki, 2006; World Health Organization (WHO), 2014).

While Christians have traditionally been over-represented among abstainers in Norway, Muslim youth account for a considerable proportion of this group in Oslo (Pedersen and Kolstad, 2000), and immigrants from Muslim majority countries on average drink much less than the native majority population in Norway, although immigrants from Iran are a partial exception (Amundsen, 2012). Several Norwegian studies suggest that immigration may be an important aspect of the changing drinking patterns among adolescents in Oslo (Amundsen, 2005, 2012; Vedøy and Amundsen, 2008). In addition to the effect of an increasing proportion of adolescents with immigrant backgrounds from Muslim majority countries, there may be bi-directional acculturation processes at work, whereby the majority population adapt to the behaviors of the immigrant background population and vice versa (Amundsen et al., 2005).

### 1.2. Context

Oslo's immigration history has been shaped in part by international developments such as wars and conflicts, the expansion of the EU<sup>1</sup>, and fluctuating flows of asylum seekers. Labor migrants, and later family reunification migrants from predominantly Muslim countries such as Turkey, Morocco and Pakistan started arriving in the 1960s and 1970s. During the late 1980s, peaks in immigration to Norway were driven by refugees from Chile, Sri Lanka and Iran, while many refugees from the Balkans arrived in the 1990s. Later, many refugees, asylum seekers and family reunification migrants came from predominantly Muslim and/or low-consumption countries including Iraq, Iran, Afghanistan, Somalia and Eritrea. Increasing numbers of work migrants have also come from new EU countries, in addition to migrants from the Philippines and European countries such as Sweden and Germany (Cappelen et al., 2016; Statistics Norway, 2018a; Tjelmeland and Brochmann, 2003). Today, children of immigrants arriving before and around the turn of the century constitute a large proportion of the adolescent population in Oslo. According to the Young in Oslo (YiO) surveys (Bakken, 1998, 2018), over the period 1996 to 2018, the proportion of adolescents with immigrant backgrounds (immigrants plus Norwegian-born with two foreign-born parents) increased from 21% to 35%.

Table 1 provides a breakdown of the proportion of adolescents aged 14–16 years from immigrant backgrounds that originate from Muslim majority countries, based on administrative register data. The total proportion of adolescents with immigrant backgrounds increased from 22.5% in 1996 to 36.4% in 2015. The share that are children of immigrants increased from 9% to 23.7%, while the proportion from Muslim majority country backgrounds increased from 13.8% to 20.8%. These figures match up well with those of the YiO survey, in which 22% of 11th graders reported that they were Muslims in 2018. Among adolescents with immigrant backgrounds from non-Muslim-majority countries, many also have backgrounds from countries with low alcohol consumption, such as India and Sri Lanka (not shown).

Oslo is also a highly segregated city. The western parts of the city are relatively affluent and ethnically homogeneous, with a high proportion of inhabitants with high incomes and high education. However, the central and eastern parts of the city are more ethnically diverse and less affluent. There, the concentration of immigrants is higher and average income and educational levels are lower (Statistics Norway, 2018b; Wessel, 2015, 2017; Wiborg, 2017), and frequent alcohol use among adolescents is less common (Pedersen et al., 2015).

## 2. Data and methods

### 2.1. Data collection

We combine data from five separate surveys (YiO) conducted in a similar fashion over the period 1996–2018. Researchers from Norwegian Social Research (NOVA) led the data collection, and teachers in Oslo schools administered the study. All surveys include students in the last two years of secondary school (grades 9–10, aged around 14–15) and the first year of high school (grade 11, aged around 16). Except for some schools for students with special medical or psychological needs or disabilities, almost all public and private schools in Oslo participated. The response rate among students in participating schools ranged from 94% (1996) to 72% (2012). Information on the number of participating schools, response rates and number of respondents is provided in Table 2. For more detailed documentation, see Andersen and Bakken (2015), Bakken (1998, 2018), Valset and Øia (2006), and Øia (2007, 2012).

<sup>1</sup> Norway is not an EU member but part of the open EU labor market.

**Table 1**  
Proportion of adolescents, aged 14–16 in Oslo in selected years 1996–2015 by immigrant background groups and Muslim-majority vs non-Muslim-majority country background (%).

Year	1996	2001	2006	2012	2015
Native majority	77.4	72.9	72.8	65.2	63.6
Immigrants, Muslim-majority countries	7.4	9.6	6.2	7.1	5.6
Immigrants, other countries	6.1	6.1	4.3	5.8	7.0
Children of immigrants, Muslim-majority countries	6.3	8.0	10.8	13.8	15.2
Children of immigrants, other countries	2.7	3.5	5.9	8.1	8.5

Note: Based on administrative register data provided by Statistics Norway through microdata.no (NSD/SSB, 2019). Numbers refer to the proportion of individuals aged 14–16 years and registered as residents in the municipality of Oslo on January 1 in the given year. “Immigrants” are defined as people born abroad with two foreign-born parents. “Children of immigrants” are defined as people born in Norway with two foreign-born parents. “Native majority” is defined as people born in Norway with one or two parents born in Norway or born abroad with one or two parents born in Norway. “Muslim majority countries” are defined by the list of 49 countries with a Muslim majority in 2010 assembled by the Pew Research Center (2011). We categorize people as originating from a Muslim-majority country if their country of origin is a Muslim-majority country. For immigrants, “country of origin” refers to the country of birth, with a few exceptions. For people born in Norway, “country of origin” refers to the individual’s parents’ country of birth, with priority given to the country of birth of the mother if this differs between parents. Country of origin is set to “Norway” for people in the native majority.

2.2. Variables and comparability

For immigrant background, respondents were asked to specify whether each parent was born abroad (1996 and 2006), whether one or both were born in Norway, or both were born abroad in (2012), or whether none, one, or both parents were born abroad (2015 and 2018). Thus, we may compare two groups consistently: those with both parents born abroad (“immigrant background”) and those with one or both parents born in Norway (“native majority”). Information on country of origin or religious affiliation was not available in all surveys.

Our indicator of HE drinking is based on a question about whether the respondent had “Drank so much that you have felt clearly intoxicated” during the previous 12 months. The sentence introducing the battery containing this item differed slightly in different survey rounds, and while respondents in 1996 and 2006 were asked to write in the exact number of occasions, later surveys used categories (“No times,” “1 time,” “2–5 times,” “6–10 times,” or “11 times or more”). To minimize the risk of bias from differently worded response options, we used a dichotomous indicator of HE drinking (“No times”/one or more) Information on sex and grade was also obtained through these surveys. In the following analyses, we exclude individuals with missing information on HE drinking (2507 individuals), immigrant background (521 individuals) or sex (908 individuals). This reduced our total sample size by 6.48%,

**Table 2**  
Participating schools, student response rates and participants in the Young in Oslo surveys 1996 to 2018.

Sources: Authors’ own calculations and (Andersen and Bakken, 2015; Bakken, 1998, 2018; Valset and Øia, 2006; Øia, 2007, 2012).

Year	Number of participating schools (invited schools) <sup>a</sup>	Student response rate	Respondents, secondary school	Respondents, high school	Respondents, total <sup>d</sup>
1996	95 (98)	94.3%	7140	4039	11179
2006	75 (88) <sup>b</sup>	92.7%	7029	4216	11245
2012	62 (approx. 80)	72%	6714	3348	10062
2015	88 (93)	79%	8177	4395	12572
2018	84 (94)	74% <sup>c</sup>	8845	4348	13193

<sup>a</sup> Overall, private schools are overrepresented among non-participating schools.

<sup>b</sup> In two secondary schools, only the 9th grade participated.

<sup>c</sup> Response rate in 2018 includes grades 8, 12 and 13. Number of respondents does not.

<sup>d</sup> Numbers include students with item nonresponses who were excluded in the analyses.

from 58,251 to 54,474 individuals (see Supplementary Material, S1 for an overview of item non-response).

2.3. Decomposition

Adolescents from immigrant backgrounds can directly affect the overall downward trend in HE drinking in two ways: either through changes in relative size (composition) between the immigrant background group and the native majority group, or through changes in drinking patterns (consumption) within the immigrant background group. Since we expect that adolescents from immigrant backgrounds drink less on average than the native majority, an increasing proportion from immigrant backgrounds in the adolescent population should reduce the total proportion of HE drinkers. However, the consumption patterns among adolescents with an immigrant background may also change over time, so that changes in drinking practices within this group may affect the aggregate proportion of HE drinkers.

In this article, we decompose the aggregate trend in adolescent HE drinking to assess the contribution from adolescents from immigrant backgrounds. To do this, we use a Kitagawa decomposition (Kitagawa, 1955; Preston et al., 2000; Tønnessen, 2019), commonly used in demographic analyses of differences in rates. We use this technique to calculate the difference in the proportion of HE drinkers at two points in time that is attributable to differences in the proportion of HE drinkers within groups (consumption), and the difference attributable to differences in the relative size of the groups (composition). As we can differentiate between groups according to sex and grade in addition to immigrant background, the change in the proportion of HE drinkers between two years (t1 and t2) can be expressed as

$$\Delta p(HE) = \sum_{g=9}^{11} \sum_{s=0}^1 \sum_{i=0}^1 [(\Delta P_{gsi} \times \frac{p(HE)_{gsi,t1} + p(HE)_{gsi,t2}}{2}) + (\Delta p(HE)_{gsi} \times \frac{P_{gsi,t1} + P_{gsi,t2}}{2})],$$

where  $\Delta p(HE)$  is the overall change in the proportion of HE drinkers (those that have drunk so much that they felt clearly intoxicated) between t1 and t2, namely  $p(HE)_{t2} - p(HE)_{t1}$ .  $p(HE)_{gsi}$  is the group-specific proportion of HE drinkers in a given group defined by the combination of g (grade), s (sex) and i (immigrant background), and  $P_{gsi}$  is the proportion of all individuals that are in a given grade  $\times$  sex  $\times$  immigrant background group (a shorthand for  $\frac{N_{gsi}}{N}$ ), where N is the number of individuals.  $\Delta p(HE)_{gsi}$  is the change in the proportion of HE drinkers in a given grade  $\times$  sex  $\times$  immigrant background group ( $p(HE)_{gsi,t2} - p(HE)_{gsi,t1}$ ), and  $\Delta P_{gsi}$  is the change in the proportion of all individuals that are in a given grade  $\times$  sex  $\times$  immigrant background group ( $P_{gsi,t2} - P_{gsi,t1}$ ).

The first part of this term represents the contribution from changes in composition, i.e., changes in the proportion of adolescents within each grade  $\times$  sex  $\times$  immigrant background group, weighted by the average proportion of HE drinkers in the group over the years t1 and t2.

The second part is the contribution from changes in the proportion of HE drinkers within each *grade × sex × immigrant background* group, weighted by the average proportion of adolescents in the group over the years t1 and t2.

However, regarding compositional changes, we are not primarily interested in the contribution from changes in the proportion of adolescents within each *grade × sex × immigrant background* group. Rather, we are interested in the contribution from changes in the proportion of adolescents from immigrant backgrounds independent of grade and sex. Thus, following Kitagawa (1955: 1193–1194), we calculate the following subcomponents:

$$Net I_{GS} = \sum_{g=9}^{11} \sum_{s=0}^1 \sum_{i=0}^1 \left( \frac{p(HE)_{gsi,t1} + p(HE)_{gsi,t2}}{2} \right) \times \left( \frac{N_{gs,t1}}{N_{i,t1}} + \frac{N_{gs,t2}}{N_{i,t2}} \right) \times \left( \frac{N_{gsi,t2}}{N_{gs,t2}} - \frac{N_{gsi,t1}}{N_{gs,t1}} \right),$$

where  $Net I_{GS}$  is the net contribution from the change in the immigrant background composition, independent of sex and grade (i.e. the change in the total share of HE drinkers when holding group-level shares of HE drinkers and the grade/sex composition constant), and

$$Net (GS)_I = \sum_{g=9}^{11} \sum_{s=0}^1 \sum_{i=0}^1 \left( \frac{p(HE)_{gsi,t1} + p(HE)_{gsi,t2}}{2} \right) \times \left( \frac{N_{i,t1}}{N_{i,t1}} + \frac{N_{i,t2}}{N_{i,t2}} \right) \times \left( \frac{N_{gsi,t2}}{N_{i,t2}} - \frac{N_{gsi,t1}}{N_{i,t1}} \right),$$

where  $Net (GS)_I$  is the net contribution from the change in the sex and grade composition, independent of immigrant background. A third subcomponent, *Joint I (GS)*, captures differences attributable to changes in combined *immigrant background*, and *grade × sex* composition that cannot be independently allocated to either. This term is very small and not discussed further:

$$Joint I(GS) = \sum_{g=9}^{11} \sum_{s=0}^1 \sum_{i=0}^1 \left( \frac{p(HE)_{gsi,t1} + p(HE)_{gsi,t2}}{2} \right) \times \left( \frac{N_{gsi,t1}}{N_{i,t1}} \times \frac{N_{i,t2}}{N_{i,t2}} - \frac{N_{gsi,t2}}{N_{gs,t2}} \times \frac{N_{gs,t1}}{N_{i,t1}} + \frac{N_{gsi,t1}}{N_{gs,t1}} \times \frac{N_{gs,t2}}{N_{i,t2}} - \frac{N_{gsi,t2}}{N_{i,t2}} \times \frac{N_{i,t1}}{N_{i,t1}} \right)$$

Confidence intervals for the decomposition components are obtained by bootstrap resampling from the analysis sample (5000 resamples, calculating all components each time), and taking the 2.5<sup>th</sup> and 97.5<sup>th</sup> percentile of the bootstrap distribution of each component. Analyses were performed in RStudio (RStudio Team, 2015).

### 3. Results

#### 3.1. Trends in HE drinking

As shown by Bakken (2018), there has been a downward trend in adolescent HE drinking in Oslo, from 0.42 in 1996 to 0.25 in 2018. Fig. 1 shows the trends separately for each grade. The aggregated data used to produce this figure and all subsequent figures, tables and analyses are provided as supplementary material (S2).

While the proportion of girls in the sample varies very little between survey rounds, the proportion from immigrant backgrounds has increased from 0.21 in 1996 to 0.34 in 2018 (among respondents without item non-responses). Breaking down the trends in HE drinking by grade, sex and immigrant background groups provides a more detailed description of how these trends relate, and this is shown in Fig. 2, with the size of each group represented by grey circles. There are three important points to note in this figure. First, HE drinking changes little over time among adolescents from immigrant backgrounds, though we see a slight increase among 11<sup>th</sup> grade boys and a smaller decline among 9<sup>th</sup> and 11<sup>th</sup> grade girls since 1996. Thus, it is unlikely that changes in the proportion of HE drinkers among adolescents from

immigrant backgrounds contribute much to the overall trend. Second, the prevalence of HE drinking is much lower among adolescents from immigrant backgrounds than among native majority adolescents (although the difference decreases over time). As the immigrant background group grows in relative size over time, the low consumption and increasing proportion of adolescents in this group may have accelerated the aggregate downward trend in adolescent HE drinking. Third, the downward trend in HE drinking is quite pronounced among native majority adolescents, suggesting that the overall downward trend is largely driven by changes in consumption within this group. These patterns are roughly similar between boys and girls.

#### 3.2. Decomposing the change between 1996 and 2018

Decomposing the change in the proportion of HE drinkers between 1996 and 2018 into changes in consumption within each group and changes in composition between groups, we obtain the results summarized in Table 3. The largest contribution to the downward trend comes from changes in consumption within the native majority group. The change in the proportion of HE drinkers in this group accounts for 70.8% (95% CI: 67.5%–74.2%), or -12 percentage points, of the change in the overall proportion of HE drinkers between 1996 and 2018. This contribution is largest among the younger teenagers (grades 9–10) and among boys. The contribution from changes in consumption among adolescents from immigrant backgrounds is very small (2%, (95% CI: -0.9%–4.8%), or -0.3 percentage points) and of little practical importance for the overall trend. This is as expected, since the proportion of HE drinkers in this group has changed little since 1996 (Fig. 2).

Changes in composition have contributed substantially to the downward trend. In total, compositional changes account for 27.2% (95% CI: 24.41%–30.06%), or -4.6 percentage points, of the observed decline, and the increased proportion of adolescents from immigrant backgrounds accounts for 21.4% (95% CI: 19.2%–23.8%), or -3.6 percentage points, of the overall downward trend.

#### 3.3. Decomposing the trend for all years

Repeating the decomposition above, for all periods since 1996 (1996–2006, 1996–2012, etc.) allows us to visualize how changes in HE drinking within groups and changes in composition between groups have affected the overall proportion of HE drinkers over time, and the result is shown in Fig. 3. Between 1996 and 2006, the largest contribution to the (comparatively small) reduction in adolescent HE drinking came from an increasing proportion of adolescents from immigrant backgrounds (62.3%, or -2.4 percentage points). After 2006, the main reason for the decline has been a reduced proportion of HE drinkers among native majority adolescents.

### 4. Discussion

The contribution from an increasing proportion of adolescents from immigrant backgrounds to the decline in adolescent HE drinking in Oslo is quite substantial, and accounts for one-fifth of the observed trend. However, the majority of the decline is attributable to native majority adolescents drinking less – particularly young teenagers and boys. Our finding that an increasing proportion of adolescents from immigrant backgrounds is an important contributing factor to the recent decline in HE drinking is contradictory to the conclusion by Svensson and Andersson (2015). This discrepancy may be due to our use of individual-level data, or the fact that we studied an urban population with a higher proportion of adolescents from immigrant backgrounds. The finding that the decline has been largest among younger adolescents and boys is consistent with the previous literature (Pape et al., 2018).

We consider it likely that the contribution from an increasing proportion of adolescents from immigrant backgrounds is primarily driven

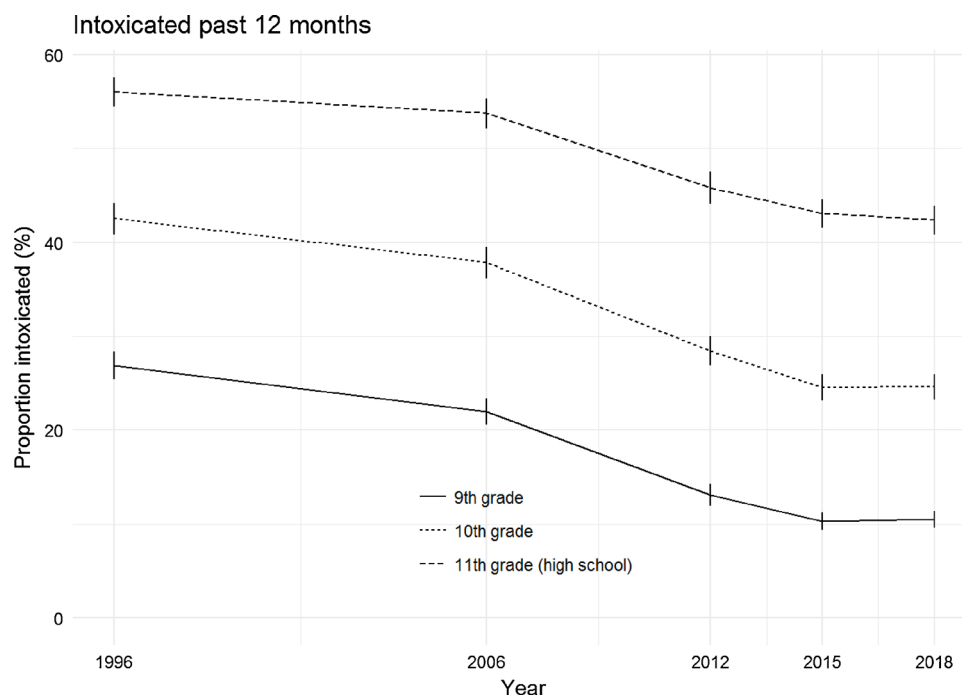


Fig. 1. Proportion that have drunk so much that they felt clearly intoxicated during the past 12 months, by grade. Vertical spikes are 95% CIs.

by teenagers with backgrounds from low-consumption countries, and particularly Muslim-majority countries. Although abstinence is not universal, previous studies have shown high abstinence rates and low alcohol consumption in these groups in Norway (Amundsen, 2012; Pedersen and Kolstad, 2000). However, factors other than religion and culture, such as economic resources and peer networks may be important. The relevance of immigration for drinking trends in Oslo also suggests that immigration may be important in other national contexts as well, and should receive more attention in research on drinking patterns.

Indirect effects of immigration, whereby adolescents from immigrant backgrounds with low alcohol consumption influence the drinking patterns of native majority adolescents, may also have contributed to this trend (Amundsen et al., 2005). However, this is unlikely to be the only factor, as similar trends have been observed in relatively low-immigration countries such as Iceland and Finland (Kraus et al., 2016; Kristjansson et al., 2016; Torikka et al., 2017). The small contribution from changes in sex and age composition is largely driven by a higher proportion of younger students in later survey rounds.

While numerous studies have investigated potential explanations for the observed reductions in adolescent alcohol consumption, limited attention has been devoted to investigating the extent to which compositional changes in the teenage population may have contributed to the decline. Our findings highlight the importance of paying attention to compositional changes when studying aggregate social trends, and (more specifically) the importance of collecting data on and accounting for immigrant background in studies of alcohol consumption. Decomposition methods, as employed here, may contribute greatly to our understanding of social changes where both compositional and behavioral effects may be at work.

#### 4.1. Limitations

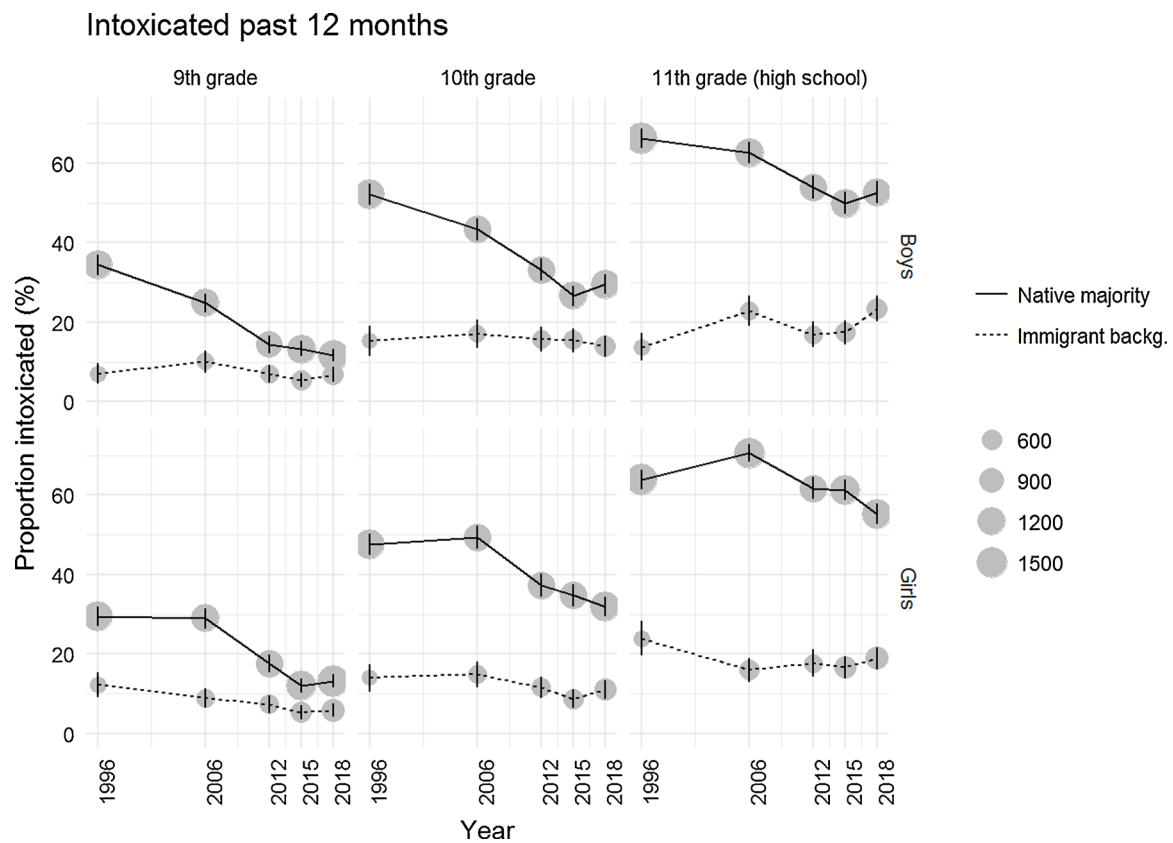
Although the response rates in these surveys were high overall (72–94%), selective non-response at the school or individual level may have influenced our results. Notably, the lower student response rate in later survey rounds may bias our results if non-response is correlated with HE drinking. Item non-response regarding HE drinking is also

more common among adolescents from immigrant backgrounds (Supplementary Material, S1), and selective non-response or under-reporting may be particularly common among adolescents with backgrounds from low-consumption or Muslim majority countries, either due to some social desirability bias (Michalak and Trocki, 2006) or because people who do not drink are less likely to respond to such items. The slightly different question wordings and response options with regard to immigrant background and HE drinking may also have biased our results. Related to this, the lack of comparable data over time on religious affiliation, country of origin, the “immigrant generation,” etc. has limited the scope of this study.

Although country of origin and religion likely play a major role, we cannot say how without more detailed data. Our coarse grouping by immigrant background likely conceals considerable heterogeneity, given that it groups together adolescents with backgrounds from both high- and low-consumption countries and because the country of origin and “immigrant generation” composition changes over time within this group. Notably, adolescents with immigrant backgrounds from high-consumption contexts such as Europe may “water down” the effect of immigration from low-consumption countries. Other indicators of drinking would have further enabled us to study immigrant background adolescents’ contribution to rising abstinence rates, reductions in drinking frequency or other trends. Furthermore, our data do not allow us to investigate why native majority adolescents drink less than they used to, or why adolescents with an immigrant background drink less than the native majority: Cultural and normative shifts in the teenage population and changing parental practices may be relevant factors (Pape et al., 2018), although their relative importance is difficult to assess. Additionally, our sample of adolescents in Oslo is far from representative of the nation as a whole, and we expect immigration to matter less for drinking trends in rural areas.

#### 4.2. Recommendations for future research

More research is needed to understand both the reasons for the reduced alcohol consumption among native majority teenagers and why adolescents from immigrant backgrounds drink less than the native majority. The potential indirect effects of immigration on drinking



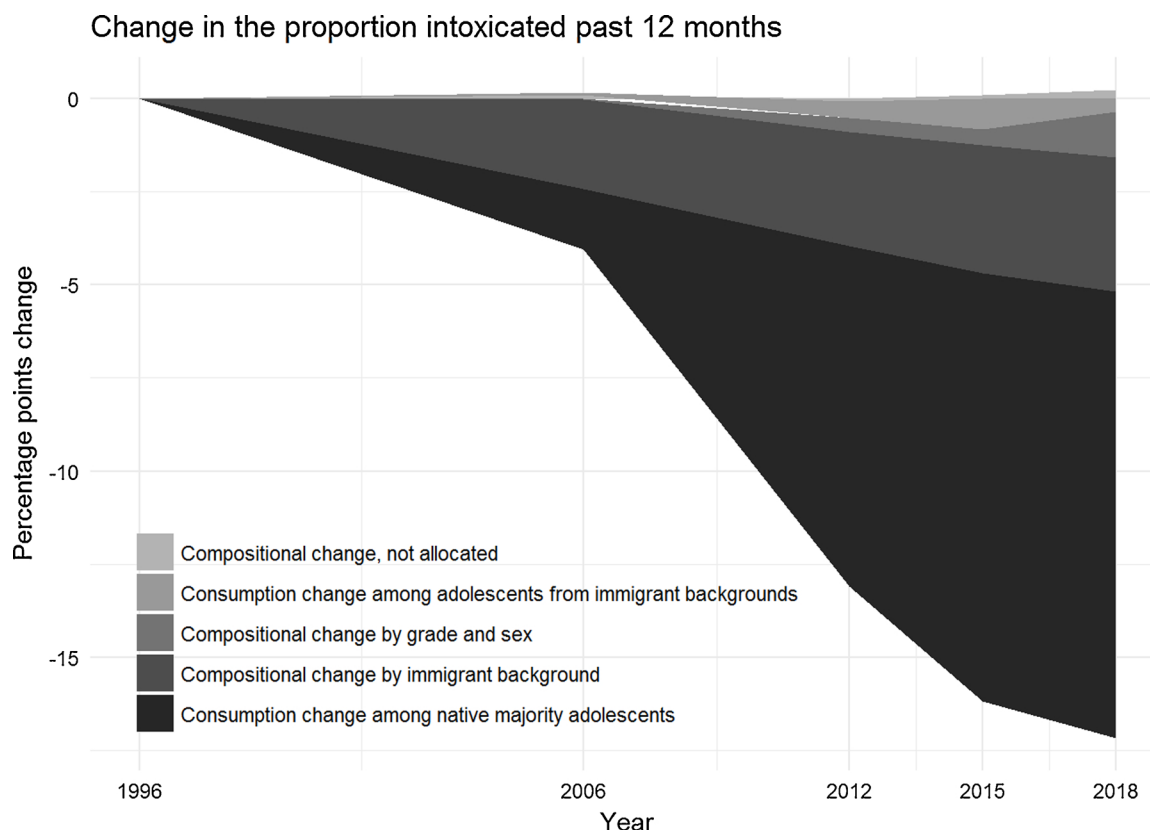
**Fig. 2.** Proportion that have drunk so much that they felt clearly intoxicated during the past 12 months, by grade, sex and immigrant background. Vertical spikes are 95% CIs. The area of the grey circles represents group size.

Note: Percentage point differences between 1996 and 2018 in the proportion of HE drinkers in each grade, sex and immigrant background group and two-tailed p-values for the difference (in parentheses): native majority 9th grade boys: -0.228 (0.000); native majority 9th grade girls: -0.163 (0.000); immigrant background 9th grade boys: -0.002 (0.883); immigrant background 9th grade girls: -0.064 (0.000); native majority 10th grade boys: -0.227 (0.000); native majority 10th grade girls: -0.158 (0.000); immigrant background 10th grade boys: -0.015 (0.529); immigrant background 10th grade girls: -0.028 (0.184); native majority 11th grade boys: -0.136 (0.000); native majority 11th grade girls: -0.087 (0.000); immigrant background 11th grade boys: 0.096 (0.000); immigrant background 11th grade girls: -0.050 (0.048). Percentage point differences between 1996 and 2018 in the proportion of adolescents from immigrant backgrounds in each grade and sex group and two-tailed p-values for the difference (in parentheses): 9th grade boys: 0.088 (0.000); 9th grade girls: 0.102 (0.000); 10th grade boys: 0.132 (0.000); 10th grade girls: 0.120 (0.000); 11th grade boys: 0.149 (0.000); 11th grade girls: 0.163 (0.000).

**Table 3**

Decomposition of the observed reduction in adolescent heavy episodic drinking between 1996 and 2018.

	Percentage point change	Percentage of change	95% CI for percentage of change
Total change	-16.93	100.00	
Change due to changes in composition (the proportion of adolescents in each group)	-4.60	27.17	24.41 – 30.06
... attributable to changes in the <i>immigrant background</i> composition	-3.62	21.39	19.22 – 23.80
... attributable to changes in the <i>sex and grade</i> composition	-1.23	7.24	5.27 – 9.23
... attributable to changes in composition that cannot be independently allocated	0.25	-1.46	-2.28 – -0.68
Change due to changes in consumption (the proportion of HE drinkers within each group)	-12.33	72.83	69.94 – 75.59
... among adolescents with an <i>immigrant background</i>	-0.34	2.02	-0.87 – 4.79
... that are boys in the 9th grade	-0.01	0.07	-0.79 – 0.93
... that are girls in the 9th grade	-0.32	1.86	0.84 – 2.90
... that are boys in the 10th grade	-0.06	0.37	-0.78 – 1.53
... that are girls in the 10th grade	-0.13	0.74	-0.37 – 1.90
... that are boys in the 11th grade (high school)	0.42	-2.47	-3.75 – -1.20
... that are girls in the 11th grade (high school)	-0.24	1.44	-0.03 – 2.90
... among adolescents in the <i>native majority</i>	-11.99	70.82	67.54 – 74.16
... that are boys in the 9th grade	-2.72	16.06	13.96 – 18.30
... that are girls in the 9th grade	-2.06	12.18	10.04 – 14.31
... that are boys in the 10th grade	-2.59	15.33	12.99 – 17.71
... that are girls in the 10th grade	-1.85	10.92	8.47 – 13.29
... that are boys in the 11th grade (high school)	-1.66	9.83	7.29 – 12.29
... that are girls in the 11th grade (high school)	-1.10	6.50	3.89 – 9.04



**Fig. 3.** Decomposition of the downward trend in adolescent heavy episodic drinking in Oslo.

patterns would also be worth investigating further. Because such effects are not accounted for in the present study, we interpret our results as a lower-bound estimate of the net effect of immigration on adolescent HE drinking. Additionally, we encourage researchers and agencies studying alcohol consumption to collect detailed data on immigrant background, and to conduct research into the role of immigration in explaining changes in alcohol consumption in other national contexts.

## 5. Conclusions

We find that immigration matters for adolescent HE drinking, but that changes in drinking patterns among native majority adolescents matter more. The increasing proportion of adolescents from immigrant backgrounds explains one-fifth of the decline in adolescent HE drinking in Oslo. A reduced proportion of HE drinkers among native majority adolescents accounts for 71% of the decline. Given the growing proportion of adolescents from immigrant backgrounds in most Western countries, immigration may also be an important factor in explaining downward drinking trends in other such contexts.

## Author disclosures

### Role of source funding

This research received funding from the Norwegian Research Council, project 240129: Alcohol consumption in Norway: A mixed-methods approach.

## Contributors

A.F.R. originally developed the idea behind the paper, took part in the planning of the article, conducted data preparation and analyses, and wrote the majority of the manuscript. W.P. Led the larger research project, took part in the planning of the article, wrote parts of the article

and revised the manuscript. A.B. was project manager for data collection, provided information on data collection and coding, provided background information on the context, and revised the manuscript.

All authors have approved the final article.

## Declaration of Competing Interest

No conflict declared.

## Acknowledgements

The authors wish to thank Tilmann von Soest, Haakon Gjerløw, Liridona Gashi, Rannveig Kaldager Hart and Marianne Tønnessen, our two anonymous reviewers, participants at the health group session at the Norwegian Sociological Association's Winter Seminar 2019 and participants at the Segregation group meeting at the Department of Sociology and Human Geography at the University of Oslo for helpful input and advice. They bear no responsibility for any errors.

## Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.drugalcdep.2019.05.031>.

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