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Adolescent alcohol use and binge drinking: An 18-year trend-study of prevalence and correlates

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Running head: Trends in adolescent alcohol consumption

Key words

Alcohol, binge drinking, adolescents, secular trends, social integration, hardening

Abstract

Aims: Several studies suggest a rapid decrease of alcohol use among adolescents after the turn of the century. With decreasing prevalence rates of smokers, a so-called “hardening” may have taken place, implying that remaining smokers are characterized by more psychosocial problems. Are similar processes witnessed among remaining adolescent alcohol users as well?

Methods: In 1992, 2002, and 2010 we used identical procedures to collect data from three population-based samples of 16- and 17-year old Norwegians (N = 9,207). We collected data on alcohol consumption, binge drinking, parental factors, use of other substances, conduct problems, depressive symptoms, social integration, sexual behaviour, and loneliness. **Results:**

There was a steep increase in all measures of alcohol consumption from 1992 to 2002, followed by a similar decline until 2010. Most correlates remained stable over the time span.

Conclusion: Alcohol use was consistently related to psychosocial problems; on the other hand, alcohol users reported higher levels of social acceptance and social integration than did non-users. There were no signs of “hardening” as seen for tobacco use.

INTRODUCTION

What was termed “a new culture of intoxication” manifested itself in the 1990s, when European researchers found a strong increase in alcohol consumption among young people (Järvinen and Room, 2007; Parker et al., 1998). In most countries, the increase in alcohol use among adolescents seems to have ended at the turn of the century (Aldridge et al., 2011; Andersen et al., 2013). However, several studies indicate that increasing problems with response rates in substance use surveys may bias recent estimates (Zhao et al., 2009). Moreover, the total registered alcohol consumption in e.g. Norway across age groups *increased* almost 50% from 1995 to 2010 (Rossow, 2010). Thus, high-quality survey data is needed to confirm possible divergent trends in different age cohorts. The first aim of the study is to present data about trends in alcohol use among adolescents over an 18-year span.

What happens when the prevalence of alcohol users and the level of consumption rapidly increase? Will alcohol users become more “ordinary”, more integrated and less marginalized? What if prevalence decreases, as it seems to have done after the turn of the century? Did those adolescents who nevertheless started using alcohol report more psychosocial problems and more marginal social positions?

Such research questions have been examined during the past decade with respect to tobacco use. With falling rates of smoking, researchers have argued that those who continue to smoke tend to “harden”. Typical indicators of “hardening” include increasing levels of nicotine dependence and reduced intentions to quit smoking (Fagerstrøm and Furberg, 2008). Remaining smokers may also increasingly be recruited from adverse backgrounds and be more likely to suffer from psychiatric and substance use comorbidity (Hughes, 2011). Hardening, then, refers to (i) an increased prevalence of “hardcore” smokers likely to continue smoking, as well as (ii) rising levels of psychosocial problems in the remaining population of smokers. A recent Norwegian study, based on the same data set which is used in the present

study, suggest signs of hardening of adolescent smokers in the second meaning of the term (von Soest and Pedersen, 2014). The choice among possible strategies to prevent smoking depends upon whether or not such “hardening” has occurred (Docherty and McNeill, 2012).

Recent studies of alcohol use as well indicate that prevention strategies must consider the characteristics of the targeted groups to be successful (see e.g. Koning et al., 2010). The second aim of this study is therefore to examine whether adolescents who started using alcohol in the early 1990s (when the rate of adolescent alcohol users was low) were characterized by more psychosocial problems (relative to their non-drinking peers) than were their counterparts at the end of the century (when the rate of adolescent alcohol users had increased). That is, did adolescent alcohol users “soften” (have fewer psychosocial problems) when larger numbers of adolescents started using alcohol? If we in fact find a decline in adolescent alcohol use after the turn of the century, we ask whether there has been a “hardening” among alcohol users. That is, are they characterized by a greater use of legal and illegal substances, and more conduct problems and depressive symptoms (relative to non-drinking adolescents) than their counterparts at the turn of the century?

Adolescent alcohol use: correlates and predictors

There has been a considerable research-based effort to identify causal factors of the development of adolescent alcohol use. Usually, low parental socioeconomic status is a risk factor for problematic outcomes in offspring. However, a recent review found little evidence that such factors are associated with alcohol use (Wiles et al., 2007). Associations to care and the importance of family disruptions have been uncovered (Marshall and Chassin, 2000; Nash et al., 2005), even though research in this area have also been challenged (Barnes et al., 2006). On the other hand, parental alcohol practices have been identified as robust predictors of adolescent alcohol use (for a review, see: Ryan et al., 2010). During the last couple of

decades, the proportion of immigrants has increased in Norway, many of them are Muslims, and they are often alcohol abstainers (Amundsen et al., 2005).

Substance abuse is often linked to psychosocial problems. However, studies suggest that a j-shaped curve often describes the relationship between alcohol use and such problems (Skog, 1996), and research from the USA (Naimi et al., 2005) and Scandinavia (Leifman et al., 1995; Skogen et al., 2009) indicate that alcohol *abstinence* may be associated with weaker social networks and more loneliness than moderate alcohol consumption. Moreover, there is a positive correlation between alcohol consumption and the initiation of sexual intercourse (Pedersen et al., 2003). However, little is known about possible changes in such associations in periods when the rate of adolescent alcohol users is increasing or falling.

Research has shown that alcohol use is initiated at approximately the same time as smoking and that the use of these legal substances typically precedes the use of cannabis (Kosterman et al., 2000). The importance of conduct problems for alcohol use and alcohol problems has also been documented (see Fergusson et al., 2005). The association between the use of alcohol and internalizing mental health symptoms is not as unambiguous (Mason et al., 2008). However, this may be because of the wide variety of measures that have been used to assess as well alcohol use as e.g. depression, and the current literature at least suggests a causal link between alcohol use disorders (AUD) and episodes of major depression (Boden and Fergusson, 2011).

In the present study, we will first investigate time trends in adolescent alcohol use and binge drinking over an 18-year period. Second, we will investigate whether the associations between alcohol use and binge drinking and (i) socioeconomic and family factors, (ii) social integration, sexual behaviours and loneliness, and (iii) the use of other substances, conduct problems and mental health problems have changed over the same time span in tandem with changes in the level of alcohol consumption.

Our hypothesis is that we will find an increase in the prevalence of alcohol use during the 1990s and that this may be accompanied by a “softening” of alcohol users relative to non-users. After the turn of the century, we will probably observe a decline in alcohol consumption, and this may be accompanied by a “hardening”. This will imply that more psychosocial problems will characterize alcohol users as opposed to those who do not drink.

METHODS

Sample and procedure

We used three cross-sectional population-based data sets drawn from the compulsory Norwegian school system in 1992, 2002, and 2010 (see: von Soest and Wichstrøm, 2014). The study sample in 1992 comprised students from 28 senior high schools. The register from which participating schools were selected included every school in the country. The sample was stratified according to geographic region and school size, which is closely related to the degree of urbanization in Norway. Each school’s sampling probability was proportional to the number of students enrolled (proportional allocation), thereby ensuring that the probability of being selected to participate in the study was equal for all students in Norway. The same procedures were utilized in 2002. In 2010, the same schools as in 2002 were asked to participate. Schools which declined to renewed participation were replaced by back-up schools with similar geographic location and size. All students gave informed consent in accordance with standards prescribed by the Norwegian Data Inspectorate. The Regional Committee for Medical Research Ethics endorsed the surveys. The response rates in 1992, 2002, and 2010 were 97.0%, 91.0%, and 83.2%, respectively. The total sample comprised 9,207 persons—4,714 boys (51.2%) and 4,493 girls (48.8%).

Measures

Alcohol consumption: First, we used a revised version of the Quantity/Frequency (QF) approach (Knupfer, 1966; Straus and Bacon, 1953) and asked, “How many times during the past four weeks did you drink more than a few sips of alcohol?” and “The last time you drank alcohol, how many ‘drinks’ did you have? By ‘drink’ we mean 0.33 litres of beer, a glass of wine, or a drink of liquor.” This gave us a prevalence estimate of use of alcohol in the previous four weeks (no/yes). The product of these two items gives a proxy for the number of “drinks” and thus a measure of the amount of alcohol consumed during the past four weeks. A typical approach to measure binge drinking is to measure how often 5+ units are consumed during a drinking session (Cahlahan et al., 1969). However, many Norwegian adolescents report a higher intake (Pedersen and von Soest, 2013). Thus, we also used a cut-off of 10+ units. . To capture the subjective experience of intoxication, we asked: “During the past 12 months, how often have you drunk so much that you clearly felt drunk?” Response options were: Never, 1 time, 2–5 times, 6–10 times, 11–50 times, and More than 50 times.

Substance use, conduct problems and depressive symptoms: We asked about daily smoking (no/yes) and cannabis use (no/yes) during the past 12 months. We used a 15-item measure of conduct problems, which approximates diagnostic criteria for conduct disorder in the DSM-III-R (Wichstrøm et al., 1996). The Depressive Mood Inventory (values 1–4) was used to measure depressive symptoms .

Parental characteristics: We assessed whether parents were living on social welfare or were unemployed (no/yes). Parental care was assessed by the Parental Bonding Instrument (Parker et al., 1979). We also asked whether the respondent was living with both biological parents or not. To capture parental alcohol intoxication, we asked, “Have you ever seen your parents drunk?” Those who reported at least “several times each month” were compared with the rest of the sample.

Social acceptance, loneliness and sexual activity: To measure social acceptance by peers, we used a subscale of the Self-Perception Profile for Adolescents (Wichstrøm, 1995). Four items from the UCLA loneliness scale (Russel et al., 1980) were used to assess perceived loneliness. Finally, we asked whether the respondents had had sexual intercourse (no/yes).

Covariates: Age, gender, and country of birth (Norway or abroad) were assessed.

Statistics

For dichotomous variables, the development of alcohol consumption and possible differences between boys and girls were investigated by means of chi-square tests. Concerning numbers of drinks consumed, time trends were examined by means of Poisson regression analyses. Time period was dummy-coded and included as independent variable. Binge drinking frequency was handled as ordered categorical variable by using ordinal logistic regression models (Agresi, 1996). In these models, proportional odds ratios are reported as measures of associations between predictors and binge drinking. Time trends were tested by dummy coding time period. Moreover, equality of variance of alcohol consumption measures across time periods was tested by Levene's test for equality of variances based on the median (Brown and Forsythe, 1974).

We then examined the relationship between psychosocial variables and alcohol consumption with regression analyses at each time point. Binary logistic regressions were applied with alcohol usage (use of alcohol during the past four weeks, no/yes) as the outcome variable, whereas binge drinking frequency again was analysed by using ordinal logistic regression analyses. To test whether the relationship between predictors and alcohol measures varied in strength over time, we used the whole data set and included dummy variables for time period, the predictor, and interaction terms of the predictor and dummy variables in binary and ordinal logistic regression analyses (see: Aiken and West, 1991, for more

information on the interaction analyses). We used age, gender, and country of birth as covariates in all regression analyses.

RESULTS

Table 1 first displays the proportion of alcohol users (defined as those who had used alcohol during the past four weeks). Note the increase from 1992 to 2002 and the subsequent decrease in 2010 ($p < 0.001$). The same trend was observed for all other alcohol measures, with an increase from 1992 to 2002, and then a decline from 2002 to 2010 ($p < 0.001$).

Table 1 reveals that there were no differences between the genders with regard to the proportion of alcohol users (see row 1) from 1992 to 2010. However, across the whole time span, boys reported higher scores for all measures of high alcohol intake and frequent binge drinking ($p < 0.001$), whereas there was no significant gender differences on the mean intoxication frequency measure (see row 7).

There were significant differences in the variance in number of drinks consumed the previous four weeks and number of episodes being drunk during the last 12 month across time points ($p < .001$), with greater variances in 2002 compared to both 1992 and 2010. To examine whether the decreasing time trend in alcohol usage was consistent across schools, we compared means and medians from the same schools in 2002 and 2010. Out of 28 schools, students in 24 schools reported higher average binge drinking frequencies in 2002 compared to 2010. Likewise, the median was higher or equal at 25 schools in 2002 compared to 2010.

Table 2 shows logistic regression analyses with alcohol use the previous four weeks (no/yes) as the dependent variable and parental and individual characteristics as independent variables. A stable picture emerged over the three data collections, with a negative association to parental care, and a positive association to parental alcohol intoxication. Moreover, there were positive associations with smoking and cannabis use, as well as with depressive

symptoms and conduct problems. Social acceptance was also positively associated with alcohol use, whereas a negative association was uncovered with regard to loneliness. Some minor changes occurred: having parents on social welfare was only significantly associated with alcohol use in 2010, whereas the importance of not living with both biological parents gradually declined. The association with cannabis use and depressive symptoms declined somewhat. Thus, these latter findings may in fact represent some signs of a “softening”.

Table 3 shows the results of ordinal logistic regressions with the frequency of episodes being drunk the last 12 month as the dependent variable. By and large, the same pattern seen in Table 2 was revealed: a stable picture for most of the variables, but an increased impact of having parents on social welfare, and a reduced association with not living with both parents. We observed a gradually weaker association to cannabis use. The association between depressive symptoms and binge drinking declined from 1992 to 2002, in accordance with the hardening hypothesis. However, after 2002 the associations remained at the same low level. Thus, there are no patterns indicating a hardening tendency in this table either.

DISCUSSION

Main findings and limitations of the study

We investigated secular trends in the use of alcohol among adolescents over an 18-year span. There was an increase in all alcohol measures during the 1990s, followed by a decrease of the same magnitude from the turn of the century. Inspired by research from the tobacco field, we examined characteristics of alcohol users to see whether they “softened” as the prevalence of use increased and “hardened” as the prevalence fell. No support for such a hypothesis was found. On the contrary, a stable pattern of correlates was uncovered over the whole 18-year time span. On the one hand, alcohol was related to problematic circumstances, such as low levels of parental care and high levels of binge drinking among parents. We also found

associations to conduct problems and depressive symptoms, and to the use of tobacco and cannabis. On the other hand, alcohol use was associated with social acceptance and the initiation of sexual relationships, and alcohol users were less lonely than non-users.

This study has several strengths. The sample was representative of the Norwegian adolescent population and the response rates were high, even though they dropped somewhat over the course of the study. Attrition in such studies has been reported to be associated with use of substances (McAdam et al., 1996), and some of the reduction in the prevalence of alcohol users from 2002 to 2010 may be attributable to a reduction in the response rate. However, this cannot account for the large reduction observed. A further strength is the use of a large number of measures to capture the different dimensions of alcohol use. Indeed, we did use a revised version of the QF approach, where we did not ask for “the typical” amount of alcohol consumed at a drinking occasion, but for the amount consumed at “the last” drinking occasion. However, this source of error will most likely be the same over the three data collections. Our data do not allow us to offer explanations as to why there were such large changes in adolescent alcohol consumption but not in adult groups. Understanding this increasing difference between adult and adolescent alcohol consumption patterns should be a high priority in subsequent studies.

Patterns of alcohol use

We were able to describe the development of (i) the prevalence of alcohol “users” as well as (ii) the amount of alcohol consumed (total number of “drinks”), (iii) the proportion who reported drinking beyond two cut-offs (5+ units and 10+ units) the last time they drank alcohol, and (iv) the development of the subjective experience of intoxication. The same pattern emerged for all measures: an increase during the 1990s and a decrease after the turn of the century. Note also that this change occurred during a period when the total consumption of alcohol increased considerably in Norway (Rossow, 2010). Other studies suggest that the

recent increase has been greatest among those 50 years of age or older (Krokstad and Skjei, 2011).

Much of the research on alcohol use in the past couple of decades has been based on the theory of the “collectivity of drinking cultures” (Skog, 1985). It suggests that changes in alcohol consumption typically occur across all segments of the population. As originally formulated, this idea maintains that, “the population might be expected to move in concert up and down the consumption scale” (Skog, 1985:97) (see also Babor, 2010). However, recent studies have shown that we still lack a theoretically elaborate understanding of the types of social networks or social ties that would produce such results (Azarian, 2010). Our findings suggesting that there may be different patterns in different age groups imply that social networks theories need to be investigated in more detail. Some studies show that adolescents mainly drink alcohol in the company of their peers (Kreager and Haynie, 2011). Thus, a key to the puzzle may be that adolescents and adults do not typically drink in the same networks. Another possible mechanism may be related to the increasing immigrant population in Norway. Ethnic Norwegian youth living in environments with a high proportion of Muslim youth seem to be influenced by their low level of alcohol consumption (Amundsen et al., 2005), and it may be that such contacts and influences are less pronounced in adult groups.

Parental factors

Parental binge drinking and low levels of parental care were robust predictors of children’s alcohol use over all three data collections. However, the importance of living with both biological parents gradually declined during this period. There has been an increasing rate of divorce and family dissolution in Norway (Statistics Norway, 2012). In addition, an increasing proportion of people cohabitate rather than marry, and such unions are more easily dissolved (Wiig, 2009). Thus, there are two likely explanations for the declining association between parental break-up and children’s alcohol use. One possibility is that, with the

increased prevalence of such break-ups, selection to this status is changing and children from broken homes are less deviant than they were when divorce was less prevalent. The other explanation may be related to a reduced negative *effect* of break-ups on children. There are still no studies that have investigated such associations in different cohorts in Norway.

Previous studies on the relationship between parental social class and alcohol consumption have presented conflicting evidence. Our findings suggest that adolescents with parents on social welfare now may be at increased risk of becoming “alcohol users” (Table 2) and of engaging in binge drinking (Table 3). This development may be an indication of “hardening”, and it may also reflect the fact that (in relative terms) alcohol has become cheaper and more readily accessible in Norway (Rossow, 2010), which could especially impact the level of alcohol consumption among youth from low socio-economic backgrounds (Chaloupka et al., 2002). Developments in this area should be monitored closely.

Social integration, loneliness, and sexual behaviours

A striking finding across all three data collections was that alcohol use was positively associated with social integration and negatively associated with loneliness. These findings point to a key aspect of alcohol use: the main recruitment base consists of socially integrated adolescents, not those at the social margins. In a classic study from the USA, Shedler and Block (1990) also found that those who had experimented with alcohol and cannabis reported higher levels of social integration and better social adjustment than those without such experiences. Other studies have found that alcohol abstainers are more likely to be lonely and have weaker social networks than moderate users of alcohol (Leifman et al., 1995).

We also found positive associations between alcohol use and the experience of early sexual intercourse. A large number of studies have reported associations between early sexual experiences and various risk behaviours (Costa et al., 1995; Huang et al., 2012). However, in more recent research, adolescent sexual experience is also regarded as a valuable dimension

of identity development (Haavio-Mannila et al., 2002). Moreover, in many instances alcohol facilitates formation of intimate relationships (Lewis et al., 2012).

Use of other substances, conduct problems, and depressive symptoms

Consistent with previous studies, we found that the use of alcohol was related to conduct problems (Colman et al., 2009) and the use of cigarettes and cannabis (Hale and Viner, 2013). There was a decline in the size of the association between binge drinking and cannabis use over the time span we investigated, and thus a tendency towards the “softening” of alcohol users in this respect. The association between binge drinking and depressive symptoms declined between 1992 and 2002, and the association remained at this lower level in 2010. Thus, there was no indication of “hardening” here either. Still, we should note that the association between binge drinking and depressive symptoms remained significant at all three data collection points. There is some heterogeneity in previous findings in this area, possibly because key variables have been measured in different ways (Graham et al., 2007).

CONCLUSION

The proportion of alcohol users, the level of alcohol consumption, and a number of binge drinking measures all followed the same pattern: a steep increase in the 1990s, followed by a decrease of the same magnitude after the turn of the century. We also investigated whether the characteristics of alcohol users changed when prevalence increased in the 1990s and whether other changes took place when consumption decreased after the turn of the century. However, these hypotheses received little support. On the contrary, the characteristics of alcohol users and binge drinkers seem to have been surprisingly stable over this time span.

Recent research suggesting that a “hardening of smokers” was associated with the reduced prevalence rates of smoking (Hughes, 2011) motivated our study. However, whereas we have clearly witnessed a rapid marginalization of smoking habits, no such development is

evident for alcohol use in our data. This may be because the reduction in smoking reflects a gradually tougher and more restrictive tobacco policy. It has been accompanied by social changes in perceptions and values and associated stigma (Graham, 2012). The changes in alcohol consumption we observed seem to be more random. At least they do not reflect changes in Norwegian alcohol policy over the time span we investigated. Here, there has been a tendency to liberalization over the last decade (Storvoll and Halkjelsvik, 2013) - i.e. over the same time span when we witnessed a clear reduction in alcohol use among adolescents.

Thus, developments in the tobacco and alcohol fields seem to be very different. Whereas smoking habits are gradually marginalized, alcohol use still seems to be normative behaviour for adolescents in Norway.

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Conflicting interests

None

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Table 1. Measures of alcohol consumption and binge drinking in 1992, 2002, and 2010, among 16 and 17 year old boys and girls

	1992			2002			2010		
	Total	Boys	Girls	Total	Boys	Girls	Total	Boys	Girls
Alcohol use previous 4 weeks (no/yes), n %	1664 (55.7)	841 (54.6)	823 (56.8) ^{ns}	2101 (61.4)	1054 (61.1)	1047 (61.7) ^{ns}	1462 (52.3)	733 (50.6)	729 (54.1) ^{ns}
5 + units of alcohol on last drinking occasion, n %	1393 (47.1)	803 (52.6)	590 (41.2) ***	1964 (57.4)	1085 (62.9)	879 (51.8) ***	1255 (44.9)	681 (47.0)	574 (42.6) ***
10+ units of alcohol on last drinking occasion, n %	717 (24.2)	500 (32.8)	217 (15.2) ***	1045 (30.5)	733 (42.5)	312 (18.4) ***	668 (23.9)	446 (30.8)	222 (16.5) ***
Number of drinks last month, mean, st.dev.	11.4 (18.3)	13.6 (20.1)	9.0 (15.6) ***	15.7 (23.1)	18.9 (25.7)	12.6 (19.7) ***	11.0 (19.6)	13.0 (22.2)	8.8 (15.3) ***
10+ times intoxicated past 12 months, n %	648 (21.7)	374 (24.3)	274 (18.9) ***	1206 (35.3)	675 (39.2)	531 (31.3) ***	533 (19.1)	287 (19.8)	246 (18.3) ^{ns}
50+ times intoxicated past 12 months, n %	122 (4.1)	87 (5.6)	35 (2.4) ***	317 (9.3)	197 (11.4)	120 (7.1) ***	98 (3.5)	64 (4.4)	34 (2.5) ^{**}
Times intoxicated past 12 months, mean st.dev.	1.6 (1.7)	1.7 (1.8)	1.6 (1.6) ^{ns}	2.3 (1.7)	2.4 (1.8)	2.2 (1.7) ^{ns}	1.6 (1.6)	1.6 (1.7)	1.7 (1.6) ^{ns}

Note: For all measures, differences between 1992 and 2002 and 2002 and 2010 were significant ($p < .001$). For all measures, differences between 1992 and 2010 were not significant ($p < .05$), with the exception of number of drinks last month ($p < .001$). Differences between boys and girls: ^{**} $p < .01$, ^{***} $p < .001$, ^{ns} non-significant.

Table 2. Odds ratios (OR) for the association between predictors and alcohol use the past four weeks among 16 and 17 years old adolescents in 1992, 2002 and 2010

	1992		2002		2010		Difference
	OR	95 % CI	OR	95 % CI	OR	95 % CI	
Gender [§]	1.06	.91–1.23	.99	.86–1.14	1.10	.94–1.28	
Immigrant background [§]	.67*	.46–.99	.45***	.33–.61	.46***	.33–.64	
Parental characteristics							
Parents on welfare (range 0–1)	.94	.75–1.18	.77*	.62–.95	1.29*	1.03–1.61	2–3
Parental care (range 1–4)	.73***	.64–.83	.79***	.70–.89	.79***	.70–.90	
Not living with both biological parents (range 0–1)	1.90***	1.60–2.26	1.34***	1.14–1.56	1.07	.92–1.26	1–2, 1–3
Parental alcohol intoxication (range 0–1)	2.67***	1.89–3.77	2.15***	1.56–2.97	2.99***	2.08–4.30	
Integration, sexual behaviour, loneliness							
Social accept (range 1–4)	1.68***	1.42–1.98	1.82***	1.57–2.09	1.62***	1.39–1.89	
Sexual intercourse (range 0–1)	5.11***	4.26–6.13	3.75***	3.20–4.40	3.66***	3.09–4.33	1–2, 1–3
Loneliness (range 1–4)	.75***	.65–.87	.66***	.58–.75	.76***	.66–.87	
Smoking, cannabis, conduct problems, depressive symptoms							
Daily smoking (range 0–1)	5.98***	4.73–7.56	4.69***	3.75–5.85	5.37***	3.54–8.16	
Cannabis use (range 0–1)	7.43***	4.41–12.53	7.62***	5.56–10.43	4.00***	2.78–5.74	2–3
Conduct problems (range 0–1)	1.61***	1.41–1.83	1.39***	1.25–1.55	1.36***	1.19–1.56	
Depressive symptoms (range 1–4)	1.41***	1.23–1.62	1.30***	1.16–1.46	1.11	.99–1.24	1–3

Note: 95% CI = 95% confidence interval of odds ratio; [§] analyses controlled for age; All other analyses controlled for age, gender, and immigrant background; * $p < .05$, ** $p < .01$, *** $p < .001$. Interaction tests: 1–2 = significant difference in relationship between 1992 and 2002, 2–3 = significant difference in relationship between 2002 and 2010, 1–3 = significant difference in relationship between 1992 and 2010.

Table 3. Proportional odds ratios (OR) for the association between predictors and binge drinking among 16 and 17 years old adolescents in 1992, 2002 and 2010

	1992		2002		2010		Difference
	OR	95 % CI	OR	95 % CI	OR	95 % CI	
Gender [§]	.89	.78-1.02	.80***	.71-.90	1.07	.93-1.22	2-3
Immigrant background [§]	.52**	.35-.78	.34***	.25-.47	.39***	.29-.53	
Parental characteristics							
Parents on welfare (range 0–1)	1.10	.90-1.34	.93	.78-1.11	1.30**	1.08-1.57	2-3
Parental care (range 1–4)	.71***	.63-.79	.77***	.70-.86	.71***	.64-.80	
Not living with both biological parents (range 0–1)	1.73***	1.49-2.01	1.47***	1.30-1.66	1.19*	1.04-1.37	1-3, 2-3
Parental alcohol intoxication (range 0–1)	2.60***	1.99-3.40	1.98***	1.56-2.51	2.86***	2.14-3.84	
Integration, sexual behaviour, loneliness							
Social accept (range 1–4)	1.80***	1.55-2.10	1.95**	1.73-2.21	1.76***	1.53-2.03	
Sexual intercourse (range 0–1)	4.83***	4.16-5.61	3.93***	3.46-4.48	5.90***	5.03-6.91	2-3
Loneliness (range 1–4)	.76***	.67-.87	.67***	.60-.75	.70***	.61-.79	
Smoking, cannabis, conduct problems, depressive symptoms							
Daily smoking (range 0–1)	4.76***	4.04-5.60	4.50***	3.90-5.20	4.48***	3.44-5.84	
Cannabis use (range 0–1)	12.73***	9.18-16.65	6.43***	5.40-3.18	5.37***	4.12-6.98	1-2, 1-3
Conduct problems (range 0–1)	1.86***	1.66-2.07	1.69***	1.53-1.86	1.79***	1.55-2.07	
Depressive symptoms (range 1–4)	1.47***	1.29-1.67	1.21***	1.10-1.33	1.22***	1.10-1.35	1-2

Note: 95% CI = 95% confidence interval of odds ratio; [§] analyses controlled for age; All other analyses controlled for age, gender, and immigrant background; * $p < .05$, ** $p < .01$, *** $p < .001$. Post hoc tests: 1–2 = significant difference in relationship between 1992 and 2002, 2–3 = significant difference in relationship between 2002 and 2010, 1–3 = significant difference in relationship between 1992 and 2010.