



Parental binge drinking and offspring's high school non-completion: A prospective HUNT survey and educational registry study

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ABSTRACT

Background: Alcohol-use disorders (AUD) in parents are associated with adverse outcomes in offspring. It is less known whether other forms of parental drinking such as binge drinking may also be a risk factor for offspring's outcomes – specifically, high school non-completion.

Methods: These questions were examined in a sample of 3101 offspring ($M_{age} = 16.1$, $SD = 1.68$; 49.5% girls) from 2510 2-parent families who participated in the Nord-Trøndelag Health Study in Norway (HUNT3; Young-HUNT3) in 2006–08 and were followed-up through the National Education Database (NUDB) until 2014.

Associations between maternal and paternal binge drinking patterns as reported in HUNT during offspring's adolescence and offspring's subsequent high school completion were examined using logistic regression models while accounting for a comprehensive set of socio-demographic, parental, and offspring characteristics as assessed at HUNT baseline. Effect modifications of these putative associations by offspring characteristics were also explored.

Findings: Approximately 1 in 6 offspring (13.6% girls, 21.1% boys) failed to graduate high school within the officially designated time period, while roughly 1 in 5 mothers (20.4%) and 1 in 2 fathers (51.2%) reported any binge drinking. Weekly or more frequent binge drinking in fathers was prospectively associated with more than doubled odds of high school non-completion in offspring; OR = 2.23, 95% CI = 1.50–3.31. This effect remained substantively identical after adjustment for all covariates (aOR = 2.20, 95% CI = 1.38–3.50) and uniform across offspring characteristics such as gender, academic orientation and performance, anxiety and depression, typical alcohol consumption, and witnessing parental intoxication as assessed at HUNT baseline.

Conclusions: Weekly or more frequent binge drinking in fathers negatively affected high school graduation prospects in their offspring.

1. Introduction

Offspring of parents affected by alcohol use disorders (AUD) are at greater risk for multiple adverse outcomes, ranging from alcohol-related, behavioral and mental health problems (Bountress and Chassin, 2015; Lieb et al., 2002; Sørensen et al., 2011) to poorer school adjustment, performance, and attainment (Berg et al., 2016; Khemiri et al., 2020; McGrath et al., 1999; Sadler et al., 2017; Torvik et al., 2011). However, understanding whether non-AUD parental drinking may also affect offspring's development is both needed and necessary (Bryant et al., 2019; Lund et al., 2015; McGovern et al., 2018; Rossow et al., 2016); after all, the number of parents who drink exceeds the

number of parents diagnosed with AUD. Yet, relatively little is known whether and in what ways parental drinking outside of clinically-diagnosed disorders – including various sub-clinical drinking patterns and binge drinking (Bryant et al., 2019; Lund et al., 2015; McGovern et al., 2018; Rossow et al., 2016) – may influence offspring's adjustment.

Recent studies addressing these questions in community samples demonstrated that even some more common forms of parental alcohol use were associated with a range of negative outcomes and consequences in offspring, especially when combined with additional risk factors in the family (Bryant et al., 2019; Burdzovic Andreas et al., 2021; Lund et al., 2019; Vermeulen-Smit et al., 2012). Binge drinking in

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parents, or consumption of four (for women) and five (for men) or more alcoholic drinks during a single occasion (National Institute of Alcohol Abuse and Alcoholism, 2004) was also associated with multiple alcohol-related outcomes in both adolescent and adult offspring (Burdzovic Andreas et al., 2021; Pedersen and von Soest, 2013; Tyler et al., 2007). The results from a recent UK study showed that the odds of negative outcomes resulting from parental alcohol use – such as receiving less attention, spending less time doing homework, etc. – were 2 ½ times greater for children who saw their parents tipsy and 7 ½ times greater for children who saw their parents drunk when compared with children who never saw their parents intoxicated (Bryant et al., 2019). This report extends this emerging line of research on parental non-dependent drinking by examining whether parental binge drinking may affect offspring's educational outcomes – specifically, the risk of dropping out or not graduating from high school.

Failure to graduate high school carries numerous personal and societal costs, including compromised mental and physical health, greater likelihoods of substance use disorders and criminal involvement, and not surprisingly, poorer employment and labor prospects (De Ridder et al., 2013a; Maynard et al., 2015; Mussida et al., 2019; Reingle Gonzalez et al., 2016). The negative consequences of leaving high school without a degree are so stark that they are increasingly being framed as a major public health issue (De Ridder et al., 2012; Freudenberg and Ruglis, 2007; Lansford et al., 2016). Yet, even in industrialized societies, many adolescents do not reach this developmental milestone (McFarland et al., 2018; OECD, 2020). The situation is similar in Norway, where each year roughly 25% of all high school students (20% of girls; 30% of boys) fail to normatively complete high school (Bania et al., 2016; Norwegian Directorate for Education and Training, 2019).

Majority of research on high school non-completion and dropout tends to focus on students; that is, on individual-level risk factors ranging from students' less than optimal academic experiences and abilities to their physical and mental health (Brännlund et al., 2017; De Ridder et al., 2013b; Gubbels et al., 2019). For example, a recent meta-analysis on school dropout identified twice as many relevant risk factors from the child-related than from the family-related domain (Gubbels et al., 2019). Most of those risk factors reflected various academic difficulties, such as the history of grade retention or low achievement. In addition, early mental health problems and drug use were also systematically associated with an elevated dropout risk in this meta-analysis (Gubbels et al., 2019) as well as in another systematic review on early school leaving (Esch et al., 2014). Interestingly, alcohol use or abuse – either by parents or children/students – did not emerge as a significant predictor of school dropout in either of these reviews, possibly due to the relatively limited recent research on these specific risk factors (Esch et al., 2014; Gubbels et al., 2019). An older systematic review noted that the students' alcohol use was associated with increased risk of high school non-completion, but that these associations tended to weaken or disappear after accounting for additional risks (Townsend et al., 2007).

Whether high school non-completion may be affected by familial characteristics such as parental drinking remains largely unexplored (McGovern et al., 2018). The extant research focuses predominantly on parental AUD as a risk factor and examines various educational outcomes in offspring but seldom the actual high school (non-)graduation (Berg et al., 2016; Khemiri et al., 2020; McGrath et al., 1999; Sadler et al., 2017; Torvik et al., 2011). Recent evidence from two large national samples of American adolescents showed that “parental drinking problems” as recalled by young participants were associated with increased odds of their high school dropout (Plunk et al., 2015). However, parental drinking problems here likely included use disorders because participants were asked to recall, among other things, if their parents were “ever alcoholic”. The effects of parental drinking were explored in one large-scale longitudinal study only, which underscored the negative effects of excessive maternal alcohol consumption on adult offspring's educational attainment and achievement (Mangiacavchi and

Piccoli, 2018). However, the examined educational outcomes in this study once again did not include high school graduation/dropout specifically.

1.1. Study aims

Given the high rates of high school non-completion in industrialized societies (McFarland et al., 2018; OECD, 2020) and its large-scale and long term ramifications (De Ridder et al., 2013a, 2012; Maynard et al., 2015), better understanding of the relevant and potentially modifiable risk factors is imperative. We investigated whether parental drinking other than clinically diagnosed alcohol use disorders – specifically, patterns of binge drinking – may be one such risk factor. We further examined whether its effects may vary across offspring characteristics such as gender, academic orientation and performance, anxiety and depression, drinking, and witnessing of parental intoxication during adolescence.

These questions were examined using a large community sample of adolescents and their parents from Norway; a unique design combining survey data with educational registry follow-ups over time with practically no attrition; and statistical control for factors previously associated with poorer school outcomes such as parental education and mental health (Farahati et al., 2003; Gubbels et al., 2019; Sadler et al., 2017; Torvik et al., 2020), and adolescents' early academic performance, mental health, and alcohol use (Brännlund et al., 2017; Butterworth and Leach, 2018; De Ridder et al., 2013b; Esch et al., 2014; Gubbels et al., 2019; Kelly et al., 2015; Silins et al., 2015; Townsend et al., 2007).

2. Methods

2.1. Design, data sources, and procedures

This report prospectively combined: 1) self-reports obtained from parents and adolescent offspring who participated in the Nord-Trøndelag Health Studies Norway (Holmen et al., 2003, 2014; Krokstad et al., 2013) administered in 2006–2008 (HUNT3/Young-HUNT3) which served as the study baseline and provided data on the key exposures and covariates, and 2) administrative records from the National Education Database (NUDB) between 2004 and 2014 which served as the study follow-up and provided data on the substantive outcome of interest, i.e., offspring's high school (non)graduation.

The HUNT/Young-HUNT are general population health studies in Norway conducted in a series of waves where all adults older than 20 (HUNT) and all adolescents between 13 and 19 years of age (Young-HUNT) in Nord-Trøndelag county were invited to participate. NUDB is managed by Statistics Norway and it contains individual-level information on various educational outcomes, including the highest attained educational level as of October 1st each calendar year. Statistics Norway facilitated identification of family relationships, as well as of the individual-level linkages between all data sources using the unique national Personal Identification Numbers. Informed consent/assent was obtained for all participants by the original HUNT/Young-HUNT studies, including permissions for registry linkages.

This study was approved by the Regional Committees for Medical and Health Research Ethics (# 2014/867) and The Norwegian Data Protection Authority (# 38949).

2.2. Sample

Our analytical sample included 3101 offspring from 2510 2-parent families who participated in the Young-HUNT3 survey administered in 2006–2008 when they were between 13 and 19 years of age (i.e., baseline), and who would have been old enough to have graduated high-school by the last year of NUDB education administrative data (i.e., 2014) available to us as means of follow-up.

2.3. Measures

2.3.1. High school non-completion

High school or upper secondary education in Norway generally enrolls students when they are 16 years old and entails a 3-year general or vocational study program. Although the program duration is three years only, dropout is officially defined as the non-completion of study program within five years (Bania et al., 2016; Norwegian Directorate for Education and Training, 2019). Participants who presented in the NUDB database with five or more consecutive years of middle school diploma as the highest educational attainment by 2014 therefore met the official non-completion definition and were classified as such. The exact timing of drop-out was not known.

2.3.2. Parental binge drinking patterns

Both parents reported their *binge drinking pattern* in HUNT surveys by checking either “never”, “monthly”, “weekly”, or “daily” response option to the question of how often they consumed 5 or more glasses of beer, wine, or liquor during the same occasion. Parents who skipped this item but reported no lifetime or no past year alcohol consumption, or alcohol consumption of under 10 standard drinks during the usual 2-week period were re-classified as “never” engaging in binge drinking. This was our reference category in all analyses to follow.

2.3.3. Additional parental characteristics

Both parents reported their *anxiety/depression* symptoms on the 14-item Hospital Anxiety and Depression Scale (HADS); these scale scores were dichotomized (normative vs. clinical range) based on the previously established cutoffs in Norwegian samples (Mykletun et al., 2001; Stordal et al., 2001).

2.3.4. Adolescent offspring characteristics

Adolescent reports of their future educational plans were dichotomized such that “No plans” and “Don’t know” responses were grouped to reflect the risk of *no educational plans* (vs. rest). Adolescent reports of whether they understand what is being taught during school lessons were dichotomized such that “Never” and “Sometimes” responses were grouped to reflect the risk of *academic difficulties* (vs. rest). Adolescent reports of their current *anxiety/depression symptoms* on the 5-item Hopkins Symptom Checklist (SCL-5) were dichotomized into clinical range (vs. rest) based on the established SCL-5 cutoffs (Strand et al., 2003). Adolescent reports of the number of standard drinks (i.e., cans/bottles of beer, glasses of wine, and shots of liquor) typically consumed during the regular 2-week period were categorized to reflect typical *bi-weekly alcohol consumption* of none, 1–5 drinks, and more than 5 alcoholic drinks. Finally, adolescent reports of how often they *witnessed parental alcohol intoxication* were dichotomized to reflect the risk of ever witnessing such situations (vs. rest).

2.3.5. Demographics

At HUNT participation, adolescent offspring reported their birthday (used to compute *age at HUNT survey participation*), *gender*, and *family structure* (biological vs. stepparent). Using the NUDB information on parental education, *parental education index* was constructed to reflect three categories: neither/either/both parents graduated college or greater.

2.4. Analyses

Because the NUDB national educational registry provided information on high school completion, there were no missing values on the examined outcome. Missing values on covariates were low (from $max\ n = 184$ for academic difficulties to $min\ n = 56$ for SCL-5) and were classified into the “rest” category in all dichotomization procedures. However, missing values on the measures of parental mental health ($n = 567$, or 18.2% for maternal HADS, and $n = 740$, or 23.8% for paternal

HADS) were retained and analyzed as separate “not known” categories. Similarly, missing values on our substantive alcohol-related exposures – be it parental or offspring’s – were also retained and analyzed as a separate “not known” categories. These decisions to retain and not impute missing values on these variables were based on previous reports demonstrating that both mental health and alcohol use were predictive of non-responses in the HUNT studies (Knudsen et al., 2010; Langhammer et al., 2012; Torvik et al., 2012). Finally, because no mother and only 2 fathers reported daily binge drinking, these cases were folded into the newly-created “weekly or more frequent binge drinking” category for analytical purposes.

The associations between study variables and high school non-completion in offspring were examined with unadjusted and fully adjusted logistic regression models. To formally test for effect modification by adolescent characteristics as assessed at HUNT baseline, we fit a set of six stratified logistic regression models, each testing one effect modification of interest (Rothman et al., 2008). Specifically, we compared maternal and paternal binge drinking estimates obtained from the logistic regression models stratified across boys and girls; presence and absence of educational plans; presence and absence of academic difficulties; presence and absence of SCL-5 clinical-level symptomatology; presence or absence of any bi-weekly alcohol intake; and presence or absence of witnessing parental alcohol intoxication using the Wald tests for nonlinear models comparison (Clogg et al., 1995).

All analyses were conducted in Stata v.15 (StataCorp, 2017). All reported estimates were adjusted for within-family nesting using the *vce* (cluster) option in Stata (Williams, 2000), and plotted using the *-coefplot* command (Jann, 2014). Wald tests used to test effect modification were performed using model stratification and the *-suest* post-estimation command. P-values were 2-sided, and statistical significance was set at .05 in the main analyses, and .01 in effect modification analyses to control for multiple comparisons. The hypotheses were not pre-registered, and the results should be considered exploratory.

3. Results

3.1. Sample characteristics

Table 1 shows sample characteristics, including by offspring gender. The proportion of offspring who did not normatively complete high school was 17.5% (13.6% girls; 21.1% boys).

3.2. Parental binge drinking patterns

Slightly over 3 in 4 mothers reported never engaging in binge drinking (78.4%), while another 19.4% and 1.0% reported doing so monthly and weekly. No mother reported daily binge drinking. We had no information regarding maternal binge drinking for 37 offspring from 32 families. Slightly under 1 in 2 fathers (47.2%) reported never engaging in binge drinking, while 46.4% reported doing so on a monthly basis. Another 4.8% reported binge drinking weekly or more often (including 2 fathers who reported daily binge drinking). We had no information regarding paternal binge drinking for 41 offspring from 34 families.

3.3. Parental binge drinking patterns and the risk of high school non-completion in offspring

Table 2 shows crude estimates (column 1), as well as the fully adjusted estimates (column 2) for the odds of offspring’s high school non-completion as a function of maternal and paternal binge drinking patterns and all covariates. When compared with “never binge drinking” category, all remaining patterns of maternal and paternal binge drinking were associated with increased odds of offspring’s high school non-completion in crude models, but only one pattern was so at the $p <$

Table 1
Sample characteristics; entire sample (N = 3,101) and by offspring gender.

Study variables	Entire sample	Girls	Boys
	N = 3101	n = 1535	n = 1566
Outcome:			
High school non-completion	17.4%	13.6%	21.1%
Parental binge drinking:			
Mother:			
Never	78.4%	78.3%	78.6%
Monthly	19.4%	19.2%	19.5%
Weekly	1.0%	1.0%	1.0%
Not known	1.2%	1.5%	.9%
Father:			
Never	47.5%	45.9%	49.1%
Monthly	46.4%	47.4%	47.5%
Weekly or more frequently	4.8%	5.3%	4.2%
Not known	1.3%	1.4%	1.2%
Additional parental characteristics:			
Anxiety/depression (mother):			
HADS normative range	52.7%	52.3%	53.3%
HADS clinical range	29.0%	28.7%	29.1%
Not known	18.3%	19.0%	17.6%
Anxiety/depression (father):			
HADS normative range	48.2%	47.6%	48.7%
HADS clinical range	27.9%	28.7%	27.2%
Not known	23.9%	23.7%	24.1%
Adolescent offspring characteristics:			
Lack of educational plans	42.0%	41.6%	42.3%
Academic difficulties	14.1%	14.2%	13.9%
SCL-5 clinical range	16.8%	25.5%	8.2%
2-week alcohol intake:			
None	52.6%	52.6%	52.6%
1–5 drinks	19.0%	21.5%	16.5%
> 5 drinks	22.0%	19.3%	24.7%
Not known	6.4%	6.6%	6.2%
Witnessing parental intoxication	58.2%	59.4%	57.9%
Demographics:			
Offspring age (M, SD)	16.1 (1.7)	16.2 (1.7)	16.1 (1.6)
Stepparent family	16.4%	16.7%	15.7%
Parental education index:			
Neither parent w/college	50.3%	51.4%	49.3%
One parent w/college	31.3%	30.3%	32.2%
Both parents w/college	18.4%	18.3%	18.5%

Note:

High school non-completion was coded and classified based on the National Education Database (NUDB) registrations for offspring in 2014 using the official definition in Norway; that is, not completing a 3-year general or vocational study program within a designated 5-year period.

The remaining study variables reflect parental and offspring characteristics at this study baseline, that is, at the time of their participation in the Nord-Trøndelag Health Studies (HUNT3/Young-HUNT3) in 2006–2008.

HADS = Hospital Anxiety and Depression Scale

SCL-5 = Hopkins Symptom Checklist, anxiety/depression

.05 level. Specifically, paternal weekly or more frequent binge drinking was prospectively associated with more than doubled odds of offspring's high school non-completion; OR = 2.23, 95% CI = 1.50–3.31. These initial crude estimates remained substantively unchanged in the fully adjusted model (Table 2, column 2; also Fig. 1); aOR = 2.20, 95% CI = 1.38–3.50.

Almost all covariates were significantly associated with high school non-completion in crude models (Table 2, column 1), but only some of them remained so in the fully adjusted models. Specifically, demographic characteristics such as the offspring gender (boy) and younger age, stepparent family, and lack of higher education in one or both parents all significantly increased the odds of high school non-completion, as did the clinical-level anxiety/depression symptoms in mothers. Further, academic difficulties, clinical-level anxiety/depression symptoms, and bi-weekly alcohol intake exceeding 5 alcoholic drinks in offspring also significantly increased their odds of failure to graduate high school. Not surprisingly, the strongest risks for school non-completion were imparted by the absence of higher education in

Table 2
High school non-completion in offspring as a function of parental binge drinking patterns.

Study variables	Crude	Fully adjusted
	OR (95% CI)	aOR (95% CI)
Parental binge drinking:		
Mother: ^a		
Monthly	1.17 (0.92–1.49)	1.01 (0.78–1.30)
Weekly	1.51 (0.64–3.53)	.95 (0.33–2.70)
Not known	1.37 (0.63–2.95)	1.19 (0.55–2.58)
Father: ^a		
Monthly	1.03 (0.85–1.27)	.94 (0.75–1.18)
Weekly or more frequently	2.23 (1.50–3.31)***	2.20 (1.38–3.50)***
Not known	1.65 (0.82–3.33)	1.30 (0.71–2.59)
Additional parental characteristics:		
Mother: ^b		
HADS clinical range	1.44 (1.16–1.79)***	1.26 (1.00–1.59)*
HADS not known	1.07 (0.81–1.39)	.90 (0.67–1.20)
Father: ^b		
HADS clinical range	1.39 (1.11–1.75)**	1.17 (0.92–1.50)
HADS not known	1.37 (1.07–1.74)**	1.22 (0.94–1.58)
Adolescent offspring characteristics:		
Lack of educational plans	1.22 (1.01–1.47)*	1.18 (0.96–1.45)
Academic difficulties	3.54 (2.83–4.42)***	3.06 (2.40–3.90)***
SCL-5 clinical range ^b	1.32 (1.05–1.68)*	1.44 (1.10–1.88)**
2-week alcohol intake: ^c		
1–5 drinks	.92 (0.70–1.20)	.99 (0.72–1.35)
> 5 drinks	1.58 (1.26–1.97)***	1.65 (1.21–2.26)**
Not known	1.44 (0.99–2.06)	1.30 (0.87–1.95)
Witnessing parental intoxication	1.26 (1.04–1.53)*	1.01 (0.81–1.27)
Demographics:		
Offspring gender (boy)	1.69 (1.39–2.05)***	1.90 (1.54–2.36)***
Offspring age	.95 (0.89–1.002)	.87 (0.80–0.94)***
Stepparent family	1.67 (1.33–2.11)***	1.66 (1.29–2.14)***
Parental education index: ^d		
One parent w/ college	3.19 (2.11–4.81)***	2.85 (1.88–4.31)***
Neither parent w/ college	5.19 (3.51–7.65)***	4.25 (2.87–6.29)***

Note: *p < .05; **p < .01; ***p < .001. Shown are crude and adjusted estimates (odds ratios, OR) with 95% CI. All analyses accounted for within-family nesting. Intercepts not shown.

^a Reference category = Never

^b Reference category = HADS (Hospital Anxiety and Depression Scale) and SCL-5 (Hopkins Symptom Checklist assessing anxiety and depression) scores within normative range

^c Reference category = None

^d Reference category = Both parents graduated college

both parents (aOR = 4.25, 95% CI = 2.87–6.29) and by offspring's academic difficulties reported at HUNT baseline (aOR = 3.06, 95% CI = 2.40–3.90); however, the effects of paternal weekly or more frequent binge drinking were not substantively diminished even after these known risk factors were accounted for.

3.3.1. Effect modification by offspring characteristics

We explored whether the associations between maternal and paternal binge drinking and high school non-completion in their offspring were modified by adolescent offspring's gender, educational plans, academic difficulties, anxiety/depression symptoms, alcohol intake, and witnessing of parental intoxication as reported at HUNT baseline. The results from the six stratified models are shown in Table 3. Corresponding Wald tests for comparison of coefficients across models were not significant in any model, suggesting that the effects of parental binge drinking were statistically uniform across these offspring characteristics. A handful of comparisons was significant but only at the p < .05 level and for the estimates which themselves were not statistically different from zero: paternal unknown binge pattern in Model 1; maternal weekly binge pattern in Model 4; and paternal weekly or more frequent binge drinking pattern in Model 5 (see Table 3).

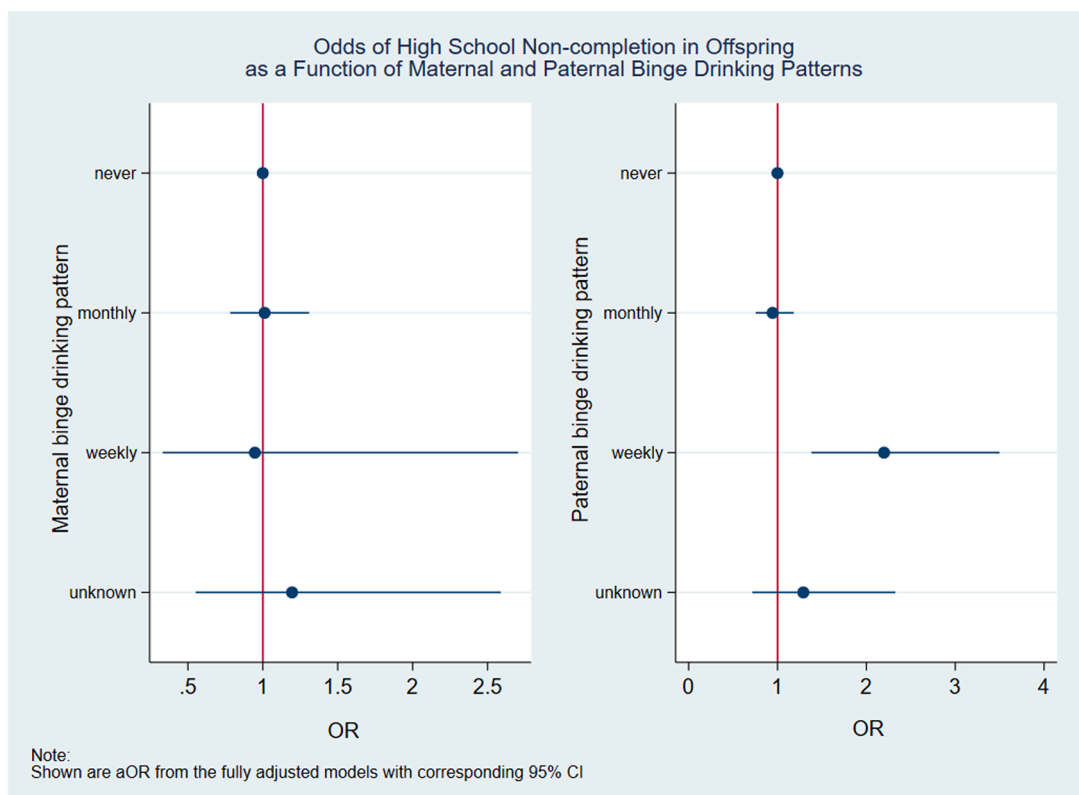


Fig. 1. High school non-completion in offspring as a function of maternal and paternal binge drinking patterns.

3.4. Sensitivity analyses

We conducted several sensitivity analyses. First, we re-ran the main analyses using the Poisson regression instead of logistic regression model. This approach is suitable for both dichotomous and count outcomes (Zou, 2004) while providing easily interpretable estimates in the form of relative risks (RR). The estimates expressed as relative risks were substantively identical to those obtained from the logistic models, such that the paternal weekly or more frequent binge drinking was associated with elevated risk for high school non-completion even in fully adjusted models; aRR = 1.73; 95% CI = 1.27–2.35. Offspring from families where fathers engaged in binge drinking weekly or more frequently were 1.75 times more likely to not graduate high school than offspring from families where fathers never did so.

Second, we re-ran the analyses while keeping the original classification of paternal binge drinking, even though there were only 2 cases of daily binge drinking. The results were substantively identical to those obtained from the main analyses, such that we observed a dose-response association between binge drinking in fathers and high school non-completion in offspring. This was the case whether we retained the entire sample as in the main analyses (aOR = 2.11, 96% CI = 1.31–3.39 for weekly, and aOR = 2.84; 95% CI = 1.88–4.28 for daily binge drinking among fathers) or used list-wise deletion to address the issue of missing values on covariates (aOR = 2.07, 95% CI = 1.27–3.38 for weekly and aOR = 2.99, 95% CI = 1.93–4.62 for daily binge drinking among fathers).

Third, we created an index variable reflecting no binge drinking in either parent, monthly binge drinking in either parent, monthly binge drinking in both parents, and weekly binge drinking in at least one/ either parent. Again, substantively identical estimates were obtained for weekly binge drinking in at least one parent, aOR = 2.07, 95% CI = 1.34–3.20. However, these results were most likely driven by fathers, given the relatively small numbers of mothers reporting weekly bingeing.

4. Discussion

This was the first study to explore prospective associations between parental non-dependent drinking and offspring's high school non-completion – a major adverse event negatively shaping subsequent child development and multiple life outcomes (De Ridder et al., 2013a, 2012; Freudenberg and Ruglis, 2007; Lansford et al., 2016; Maynard et al., 2015; Mussida et al., 2019; Reingle Gonzalez et al., 2016). Our results demonstrated significant associations between paternal binge drinking taking place on a weekly or more frequent basis and offspring's subsequent failure to complete high school education. These associations were also statistically uniform across all of the adolescent offspring characteristics examined in this study, ranging from gender to early mental health, academic difficulties, and alcohol use. Finally, these associations were meaningful, as they roughly doubled the already high odds of high school non-completion in offspring; they were robust, as they were substantively unaffected by multiple covariates (including parental educational attainment and offspring's academic difficulties) and across multiple regression models and sensitivity analyses; and they were prospective, as they manifested over time.

These results reiterate the emerging evidence demonstrating that parental drinking does not necessarily have to meet clinical criteria for use disorders to impart negative consequences for offspring (Bryant et al., 2019; Burdzovic Andreas et al., 2021; Lund et al., 2019; McGovern et al., 2018; Vermeulen-Smit et al., 2012). And while the individual hazards and societal costs of binge drinking have been long recognized (Kuntsche et al., 2017; Sacks et al., 2015), these results and related research suggest that there are considerable indirect hazards and costs for the offspring of binge drinkers as well (Burdzovic Andreas et al., 2021). These results also align with recent calls for social and care services to focus on children living in families characterized not only by parental substance use disorders, but also by parental risky alcohol consumption and heavy episodic (i.e., binge) drinking (Manning et al., 2009; Varnaccia et al., 2019). Indeed, binge drinking in parents was

Table 3
High school non-completion in offspring as a function of parental binge drinking patterns; effect modification by adolescent offspring characteristics.

Effect modification models	Adolescent characteristic stratified; estimate	
	aOR (95% CI)	aOR (95% CI)
Model 1:	Girls	Boys
Gender	n = 1535	n = 1566
Binge drinking (mother):		
<i>Monthly</i>	.80 (0.53–1.20)	1.16 (0.83–1.61)
<i>Weekly</i>	1.02 (0.24–4.28)	1.04 (0.27–4.03)
<i>Not known</i>	.88 (0.27–2.81)	1.36 (0.38–4.83)
Binge drinking (father):		
<i>Monthly</i>	.73 (0.52–1.03)	1.09 (0.82–1.44)
<i>Weekly or more frequently</i>	2.87 (1.61–5.11)***	1.58 (0.83–3.02)
<i>Not known</i>	.30 (0.04–2.36)	2.46 (0.91–6.65)
Model 2:	Present	Absent
Educational plans	n = 1800	n = 1301
Binge drinking (mother):		
<i>Monthly</i>	.99 (0.70–1.41)	1.03 (0.70–1.51)
<i>Weekly</i>	1.21 (0.32–4.49)	.72 (0.16–3.30)
<i>Not known</i>	2.12 (0.86–5.24)	–
Binge drinking (father):		
<i>Monthly</i>	.97 (0.73–1.32)	.89 (0.64–1.23)
<i>Weekly or more frequently</i>	1.85 (1.06–3.26)*	2.76 (1.40–5.43)**
<i>Not known</i>	1.06 (0.42–2.68)	2.30 (0.47–11.31)
Model 3:	Absent	Present
Academic difficulties	n = 2665	n = 430
Binge drinking (mother):		
<i>Monthly</i>	.99 (0.74–1.33)	1.18 (0.69–2.00)
<i>Weekly</i>	1.27 (0.45–3.58)	.33 (0.03–4.22)
<i>Not known</i>	1.46 (0.56–3.77)	.38 (0.04–3.52)
Binge drinking (father):		
<i>Monthly</i>	.95 (0.74–1.23)	.83 (0.52–1.28)
<i>Weekly or more frequently</i>	2.56 (1.59–4.13)***	1.22 (0.45–3.20)
<i>Not known</i>	.68 (0.22–2.02)	–
Model 4:	Normative range	Clinical range
SCL-5 Anxiety/Depression	n = 2581	n = 520
Binge drinking (mother):		
<i>Monthly</i>	1.03 (0.77–1.37)	.84 (0.48–1.50)
<i>Weekly</i>	.60 (0.19–1.92)	5.95 (0.80–44.30)
<i>Not known</i>	1.09 (0.42–2.77)	1.54 (0.22–10.65)
Binge drinking (father):		
<i>Monthly</i>	.99 (0.78–1.27)	.72 (0.43–1.19)
<i>Weekly or more frequently</i>	2.57 (1.59–4.15)***	1.22 (0.44–3.37)
<i>Not known</i>	1.11 (0.45–2.77)	2.78 (0.50–15.42)
Model 5:	None	Any
2-week alcohol intake	n = 1630	n = 1471
Binge drinking (mother):		
<i>Monthly</i>	.96 (0.66–1.42)	1.11 (0.76–1.74)
<i>Weekly</i>	.18 (0.02–1.56)	2.28 (0.15–8.20)
<i>Not known</i>	1.44 (0.49–4.20)	.65 (0.10–9.14)
Binge drinking (father):		
<i>Monthly</i>	1.17 (0.85–1.60)	.74 (0.55–1.02)
<i>Weekly or more frequently</i>	2.76 (1.43–5.30)***	1.76 (1.00–3.11)*
<i>Not known</i>	1.55 (0.44–5.49)	.98 (0.35–2.72)
Model 6:	Never	At least once
Witnessing parental intoxication	n = 1295	n = 1806
Binge drinking (mother):		
<i>Monthly</i>	1.01 (0.63–1.63)	1.00 (0.74–1.36)
<i>Weekly</i>	1.15 (0.12–10.56)	.83 (0.27–2.54)
<i>Not known</i>	1.97 (0.55–2.57)	.88 (0.28–2.79)
Binge drinking (father):		
<i>Monthly</i>	.98 (0.69–1.40)	.85 (0.67–1.17)
<i>Weekly or more frequently</i>	2.48 (1.04–5.85)*	2.08 (1.25–3.44)**
<i>Not known</i>	1.56 (0.43–5.59)	.99 (0.36–2.75)

Note: * $p < .05$; ** $p < .01$; *** $p < .001$.

All analyses accounted for within-family nesting, and for the remaining covariates (estimates not shown). Shown are thus fully adjusted estimates (odds ratios, OR) with 95% CI. Intercepts not shown. Cells with no cases and no estimates are noted with –.

None of the Wald tests for comparison of coefficients across stratified models were significant, suggesting that the effects of parental binge drinking were statistically uniform across these offspring characteristics. A handful of statistically significant comparisons at the $p < .05$ – paternal unknown binge pattern in Model 1; maternal weekly binge pattern in Model 4; and parental weekly or more frequent binge drinking pattern in Model 5 – were obtained for estimates which themselves were not statistically different from zero. Reference category for parental binge drinking patterns in all models = Never

identified as one of the non-clinical drinking patterns in need of further investigation regarding its putative negative effects on offspring (Lund et al., 2015; Manning et al., 2009; Rossow et al., 2016; Varnaccia et al., 2019), especially because majority of binge drinkers do not necessarily meet diagnostic criteria for alcohol dependence (Esser et al., 2014).

The primary aim of this investigation was to examine whether parental alcohol use other than clinically-diagnosed disorders may compromise normative high school completion in offspring, and the related need to identify potentially modifiable risk factors. Consequently, prevention strategies may take a closer look at the largely overlooked non-AUD drinking in parents from the community, as our results identify potentially sizeable groups of adolescents at risk for educational failure. If the observed associations were indeed causal in nature, then even the moderate behavioral modification in parents may result in significant proximal educational and various distal benefits for offspring (Slade and Becker, 2014). As the effects of paternal weekly binge drinking were not attenuated after controlling for parental education and offspring's own academic difficulties, it is possible that any reduction in binge drinking – be it the alcohol quantities meeting the binge drinking criteria, be it the frequency of such consumption, or both – may help interrupt the cycle of low educational attainment across generations. Similar to the evidence from the AUD research, eliminating or limiting alcohol use to the low-risk patterns may not have primary health benefits for the drinking parent alone but may also have substantial secondary benefits for their offspring as well (Burdzovic Andreas and O'Farrell, 2009; Burdzovic Andreas et al., 2006; Rounsaville et al., 2014).

4.1. Methodological considerations and limitations

This study is bounded by the parameters of the original HUNT study and the National Education Database (NUDB), including the sampling strategies, availability of data and assessed constructs, and choice of utilized measures. While general HUNT studies were designed to be largely representative, our selection of 2-parent families with adolescent offspring was likely somewhat better-adjusted than the average. However, this should not necessarily impede our general conclusions regarding the observed prospective associations (Rothman et al., 2013). In fact, this feature makes it less likely that our analytical sample included parents with AUD, whose presence in the sample may have confounded the results. Indeed, prior studies indicate that HUNT participants, if anything, were less likely to be affected by substance use disorders (Knudsen et al., 2010).

Further, parental reports may have been affected by under-reporting of socially undesirable behaviors such as excessive drinking, and were additionally bounded by the original coding of key variables. For example, the binge drinking indicator used in HUNT surveys did not differentiate between alcohol quantities consumed by men and women (National Institute of Alcohol Abuse and Alcoholism, 2004). Thus, it is possible that the occurrence of binge drinking among mothers from our sample was underestimated, and consequently, its association with educational outcomes among offspring as well. Relatedly, the number of mothers engaging in any binge drinking was relatively small, and the number of mothers who reported doing so weekly was minimal – together, these made the corresponding estimates somewhat unstable. Further, parental drinking and additional risk factors were assessed only once as part of the HUNT surveys baseline; how these behaviors and characteristics might have varied in duration, nature, or magnitude over time is not known in this study. Similarly, information available to us from the National Education Database (NUDB) reflected only the presence of a high school diploma at the end of the normatively granted 5-year period. Because the exact timing of high school leaving (if any) was not known to us, more complex models examining event occurrence and time-to-event were not possible.

Finally, this study investigated whether there are prospective associations between parental binge drinking patterns and offspring's risk of

high school non-completion, but it did not address the questions of underlying mechanisms. For example, it is possible that binge drinking rendered parents less effective in terms of parenting skills, less attentive to their children's needs, etc. – ultimately contributing to their school failure. Given the abovementioned limitations – including the availability of only one HUNT assessment and of only selected constructs and measures – these questions were beyond the scope of this report. We primarily aimed to address an under-researched question of whether parental binge drinking may be a risk factor for educational outcomes in offspring at all. Now that there is evidence that it may be, further longitudinal research is needed to explore putative mechanisms and complex developmental pathways through which these parental alcohol-related risks may operate.

4.2. Conclusion

Despite these limitations, this report provided the first set of results documenting the prospective associations between parental non-AUD drinking and offspring's high school non-completion. Paternal weekly or daily binge drinking placed offspring at greater risk for high school non-completion, even after accounting for a range of known parental- and adolescent-level risk factors. Examination of maternal and paternal drinking outside the traditional disorder paradigms can inform our understanding of school failure in offspring from the community and related prevention strategies.

Compliance with ethical standards

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Ethics approval

This study was approved by the Regional Committees for Medical and Health Research Ethics (#2014/867) and The Norwegian Data Protection Authority (#38949).

Conflicts of interest/Competing interests

None.

Consent to participate

Informed consent/assent was obtained for all participants by the original HUNT/Young-HUNT study, including permissions for registry linkages.

Additional Contributions

We thank The Nord-Trøndelag Health Study (The HUNT Study) – a collaboration between HUNT Research Center, (Faculty of Medicine and Health Sciences, NTNU, Norwegian University of Science and Technology), Trøndelag County Council, Central Norway Regional Health Authority, and the Norwegian Institute of Public Health – for providing survey data for this study; Statistics Norway; and the National Education Database (NUDB) for providing registry data for this study.

Last, but not least, we are grateful to all the HUNT and Young-HUNT participants.

CRediT authorship contribution statement

JBA: Conceptualization of main research questions, literature review, data analysis and results interpretation, data management and curation, manuscript preparation and writing (original draft). **FAT:** Conception and design, results interpretation, critical revision of the manuscript for intellectual content. **IOL:** Conception and design, literature review, funding, results interpretation, data curation, critical revision of the manuscript for intellectual content.

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Conflict of Interest

None.

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