

Adolescent income and binge drinking initiation: prospective evidence from the MyLife study

Geir Scott Brunborg¹ , Tilmann von Soest²  & Jasmina Burdzovic Andreas¹ 

Department of Alcohol, Tobacco, and Drugs, Norwegian Institute of Public Health, Oslo, Norway¹ and PROMENTA Research Center, Department of Psychology, University of Oslo, Oslo, Norway²

ABSTRACT

Background and aims No previous studies have examined the prospective association between disposable income and binge-drinking initiation among adolescents. We aimed to examine whether there is such an association and, if so, whether it is robust to confounders, uniform across individual characteristics and linear versus non-linear. **Design** Prospective study of adolescents from 32 middle schools, stratified according to geographic location, urban and rural locations and standard of living. Adolescents were assessed in 2017 (T1) and 1 year later (T2). **Setting** Norway. **Participants** A nation-wide sample of 1845 adolescents (mean age 13.5 years, 44% boys) with no binge-drinking experience at T1. **Measurements** Data were collected on binge drinking at T1 and T2. Data on disposable income and on a range of demographic, individual and family factors were collected at T1. **Findings** Overall, 7.2% initiated binge drinking between T1 and T2. Logistic regression showed that the crude linear effect of disposable income on binge drinking initiation was substantial, and only slightly attenuated in the fully adjusted model including all putative confounders [odds ratio (OR) = 1.19, 95% confidence interval (CI) = 1.08, 1.31, $P < 0.001$]. However, interaction analyses showed disposable income to be negatively related to binge drinking initiation for adolescents who had experienced light drinking at T1 (OR = 0.66, 95% CI = 0.49, 0.89, $P = 0.006$) or who had seen their mothers intoxicated [OR = 0.62, 95% CI = 0.39, 0.99, $P = 0.043$]. **Conclusion** Norwegian adolescents with higher disposable income have a greater risk of subsequent binge drinking initiation than those with lower disposable income. Each additional 100 NOK (\approx €10) of weekly income increased the risk of binge drinking initiation in the following year by approximately 20%.

Keywords Adolescence, alcohol, binge-drinking, heavy episodic drinking, income, initiation, longitudinal study, onset, socio-economic status, spending money.

Correspondence to: Geir Scott Brunborg, Department of Alcohol, Tobacco, and Drugs, Norwegian Institute of Public Health, PO Box 222-Skøyen, N-0213 Oslo, Norway. E-mail: geir.brunborg@fhi.no

Submitted 9 March 2020; initial review completed 20 May 2020; final version accepted 25 September 2020

[Correction added on 16 November 2020, after first online publication: One of the authors' names was changed after publication.]

INTRODUCTION

Adolescent alcohol consumption, and binge drinking in particular, is associated with multiple negative consequences, and is one of the most important risk factors for reduced disability adjusted life-years among young people [1–4]. Knowledge of key modifiable risk factors for adolescent binge drinking is important for developing effective prevention strategies. One such factor may be adolescents' own income, which in western societies is typically obtained from weekly allowances, different types of paid work and gifts from family members [5,6]. The degree to which this income is freely disposable probably varies, but higher income might place adolescents at greater risk for alcohol consumption because

they may be more able to afford alcohol purchases [6]. Adolescents with higher income may also, to a larger degree, work in paid jobs where they experience less monitoring by parents and more exposure to older youth and adults who drink alcohol, which again may increase the risk of binge drinking [7]. However, the relationship between adolescents' own income and the risk of binge drinking has received surprisingly little attention from researchers.

Previous studies have shed some light on this basic association. A common assumption is that family socio-economic status (SES) is a proxy for adolescents' income, and that adolescents from higher SES backgrounds are at greater risk of alcohol use because they can afford to buy alcohol and afford greater amounts. Some studies

indicate that this may be the case [8,9]. However, a recent systematic review concluded that current research offers inconclusive evidence as to the relationship between family SES and adolescent binge drinking [10]. One reason for this is that family SES might be an imprecise proxy for adolescents' own freely disposable income [5,11–13].

We have identified only three studies where adolescents' own income was conceived as a risk factor for alcohol use. The first analyzed data were from 16 repeated cross-sectional studies conducted in Finland, and estimated the association between 14-year-olds' weekly disposable income and drinking to intoxication, with adjustment for place of residence, father's or guardian's level of education and professional status, family structure and survey year [12]. The results showed that adolescents' higher income was associated with increased odds for drinking to intoxication weekly, monthly and occasionally. The second study used cross-sectional data from 14–17-year-olds from six European cities, and estimated the association between adolescents' weekly income and binge drinking, adjusted for age, gender, migrant background, parental level of education, family affluence and academic achievement [14]. These results also showed that the odds of adolescents' weekly binge drinking increased with their income. The third study used cross-sectional data from North West England on binge drinking among 15–16-year-olds [15]. After adjusting for sex, age, social deprivation, ethnicity, ever buying own alcohol, membership of a youth organization and others supplying alcohol, the study found that adolescents with more than £10 of spending money per week had greater odds for binge drinking compared to those with lower weekly income. These studies indicate that there is an association between disposable income and binge drinking; however, they were limited by their cross-sectional nature and insufficient control for possible confounders. To understand the direction of the association between income and adolescence binge drinking, longitudinal data are needed. However, to the best of our knowledge, no such prospective study has been conducted so far.

We address the lack of prospective research by using data from a large-scale prospective study of Norwegian adolescents. Weekend binge drinking—albeit in decline—remains the primary drinking mode among youth in Norway [16–18], and the rate of binge drinking is slightly below the average of European and North American countries [19]. We estimated the prospective relation between adolescents' disposable income and binge drinking initiation in the next 12 months. We also considered if this relation might be spurious by including other factors as control variables in our analysis. These factors were chosen because we assume that they are related to both income and binge drinking initiation, and may confound the hypothesized association [20]. Previous studies have shown that demographic and family factors (gender, grade

level, residing in an urban versus rural area, parents' cohabitation, belonging to a religion that prohibits alcohol consumption, family social status, family financial problems and low parental monitoring) may directly or indirectly determine adolescents' income and engagement in binge drinking [21–25]. Social influence (seeing parents drink, the importance of alcohol among peers) and own experiences with drinking small amounts of alcohol might also be related to both income and binge drinking [26]. Moreover, personal characteristics such as low self-regulation, deviant behaviour or school connectedness may be additional potential confounders of the income-bingeing relationship [2,27,28]. We also considered whether this relationship may differ across levels of important background characteristics and whether it may be non-linear, as income might infer risk only after a certain amount.

The aims of this contribution can be summarized as follows: (1) to estimate the prospective relation between adolescents' income and initiation of binge drinking in the following year while controlling for key confounding variables; if such a relationship is found, (2) to test if the relation between adolescents' income and initiation of binge drinking is moderated by key personal characteristics; and (3) to test if the relation between adolescents' income and initiation of binge drinking is linear or non-linear.

METHODS

Design

This research is based on the MyLife study, where a population-based sample of adolescents has been followed by means of surveys at two time-points 1 year apart.

Data source and sampling

The sampling strategy aimed to recruit a nation-wide yet geographically and socio-economically heterogeneous sample. For this purpose, one county was selected from each of Norway's five geographical regions. Municipalities and city districts were drawn from within each county, stratified by degree of urbanization and socio-economic indicators. In districts with several middle schools (8th, 9th and 10th grades) only one school was drawn for participation. The study design, ethical approval, recruitment and consent procedures are described in detail elsewhere [29].

Of the 42 eligible schools, 10 declined participation, leaving 32 schools with a total enrolment of 6805 students. Through school sessions, all students were instructed to deliver and return information packages with consent forms to/from their parents. A total of 4123 forms were returned, 3447 with parental consent.

Baseline assessment (T1) was completed in the 2017 autumn semester, with 86% response rate (2975 students). All eligible students were invited for the follow-up

(T2) during the 2018 autumn semester. A total of 2857 students (83%) provided valid responses, and 2514 (73%) completed both assessments.

We restricted our analysis to students in grades 8 and 9 at T1 who completed both assessments ($n = 1892$) because our main question concerned binge drinking initiation, and these youngest cohorts were less likely to have initiated at T1. Forty-seven students who reported any binge drinking at T1 were excluded for the same reason. This group was older than the main sample (74.4 versus 46.1% were in the ninth grade, $P < 0.001$), and they had higher weekly disposable income (318 NOK versus 189 NOK, $P < 0.001$). They were also over-represented in terms of having non-cohabiting parents, family financial problems, low parental monitoring, seen parents intoxicated, scored higher on conduct problems and scored lower on self-regulation and school connectedness ($P < 0.05$).

The final analytical sample comprised 1845 (44% male) 8th and 9th graders who were, on average, aged 13.5 years [standard deviation (SD) = 0.50] at T1. At both assessments the participants completed an on-line questionnaire during a regular school hour under teachers' supervision.

Measures

Binge drinking initiation

At T2, respondents indicated the frequency with which they had consumed five or more standard drinks during the same occasion in the last 12 months (i.e. since T1). A dichotomous variable (no = 0, yes = 1) was constructed to capture any binge drinking; that is, its initiation in this sample.

Disposable income

Adolescents' disposable income in Norwegian kroner (NOK) was measured at T1 by two questions: (1) 'How much is your weekly allowance (including payment for house chores)?' with responses ranging from 'none' to 'more than 500 NOK' on a five-point scale and (2) 'How much do you earn per month from other types of work?', with 13 response options ranging from 'nothing' to '10 000 NOK or more'. The responses were capped at 3000 NOK (i.e. included in the '2000–2999 NOK' category) to reduce the effect of extreme values. The responses to both questions were coded as mid-point amounts (e.g. '500–999 NOK' coded as 750) and allowance and other income (divided by four to obtain weekly amounts), summed to total income, and divided by 100 to obtain a basic metric of 100 NOK/week.

Covariates

All covariates were measured at T1. Information about residential area (rural versus urban) was obtained from Statistics Norway.

Parents' cohabitation was measured by the item: 'Do your parents live together?', with a yes/no (coded 0/1) response option.

Religious denomination was measured by the question: 'Which religion do you belong to?'. As Islam and Buddhism explicitly prohibit alcohol consumption, those two options were coded 1, while the remaining six options (including 'non-religious' and 'other') were coded 0.

Family social status was measured with an adaptation of the MacArthur Scale of Subjective Social Status—youth version [30]. Respondents indicated where in their neighbourhoods they would place their families on a scale from the least (coded 1) to most affluent (coded 10).

Family financial problems was measured with one item asking whether the adolescent's family experienced money problems. The responses 'yes, in the past 12 months' and 'yes, more than 12 months ago' were both coded 1, while 'no, never' was coded 0.

Parental monitoring was assessed by one question based on established measures [31,32]: 'How much do your parents know about what you do in your free time?'. The three response options 'They think they know what I'm doing', 'Usually they don't know what I'm doing' and 'Sometimes they know what I'm doing' were coded 1 to indicate low parental monitoring. The remaining options: 'Pretty often they know what I'm doing' and 'They always know what I'm doing' were coded 0.

Parental alcohol use was measured by two questions assessing whether the respondent had seen his/her father or mother intoxicated in the past 12 months. The response options were 'never' (coded 1), 'once or twice' (coded 2), 'three to 10 times' (coded 3) and 'more than 10 times' (coded 4).

Importance of alcohol among peers was measured by asking the participants: 'How important is drinking alcohol among your peers?'. Response options ranged from 'not important at all' (coded 1) to 'very important' (coded 4).

Frequency of light drinking was measured by asking the participants to indicate if they had ever had any alcohol (more than just taking a sip) and asking those who responded affirmatively to indicate the frequency with which they had consumed alcohol in the previous 12 months. Response options ranged from 'not at all' (0) to 'every day or almost every day' [5].

Self-regulation was measured by a set of four items adopted from a larger 31-item Self-Regulation Questionnaire [33], which included items such as: 'I make a plan for the important things that I do'. Responses were made on a four-point scale ranging from 'rarely or never' (coded 1) to 'almost always or always' (coded 4), and the

mean of item scores comprised the Self-regulation Index. Cronbach's alpha for the scale was 0.77.

Conduct problems were measured by seven items adopted from the Young in Norway Study [34], assessing the frequency of conduct problems such as vandalism, lying, stealing and fighting during the past 12 months. Responses were made on a four-point scale ranging from 'never' (coded 0) to 'five or more times' (coded 3). The sum of item scores comprised the Conduct Problems Index.

School connectedness was measured with the five-item Add Health School Connectedness Scale [35]. Participants responded to each item (e.g. 'I am happy to be at this school') using a five-point scale ranging from 'strongly disagree' (coded 1) to 'strongly agree' (coded 5). The mean of item scores comprised the School Connectedness Index. Cronbach's alpha for the scale was 0.81.

Analyses

We used Stata version 15 for data analysis [36]. Missing values were handled by multiple imputations under the missing at random (MAR) assumption [37], with the predictive mean matching module in Stata [38]. Ten data sets were created based on all study variables.

Logistic regression was used to estimate the relation between income and binge drinking initiation. Crude estimates were obtained by regressing binge drinking initiation on each of the study variables in separate models. The adjusted estimate was obtained by regressing binge drinking initiation on income and all putative confounders. All models accounted for school nesting by use of cluster-robust standard errors.

As sensitivity analysis we estimated the adjusted model with list-wise deletion, under the missing completely at random (MCAR) assumption [39]. We also estimated the adjusted model using a propensity score approach with continuous treatment [40] implemented with the 'gpscore' and 'doseresponse_model' modules in Stata [41].

We assessed moderation by adding interaction terms for income by each of the considered confounders, one by one, to the adjusted model. Some variables were dichotomized for this purpose, either converted to binary indicators or to indicate high scores (≤ 1 SD above mean = 0, > 1 SD above mean = 1); see Table 3.

To test non-linearity, the quadratic and cubic terms for income were successively added to the adjusted model.

Predicted probabilities of binge drinking initiation with control variables set at the mean were estimated with the 'mimrgns' module in Stata [42].

The analysis was not pre-registered on a publicly available platform, and the results should be considered exploratory.

RESULTS

Descriptive statistics and correlations for all study variables are presented in Table 1. In total, 7.2% initiated binge drinking in the 12 months between T1 and T2. Of those who initiated, 51% reported binge drinking on one or two occasions in the last 12 months, 23% reported once per month or less frequently and 26% reported binge drinking more frequently than once per month. Fewer of the 8th graders (4.9%) initiated binge drinking compared to the 9th graders (9.7%), $\chi^2_{(1)} = 180.02$, $P < 0.001$. Average weekly disposable income was 189 NOK (\approx €19). The 25th, 50th and 75th percentiles were 50 NOK, 113 NOK and 263 NOK, respectively.

The crude effect of disposable income on the risk of binge drinking initiation was substantial, and this relationship was only slightly attenuated in the fully adjusted model (Table 2). All covariates, apart from gender and belonging to a religion that prohibits alcohol use, were associated with greater odds of binge drinking initiation. The estimate for our key exposure (income) can be interpreted as relative risk [43]: each additional 100 NOK (\approx €10) of weekly income is associated with 19% greater risk of binge drinking initiation in the following year. As evident in Fig. 1, the risk of binge drinking initiation was small for adolescents, with no and minimal income; however, it increases with higher income. For instance, the risk for adolescents with 500 NOK weekly income was double that of adolescents with 100 NOK weekly income.

We also tested whether income from paid work had a different relationship to binge drinking initiation than weekly allowance. Regressing binge drinking initiation on income from paid work, adjusting for all covariates [odds ratio (OR) = 1.28, 95% confidence interval (CI) = 1.10, 1.50, $P = 0.002$] and repeating the model with weekly allowance (OR = 1.21, 95% CI = 1.05, 1.40, $P = 0.009$) generated estimates that were similar to the original results.

We tested whether the income-binge drinking association was moderated by any of the 15 covariates by including product terms (Table 3). Only maternal intoxication and light drinking showed statistically significant interaction effects. As shown in Fig. 2, in contrast to the general trend of higher risk for binge drinking with increasing income, among adolescents who had seen their mother intoxicated, high disposable income was related to a reduced risk of binge drinking initiation. Similarly, income was negatively related to binge drinking initiation for those who already had engaged in light drinking at T1 (see Fig. 3).

The quadratic (OR = 0.99; 95% CI = 0.97, 1.01, $P = 0.442$) and cubic (OR = 1.00; 95% CI = 1.00, 1.01, $P = 0.305$) terms for income were not statistically significant, indicating that the relation between income and binge drinking initiation was linear.

Table 1 Descriptive statistics and pairwise correlations between all study variables ($n = 1845$).

No.	Variable	Observed range	Valid cases	Mean (SD)/%	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1	Binge drinking at T2	0-1	1810	7.1%	-																
2	Income (in 100 NOK [†] per week)	0-11.25	1685	1.89 (1.95)	0.14*	-															
3	Male gender	0-1	1845	43.6%	0.02	0.01	-														
4	Grade (9th)	0-1	1845	45.7%	0.10*	0.06*	-														
5	Urban area	0-1	1845	64.2%	-	-	0.03	0.00	-												
6	Parents' non-cohabitation	0-1	1840	26.5%	0.09*	0.03	-	0.02	0.01	-											
7	Religion prohibiting alcohol consumption	0-1	1792	2.5%	-	0.02	-	-	-	-											
8	Family social status	1-10	1733	7.31 (1.66)	0.03	0.00	0.00	0.01	0.01	0.04	-										
9	Family financial problems	0-1	1806	7.7%	0.04	0.14*	0.05	0.05*	-	-	0.07*	0.08*	-								
10	Low parental monitoring	0-1	1834	16.2%	0.13*	0.00	0.02	0.04	0.02	0.16*	0.08*	0.28*	-								
11	Freq. seen father intoxicated	1-4	1711	1.08 (0.34)	0.14*	0.10*	0.11*	-	-	0.07*	0.03	0.10*	0.13*	-							
12	Freq. seen mother intoxicated	1-3	1705	1.05 (0.23)	0.08*	0.03	0.03	0.04	0.02	0.03	0.02	0.05	0.09*	0.07*	-						
13	Importance of alcohol among peers	1-4	1818	1.04 (0.29)	0.06*	0.06*	-	0.03	0.00	0.03	0.01	0.03	0.05	0.07*	0.44*	-					
14	Frequency of light drinking	1-5	1814	1.06 (0.30)	0.10*	0.05*	-	0.00	-	0.02	0.02	0.02	0.08*	0.10*	-	0.02	-				
15	Self-regulation	1-4	1712	2.74 (0.67)	0.23*	0.04	-	0.10*	0.00	0.01	-	0.02	0.06*	0.13*	0.15*	0.15*	0.15*	0.00.14*	-		
16	Conduct problems	0-12	1828	0.75 (1.04)	-	0.02	0.03	0.02	0.08*	-	0.02	0.03	-	-	-	-	-	-	-	-	-
17	School connectedness	1-5	1827	4.33 (0.74)	0.06*	0.08*	0.13*	-	0.00	0.08*	0.04	0.03	0.04	0.12*	-	0.04	0.22*	0.06*	0.04	0.06*	0.31*
								0.02			0.04	0.04	0.12*	0.34*	0.10*	0.13*	0.11*	0.31*	0.14*	0.18*	0.22*
								0.15*	0.06*	0.07*	0.03	0.21*	0.18*	0.15*	0.10*	0.06*	0.10*	0.12	0.18*	0.18*	0.22*

* $P < 0.05$ †100 NOK \approx €10. The number of missing cases for each variable is n (1845) minus the number of valid cases.

Table 2 Binge drinking initiation at T2 regressed on income and possible confounding variables ($n = 1845$).

	Crude models ^a		Adjusted model ^b	
	OR (95% CI)	P	OR (95% CI)	P
Income (in 100 ^c NOK per week)	1.22 (1.11, 1.32)	<0.001	1.19 (1.08, 1.30)	<0.001
Male gender	1.11 (0.77, 1.59)	0.577	1.04 (0.70, 1.55)	0.837
Grade (9th)	2.11 (1.30, 3.42)	0.002	1.96 (1.09, 3.54)	0.026
Urban area	0.50 (0.33, 0.78)	0.002	0.50 (0.30, 0.84)	0.009
Parents' non-cohabitation	1.71 (1.18, 2.48)	0.004	1.41 (0.92, 2.16)	0.111
Religion prohibiting alcohol consumption	0.29 (0.04, 2.19)	0.229	0.24 (0.03, 1.85)	0.171
Family social status	0.93 (0.82, 1.04)	0.184	1.01 (0.89, 1.14)	0.936
Family financial problems	3.41 (2.05, 5.69)	<0.001	2.21 (1.27, 3.85)	0.005
Low parental monitoring	3.19 (2.25, 4.52)	<0.001	1.65 (1.04, 2.61)	0.032
Frequency seen father intoxicated	1.80 (1.34, 2.41)	<0.001	1.27 (0.85, 1.88)	0.238
Frequency seen mother intoxicated	2.06 (1.21, 3.49)	0.008	0.96 (0.39, 2.34)	0.927
Importance of alcohol among peers	2.03 (1.37, 3.01)	<0.001	1.49 (0.86, 2.60)	0.155
Frequency of light drinking	3.89 (2.22, 6.80)	<0.001	2.29 (1.25, 4.16)	0.007
Self-regulation	0.73 (0.57, 0.93)	0.010	0.94 (0.71, 1.24)	0.659
Conduct problems	1.35 (1.23, 1.47)	<0.001	1.16 (1.02, 1.33)	0.020
School connectedness	0.61 (0.51, 0.72)	<0.001	0.83 (0.70, 0.98)	0.033

OR = odds ratio; CI = confidence interval. CIs were based on cluster-robust standard errors. ^aHeavy drinking initiation regressed on each variable in separate models. ^bAll variables entered simultaneously. Estimates are pooled from 10 data sets with imputed missing values using predictive mean matching. ^c100 NOK \approx €10.

The estimate for income on binge drinking initiation adjusting for putative confounders using list-wise deletion (OR = 1.17, 95% CI = 1.05, 1.29) did not differ substantially from adjusted logistic regression with multiple imputations. This was also the case for propensity score analysis (OR = 1.23, 95% CI = 1.09, 1.39).

DISCUSSION

In line with previous cross-sectional studies [12,14,15], we found that adolescents with greater income were more

likely to initiate binge drinking in the following year. This relationship was robust to adjustment for a number of putative confounding factors. However, interaction models revealed that for the small group of adolescents who had seen their mother intoxicated and those who had already engaged in light drinking at the start of the study, greater income was associated with lower risk of binge drinking initiation.

Our results echo previous cross-sectional studies investigating disposable income and smoking during adolescence [44,45], and provide converging evidence that

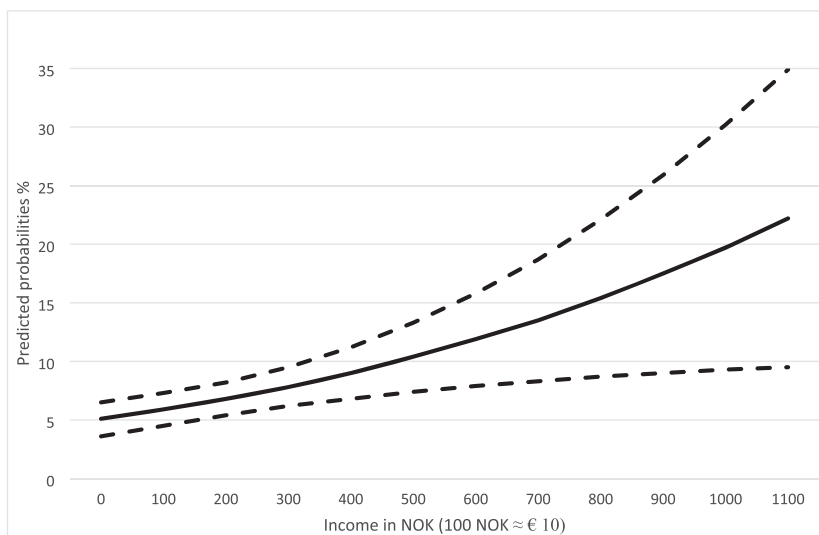


Figure 1 Predicted probabilities (%) of binge drinking initiation in the next 12 months by level of weekly income (in NOK) among Norwegian 13- and 14-year-olds. Broken lines are upper and lower 95% confidence intervals

Table 3 Logistic regression models with interaction terms to test moderation.

Model no.	Included interaction term	Income		Interaction term	
		OR (95% CI)	P	OR (95% CI)	P
Model 1	None	1.19 (1.08, 1.30)	<0.001	–	
Model 2	Income × gender	1.24 (1.12, 1.38)	<0.001	0.92 (0.79, 1.07)	0.295
Model 3	Income × grade	1.27 (1.11, 1.45)	<0.001	0.90 (0.78, 1.05)	0.169
Model 4	Income × urban area	1.22 (1.06, 1.39)	0.005	0.96 (0.79, 1.15)	0.645
Model 5	Income × parents' non-cohabitation	1.19 (1.09, 1.30)	<0.001	1.00 (0.79, 1.26)	1.000
Model 6	Income × religion prohibiting alcohol consumption	1.19 (1.08, 1.31)	<0.001	0.85 (0.68, 1.05)	0.132
Model 7	Income × low perceived social status ^a	1.20 (1.09, 1.32)	<0.001	0.98 (0.74, 1.31)	0.909
Model 8	Income × family financial problems	1.20 (1.09, 1.31)	<0.001	0.95 (0.72, 1.25)	0.716
Model 9	Income × low parental monitoring	1.21 (1.08, 1.35)	0.001	0.96 (0.78, 1.18)	0.685
Model 10	Income × seen father intoxicated ^b	1.20 (1.08, 1.32)	<0.001	0.96 (0.70, 1.32)	0.788
Model 11	Income × seen mother intoxicated ^b	1.21 (1.11, 1.33)	<0.001	0.62 (0.39, 0.99)	0.043
Model 12	Income × alcohol highly important among peers ^b	1.20 (1.09, 1.31)	<0.001	0.93 (0.65, 1.34)	0.695
Model 13	Income × light drinking ^b	1.23 (1.12, 1.35)	<0.001	0.66 (0.49, 0.89)	0.006
Model 14	Income × high self-regulation ^a	1.18 (1.07, 1.31)	0.001	1.03 (0.80, 1.32)	0.827
Model 15	Income × high conduct problems ^a	1.23 (1.11, 1.36)	<0.001	0.90 (0.73, 1.10)	0.302
Model 16	Income × low school connectedness ^a	1.22 (1.12, 1.32)	<0.001	0.88 (0.69, 1.12)	0.302

Binge drinking initiation regressed on income and the indicated interaction terms in separate models, adjusted for all other covariates. Estimates are pooled from 10 data sets with imputed missing values using predictive mean matching. OR = odds ratio; CI = confidence interval. CIs were based on cluster-robust standard errors. ^aVariable dichotomized [≤ 1 standard deviation (SD) above the mean = 0, > 1 SD above the mean = 1]. ^bVariable dichotomized (recoded 1 = 0, 2–4 = 1).

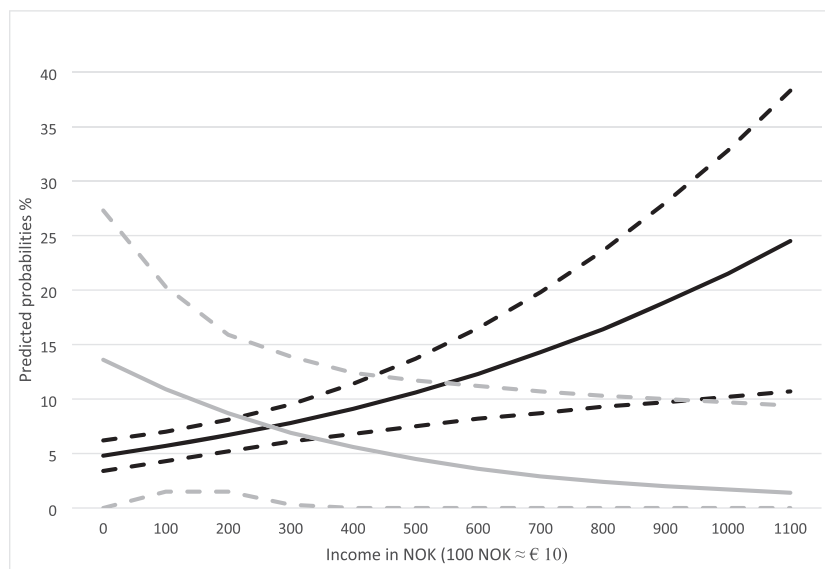


Figure 2 Predicted probabilities (%) of binge drinking initiation in the next 12 months by level of weekly income for adolescents who have not (black lines) and who have (grey lines) seen their mother intoxicated. Broken lines are upper and lower 95% confidence intervals

adolescents' own income acts as a potent yet modifiable risk factor for early substance use. Several potential mechanisms may explain the income–binge drinking association. For example, adolescents with high income may be better positioned to afford alcohol and other goods [6], and to buy enough to engage in binge drinking. Also, such adolescents may be socializing with older adolescents (e.g.

at shopping malls or outside service stations), and may be introduced to alcohol earlier through such contacts. The present study was not designed to provide conclusive information about such potential mechanisms. Understanding the role of disposable income and its mechanisms of action is an important task for future research, and may be of key importance for early alcohol prevention strategies.

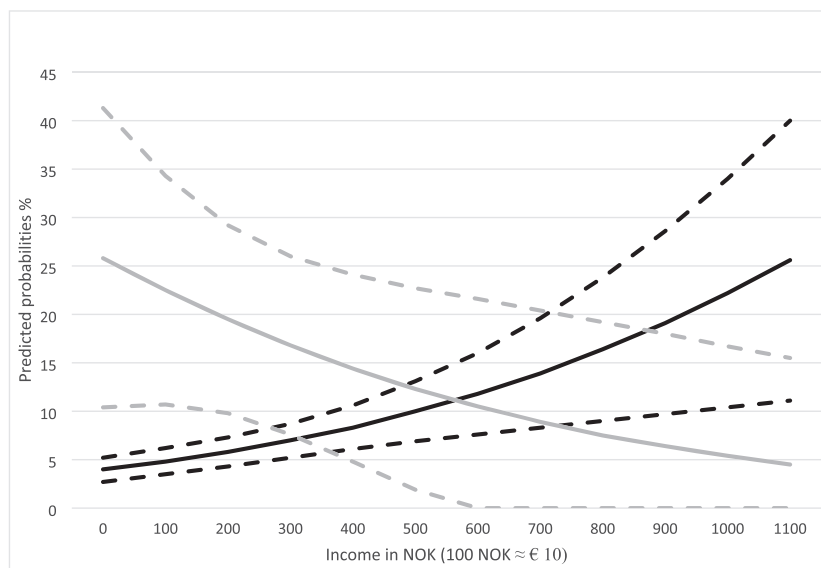


Figure 3 Predicted probabilities (%) of binge drinking initiation in the next 12 months by level of weekly income for adolescents who have not (black lines) and who have (grey lines) engaged in light drinking at T1. Broken lines are upper and lower 95% confidence intervals

We note that several of the potential confounders included in the study were statistically significant prospective predictors of binge drinking initiation in the adjusted model. Interestingly, family financial problems were independently related to binge drinking initiation, indicating a complex interplay between adolescents' own disposable income and the family financial situation as sources for binge drinking initiation. Other factors found to be of importance were urbanity, conduct problems, connectedness to school and initial experiences with light drinking. These and other characteristics need to remain integrated into future research on early substance use. Finally, our results indicate that the general association between income and binge drinking initiation may be reversed for certain adolescents, i.e. those who had seen their mother intoxicated and those with early light drinking experiences. It is possible that binge drinking in these groups was not driven by mechanisms involving financial means and alcohol purchases. They may instead reflect factors such as availability of alcohol at home, parental offering of alcohol or deterrence caused by negative experiences. Future research needs to examine such characteristics and putative subgroup differences in greater detail.

Reducing alcohol accessibility through taxation is already a cornerstone of public health policies in developed and high-income countries [46]. This strategy may be even more effective with closer parental control of their children's disposable income. Indeed, an important implication of the current study is that reducing the amount of money freely available to adolescents may translate into lowering the risk of binge drinking and adverse consequences.

Strengths and limitations

To our knowledge, this is the first prospective study of adolescents' disposable income and binge drinking. The study also accounted for a substantial number of confounding factors. The sample was both diverse and sizeable, enabling more precise estimates.

All measures were based on self-reports, which can lead to known biases, such as selective recall and socially desirable responses, especially among younger participants. Study limitations also include that a considerable number of students did not participate because parental consent forms were not returned. We do not know how such non-participation has affected the results, because it was not possible to obtain information on students whose parents did not return consent forms. The exploratory moderation analyses involved multiple testing; therefore, we cannot rule out false discoveries. Finally, while we assessed many putative confounding variables some may have been omitted, and we cannot rule out residual confounding. For instance, parental-reported measures of household income and parental education were not available.

CONCLUSION

We estimated the effect of adolescents' disposable income on the risk of binge drinking initiation, and found that each additional 100 NOK (\approx €10) of weekly income was associated with an approximately 20% greater risk of binge drinking initiation during the following year. Furthermore, this effect was robust to adjustment for multiple putative confounding factors. An important implication is that parental control of adolescents' freely disposable income

may reduce the risk of binge drinking initiation and related adverse consequences.

Declaration of interests

None.

Acknowledgements

T.v.S.'s work with this research was supported by two grants from the Research Council of Norway (grant no. 288083 and grant no. 300816).

Author contributions

Geir Brunborg: Conceptualization-equal; data curation-lead; formal analysis-lead; investigation-equal; methodology-lead; visualization-lead; writing-original draft-lead; writing-review & editing-equal. **Tilmann von Soest:** Conceptualization-supporting; data curation-supporting; formal analysis-supporting; investigation-supporting; methodology-equal; visualization-supporting; writing-original draft-equal; writing-review & editing-equal. **Jasmina Burdzovic** **Andreas:** Conceptualization-equal; data curation-Supporting; formal analysis-supporting; investigation-equal; methodology-supporting; writing-original draft-equal; writing-review & editing-equal.

References

- Hill K. G., White H. R., Chung I. J., Hawkins J. D., Catalano R. F. Early adult outcomes of adolescent binge drinking: person-and variable-centered analyses of binge drinking trajectories. *Alcohol Clin Exp Res* 2000; **24**: 892–901.
- Brunborg G. S., Norström T., Storvoll E. E. Latent developmental trajectories of episodic heavy drinking from adolescence to early adulthood: predictors of trajectory groups and alcohol problems in early adulthood as outcome. *Drug Alcohol Rev* 2018; **37**: 389–95.
- Viner R. M., Taylor B. Adult outcomes of binge drinking in adolescence: findings from a UK national birth cohort. *J Epidemiol Community Health* 2007; **61**: 902–7.
- Mokdad A. H., Forouzanfar M. H., Daoud F., Mokdad A. A., El Bcheraoui C., Moradi-Lakeh M., et al. Global burden of diseases, injuries, and risk factors for young people's health during 1990–2013: a systematic analysis for the global burden of disease study 2013. *Lancet* 2016; **387**: 2383–401.
- Meeks C. B. Factors influencing adolescents' income and expenditures. *J Fam Econ Issues* 1998; **19**: 131–50.
- Darling H., Reeder A. L., McGee R., Williams S. Brief report: disposable income, and spending on fast food, alcohol, cigarettes, and gambling by New Zealand secondary school students. *J Adolesc* 2006; **29**: 837–43.
- Frone M. R. Developmental consequences of youth employment. In: Barling J., Kelloway E. K., editors. *Young Workers: Varieties of Experience*. Washington, DC: American Psychological Association; 1999, pp. 89–128.
- Luthar S. S., Small P. J., Ciciolla L. Adolescents from upper middle class communities: substance misuse and addiction across early adulthood. *Dev Psychopathol* 2017; **30**: 315–35.
- Kendler K. S., Gardner C. O., Hickman M., Heron J., Macleod J., Lewis G., et al. Socioeconomic status and alcohol-related behaviors in mid- to late adolescence in the Avon longitudinal study of parents and children. *J Stud Alcohol Drugs* 2014; **75**: 541–5.
- Kwok K. H. R., Yuan S. N. V. Parental socioeconomic status and binge drinking in adolescents: a systematic review. *Am J Addict* 2016; **25**: 610–9.
- Soteriades E. S., DiFranza J. R. Parent's socioeconomic status, adolescents' disposable income, and adolescents' smoking status in Massachusetts. *Am J Public Health* 2003; **93**: 1155–60.
- Lintonen T., Nevalainen J. Has the role of personal income in alcohol drinking among teenagers changed between 1983 and 2013: a series of nationally representative surveys in Finland. *BMJ Open* 2017; **7**: e013994.
- Lintonen T. P., Wilska T.-A., Koivusilta L. K., Konu A. I. Trends in disposable income among teenage boys and girls in Finland from 1977 to 2003. *Int J Consum Stud* 2007; **31**: 340–8.
- Bosque-Prous M., Kuipers M. A. G., Espelt A., Richter M., Rimpelä A., Perelman J., et al. Adolescent alcohol use and parental and adolescent socioeconomic position in six European cities. *BMC Public Health* 2017; **17**: 646–646.
- Bellis M. A., Hughes K., Morleo M., Tocque K., Hughes S., Allen T., et al. Predictors of risky alcohol consumption in schoolchildren and their implications for preventing alcohol-related harm. *Subst Abuse Treat Prev Policy* 2007; **2**: 15.
- Burdzovic A. J. Perceived harmfulness of various alcohol- and cannabis use modes: secular trends, differences, and associations with actual substance use behaviors among Norwegian adolescents, 2007–2015. *Drug Alcohol Depend* 2019; **197**: 280–7.
- Brunborg G. S., Bye E. K., Rossow I. Collectivity of drinking behavior among adolescents: an analysis of the Norwegian ESPAD data 1995–2011. *Nord Stud Alcohol Drug* 2014; **31**: 389–400.
- Pape H., Rossow I., Brunborg G. S. Adolescents drink less: how, who and why? A review of the recent research literature. *Drug Alcohol Rev* 2018; **37**: S98–S114.
- Inchley J. C. D., Budisavljevic S., Torsheim T., Jåstad A., Cosma A., Kelly C., et al. *Spotlight on Adolescent Health and Well-being. Findings from the 2017/2018 Health Behaviour in School-aged Children (HBSC) survey in Europe and Canada*. International report. Copenhagen: WHO Regional Office for Europe; 2020.
- MacKinnon D. P., Krull J. L., Lockwood C. M. Equivalence of the mediation, confounding and suppression effect. *Prev Sci* 2000; **1**: 173–81.
- Chan G. C., Leung J., Quinn C., Kelly A. B., Connor J. P., Weier M., et al. Rural and urban differences in adolescent alcohol use, alcohol supply, and parental drinking. *J Rural Health* 2016; **32**: 280–6.
- Wiles N. J., Lingford-Hughes A., Daniel J., Hickman M., Farrell M., Macleod J., et al. Socio-economic status in childhood and later alcohol use: a systematic review. *Addiction* 2007; **102**: 1546–63.
- Jablonska B., Lindberg L. Risk behaviours, victimisation and mental distress among adolescents in different family structures. *Soc Psychiatry Psychiatr Epidemiol* 2007; **42**: 656–63.
- Hanson M. D., Chen E. Socioeconomic status and substance use behaviors in adolescents: the role of family resources versus family social status. *J Health Psychol* 2007; **12**: 32–5.
- Ritterman M. L., Fernald L. C., Ozer E. J., Adler N. E., Gutierrez J. P., Syme S. L. Objective and subjective social class gradients

- for substance use among Mexican adolescents. *Soc Sci Med* 2009; **68**: 1843–51.
26. Wood M. D., Read J. P., Mitchell R. E., Brand N. H. Do parents still matter? Parent and peer influences on alcohol involvement among recent high school graduates. *Psychol Addict Behav* 2004; **18**: 19–30.
 27. Lynskey M. T., Fergusson D. M. Childhood conduct problems, attention deficit behaviors, and adolescent alcohol, tobacco, and illicit drug use. *J Abnorm Child Psychol* 1995; **23**: 281–302.
 28. Davis K. D., Winsler A., Middleton M. Students' perceptions of rewards for academic performance by parents and teachers: relations with achievement and motivation in college. *J Genet Psychol* 2006; **167**: 211–20.
 29. Brunborg G. S., Scheffels J., Tokle R., Buvik K., Kvaavik E., Andreas J. B. Monitoring young lifestyles (MyLife)—a prospective longitudinal quantitative and qualitative study of youth development and substance use in Norway. *BMJ Open* 2019; **9**: e031084.
 30. Goodman E., Adler N. E., Kawachi I., Frazier A. L., Huang B., Colditz G. A. Adolescents' perceptions of social status: development and evaluation of a new indicator. *Pediatrics* 2001; **108**: e31–e31.
 31. Stattin H., Kerr M. Parental monitoring: a reinterpretation. *Child Dev* 2000; **71**: 1072–85.
 32. Kerr M., Stattin H. What parents know, how they know it, and several forms of adolescent adjustment: further support for a reinterpretation of monitoring. *Dev Psychol* 2000; **36**: 366–80.
 33. Carey K. B., Neal D. J., Collins S. E. A psychometric analysis of the self-regulation questionnaire. *Addict Behav* 2004; **29**: 253–60.
 34. Frøyland L. R., Strand N. P., von Soest T. *Young in Norway—Cross-sectional: Documentation of Design, Variables and Scales*. Oslo: NOVA; 2010.
 35. Furlong M. J., O'Brennan L. M., You S. Psychometric properties of the add health school connectedness scale for 18 sociocultural groups. *Psychol School* 2011; **48**: 986–97.
 36. StataCorp *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC; 2017.
 37. Enders C. K. *Applied Missing Data Analysis*. New York, NY: Guilford Press; 2010.
 38. StataCorp *Stata Multiple-imputation Reference Manual: Release 16*. College Station, TX: Author; 2019.
 39. Little R. J., Rubin D. B. *Statistical analysis with missing data*. Hoboken, NJ: John Wiley & Sons; 2019.
 40. Hirano K., Imbens G. W. The Propensity Score With Continuous Treatments. In: Gelman A., Meng X.-L., editors. *Applied Bayesian Modeling and Causal Inference from Incomplete-Data Perspectives*. Hoboken, NJ: Wiley Blackwell; 2004, pp. 73–84.
 41. Bia M., Mattei A. A Stata package for the estimation of the dose-response function through adjustment for the generalized propensity score. *Stata J* 2008; **8**: 354–73.
 42. Klein D. *MIMRGNS: Stata Module to Run Margins After Mi Estimate*. Boston, MA: Boston College Department of Economics; 2014.
 43. Greenland S. Interpretation and choice of effect measures in epidemiologic analyses. *Am J Epidemiol* 1987; **125**: 761–8.
 44. Perelman J., Alves J., Pfoertner T. K., Moor I., Federico B., Kuipers M. A., et al. The association between personal income and smoking among adolescents: a study in six European cities. *Addiction* 2017; **112**: 2248–56.
 45. Zhang B., Cartmill C., Ferrence R. The role of spending money and drinking alcohol in adolescent smoking. *Addiction* 2008; **103**: 310–9.
 46. Babor T., Cactano R., Casswell S., Edwards G., Giesbrecht N., Graham K., et al. *Alcohol: No Ordinary Commodity. Research and Public Policy*. Oxford: Oxford University Press; 2010.