



Fathers' alcohol consumption and risk of substance-related disorders in offspring

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ABSTRACT

Background: Few studies have assessed how children are affected by parental alcohol consumption without clinically diagnosed alcohol problems, especially in relation to more long-term and severe consequences. The aim is to investigate how fathers' alcohol use is related to the risk for substance-related disorders in offspring.

Method: A prospective cohort study of 64 710 Swedish citizens whose fathers were conscripted for compulsory military training at ages 18–20 in 1969/70. Information on fathers' alcohol consumption, frequency of intoxication and apprehended for drunkenness, was collected during conscription. Offspring was followed for substance-related disorders from age 12 to end of follow up in 2009.

Results: All measures of fathers' alcohol use were significantly and positively associated with risk for substance-related disorders in offspring. The associations were to a large extent explained by other risk factors in childhood. In the fully adjusted model, those with fathers in the highest alcohol consumption quintile still had a 63% higher risk (HR=1.63 CI 1.26–2.12) of substance-related disorders compared to those whose fathers' reported abstinence. The highest risk was found among offspring to fathers with alcohol-related disorders or that had been apprehended for drunkenness, with a more than two-fold increased risk for substance-related disorders.

Conclusions: Despite the lower risk found among offspring to fathers with sub-clinical drinking when compared to those with alcohol-related disorders, the former group accounts for a much larger proportion of all cases of substance-related disorders in the population, prompting universal prevention efforts targeting the level of total alcohol consumption in society.

1. Introduction

It is increasingly recognised that alcohol use not only has adverse consequences for the individual drinker, but also may negatively affect those in the drinker's environment (Casswell et al., 2011; Laslett et al., 2011; Ramstedt et al., 2015; Rossow et al., 2016a). In accordance with this, studies have shown that alcohol-related disorders among parents are associated with risk for social and health-related problems in the offspring, including substance misuse (Christoffersen and Sothill, 2003; Dube et al., 2002; Johnson and Leff, 1999; Jääskeläinen et al., 2016).

However, as pointed out in a review by (Rossow, Felix et al., 2016), less is known about how children are affected by alcohol consumption among parents without clinically diagnosed alcohol problems,

sometimes referred to as sub-clinical drinking (Guttmanova et al., 2017; Lund et al., 2015). While offspring whose parents have an alcohol-related disorder are more likely than others to have a heightened risk of adverse consequences, offspring whose parents drink on sub-clinical levels might account for a larger proportion of all harm owing to parental drinking, given the fact that they are more numerous.

Most studies on parental sub-clinical drinking and associations to negative outcomes for offspring, focus on short-term consequences such as offspring alcohol use (Adalbjarnardottir and Rafnsson, 2001; Alati et al., 2014; Duncan et al., 2011) or heavy episodic drinking/intoxication (Bailey et al., 2006; Latendresse et al., 2008), whereas studies on more severe, long-term consequences among offspring are scarce (Rossow et al., 2016a). It is also common to use crude measures of parental

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alcohol use, as was done in a recent Danish cross-sectional study (Pisinger et al., 2017) among youth, where perceived parental alcohol problems (reported by offspring) were associated with earlier onset of intoxication and frequency of binge drinking. Two of our own previous studies also found a crude measure of fathers' frequency of alcohol consumption (reported by their sons) to be positively associated with alcohol-related hospitalisations (Hemmingsson et al., 2017), as well as alcohol-related mortality (Landberg et al., 2018) among the sons.

Moreover, while previous research indicates that parental sub-clinical drinking tends to be positively associated with drinking and related harm in offspring, less is known about whether parental alcohol consumption in itself increases the risk of adverse consequences in offspring, or whether the associations are confounded by unmeasured factors and mechanisms (Rossow et al., 2016b). For instance, parental problematic drinking tends to cluster with other adverse childhood circumstances or risk factors such as low socio-economic position (SEP) in childhood (Makela and Paljarvi, 2008), parental psychiatric diagnoses (Castillo-Carniglia et al., 2019) such as anxiety and mood disorders (e.g. depressive disorders) (Davis et al., 2008; Rich and Martin, 2014) and other substance-related disorders (Stinson et al., 2005) and is also a risk factor for suicidal behaviour (Landberg et al., 2019).

Further, several factors have been identified as important for understanding the aetiology of family transmission of alcohol use, including sub-clinical drinking. For instance, problematic alcohol consumption, might impair a parent's ability to uphold parental responsibilities (Guttmanova et al., 2017; Johnson and Leff, 1999). For example, low parent-child relationship quality and low parental support and involvement, have been found to be associated with subsequent alcohol misuse among adolescents (Yap et al., 2017). Another mechanism enabling a transmission of alcohol use is the association between parental and offspring alcohol use through a socialisation process (Pedersen and von Soest, 2013). Children observe behaviour, attitudes (and communication) and subsequently mimic these patterns (Mares et al., 2011). In line with many other studies (Capaldi et al., 2016; Johnson and Leff, 1999; Kuppens et al., 2019) we assume the inter-generational aspect of substance use as being general rather than substance-specific. Therefore, the outcome in this study includes both alcohol- and drug-related diagnoses in offspring (hereafter denoted substance-related disorders).

The aim of the present study is to investigate how fathers' alcohol use is related to the risk for substance-related disorders in offspring, during youth and young adulthood. With the intention to overcome limitations of previous research on the association between parental sub-clinical

drinking and negative outcomes for their children, we use a unique prospective cohort design that links registry information on substance-related disorders in offspring to survey data from a full cohort of fathers born around 1950. More specifically, we assess how the risk for substance-related disorders in offspring is distributed across different dimensions of fathers' alcohol use, including volume of alcohol consumption, frequency of intoxication, being apprehended for drunkenness, and clinically diagnosed alcohol-related disorders. In order to assess to what extent the associations may be attributed to a clustering of other risk factors measured in childhood, we adjust for factors including childhood SEP, fathers' low emotional control and parental mental and substance-related disorders (measured among both mothers and fathers).

2. Material and methods

The study was based on a prospective cohort with a study population of 64 710 Swedish citizens (offspring) who were born between 1 January 1970 and 1 December 1985 and whose fathers were conscripted for compulsory military training at ages 18–20 in 1969/70 ($n = 33\,166$) (see Fig. 1). At that time all conscripts were males; no more than 2–3% of all Swedish men were exempted from conscription, in most cases due to severe handicaps or congenital disorders (Larsson et al., 2002).

At conscription, all the men (i.e. the fathers in the present study) went through a health examination and met with a physician who diagnosed any disorders according to the Swedish version of the eighth revision of the International Classification of Disease (ICD). Moreover, the conscripts met with a psychologist for a structured interview. The men were also asked to participate in a survey consisting of two questionnaires. One covered social background, behaviour, psychological factors and health etc., while the other contained questions regarding substance use, e.g. alcohol consumption (Larsson et al., 2002). During the follow-up period which spanned between 1982 and 2009, substance-related disorders in the offspring was obtained by record linkage with the National Cause of Death Register and with the National Hospital Discharge Register, in addition childhood SEP was retrieved from the 1985 and 1990 census.

Ethical approval was received from the Stockholm Regional Ethical Review Board (2010/604–32 and 2019/05990).

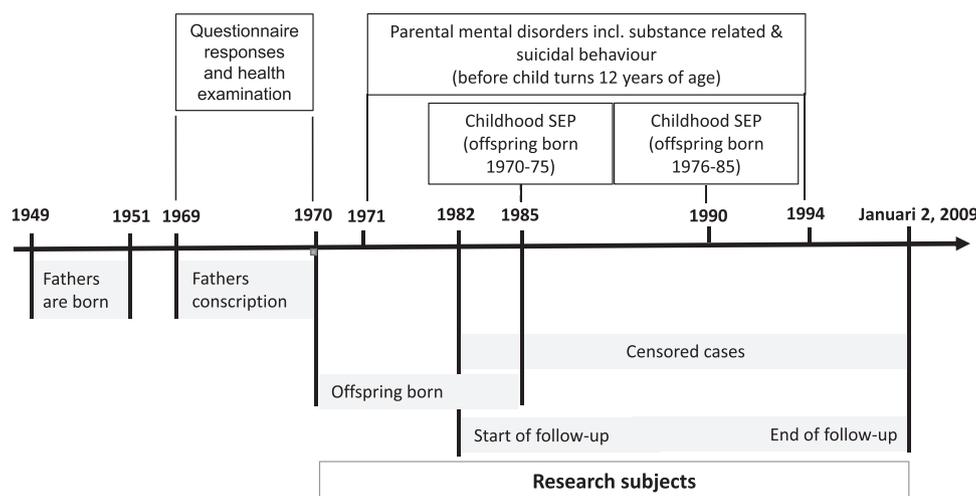


Fig. 1. Timeline of the cohort of 64 710 Swedish citizens born between 1970 and 1985 whose fathers participated in conscription in 1969/70. The timeline shows when the fathers were born, when they were conscripted and completed surveys, when their offspring were born and the time-span of follow-up through record linkage with the National Cause of Death Register and the National Hospital Discharge Register.

2.1. Measurements

2.1.1. Exposure variables

Information on the father's alcohol consumption, frequency of intoxication and being apprehended for drunkenness was measured by questionnaire responses at fathers' conscription (Larsson et al., 2002).

Volume of consumption in quintiles was measured with a frequency and quantity scale and summed into grams of 100% alcohol consumed per week, and coded into five quintiles plus a sixth category consisting of abstainers. **Frequency of intoxication** was measured using the question "How often do you drink to the extent of feeling drunk?" and subdivided into four categories: 'Abstainers', 'Consumer but no intoxication', 'Been intoxicated rarely' and 'Been intoxicated quite often/often'. **Apprehended for drunkenness** was measured by the question: "Have you ever been apprehended for drunkenness?". This question yielded four categories: 'Abstainers', 'Consumer but never been apprehended for drunkenness', 'Apprehended for drunkenness once' and 'Apprehended for drunkenness several times'.

Alcohol-related disorders that led to hospitalisation or mortality in the father before the child was 12 years were used both as an exposure and a covariate, which allowed us to adjust for fathers' alcohol-related disorders in the analyses of the other three exposure variables. Information on mortality was obtained by record linkage with the National Cause of Death Register, and alcohol-related diagnoses by record linkage with the National Hospital Discharge Register (ICD-8): 291, 303, 571.0–571.01, 980; (ICD-9): 291, 303, 305 A, 357 F, 425 F, 535D, 571A-D, 790D, 980; (ICD-10): E24.4, F10, G31.2, G62.1, G72.1, I42.6, K29.2, K70, K85.2, K86, O35.4, T51, X45, X65, Z50.2, Z71.4, Z72.1, Y90, Y91, (see [Supplementary Material](#) for the diagnoses).

2.1.2. Outcome variable

Information on hospitalisation and mortality among offspring owing to **substance-related disorders** was obtained by record linkage with the National Cause of Death Register and with the National Hospital Discharge Register. We included alcohol- and drug-related diagnoses from ICD-8/9/10. Drug-related disorders; ICD-8: 304, 965, 967.0, 970.0, 971; ICD-9: 304, 305X, 965A, 967A 969G, 969H, 969X; ICD-10: F11-F16, F18, F19, T40, T43.6, (see [Supplementary Material](#) for the diagnoses). The same ICD-codes as for the fathers were used for alcohol-related disorders. The follow-up period started when the child turned 12 years and ended at 40 years of age, death, or end of follow-up in January 2009.

2.1.3. Covariates

As covariates we included a number of risk factors for substance-related disorders in offspring that tend to co-occur with problematic parental alcohol use.

Low emotional control was measured among the fathers at conscription and was rated by a psychologist. This is a dichotomous variable where 1 stands for the subject suffering from reduced functions due to psychosomatic symptoms, low tolerance to stress and/or anxiety, problems controlling nervousness and aggression, and incapacity for emotional commitment corresponding to the lowest 30% in a Gaussian distribution of general emotional control. The measure **psychiatric diagnosis** was also issued at conscription, by a psychiatrist, according to ICD-8 and is likewise a dichotomous variable (Larsson et al., 2002).

Childhood SEP was retrieved from the 1985 and 1990 census and measured according to the father's socioeconomic classification of occupational class: unskilled workers, skilled workers, low-level non-manual employees, intermediate non-manual employees, high-level non-manual employees and self-employed. In the analyses "lowest SEP" represents unskilled workers. For offspring born between 1970 and 1975 the 1985 census was used, and for offspring born between 1976 and 1985 we used the 1990 census.

Mental disorders among both father and mother were obtained by record linkage with the National Hospital Discharge Register and

National Cause of Death Register, for the time before the child was 12 years of age. Suicide attempts and mortality diagnoses were collected according to ICD-8/9/10 (ICD-8/9: E950–E959, E980–E989; ICD-10: X60–X84, Y10–Y34). Common mental disorders included affective disorders (mood disorders); ICD-8: 296, 300.4; ICD-9: 296, 311; ICD-10: F30–F39 and nervous or stress-related disorders; ICD-8: 300, 305, 307; ICD-9: 300, 306, 308, 309; ICD-10: F40–F48.

Substance-related disorders among both father and mother included alcohol- and drug-related disorders, corresponding to the ICD codes used to define offspring alcohol- and drug-related diagnoses.

2.2. Statistical analysis

Cox regression models were used to estimate Hazard ratios (HRs) and 95% confidence intervals, for the associations between fathers' alcohol use and substance-related disorders among offspring. We also analysed Schoenfeld residuals and used logrank test to verify that the proportional hazards assumptions were not violated.

Person-time was calculated from the time the individual turned 12 years of age until the first event of substance-related hospitalisation or mortality, 40 years old, death or end of follow-up in 2009. The analysis was carried out on 64 710 men and women, all of whom had information on all variables included in the fully adjusted analysis.

First, we estimated the association between the four exposures – father's volume of consumption in quintiles, frequency of intoxication, occurrence of being apprehended for drunkenness and alcohol-related disorders – and substance-related disorders among offspring. The models were adjusted for offspring sex and year of birth. Next, we estimated the attenuation in these associations following additional adjustments for covariates in four separate models: (model 2) risk factors measured at conscription – father's psychiatric diagnosis and low emotional control; (model 3) childhood SEP; (model 4) parental suicide attempts and suicide and common mental disorders; (model 5) parental alcohol- and substance-related disorders. For the exposure "alcohol-related disorders among the fathers", the fifth model did not include alcohol-related disorders in the father.

We used the vce (cluster) option in STATA version 16 to account for the fact that the offspring were clustered on the fathers. This procedure relaxes the usual assumption of independence between observations and affects the standard errors but not the estimates.

3. Results

3.1. Descriptive statistics

Among the offspring, 52% were male, 48% female (Table 1). During follow-up, 1869 cases of substance-related disorders were recorded among offspring, corresponding to a prevalence of 3%. Among the offspring with a substance-related disorder, 4% had fathers who reported abstinence, 89% had fathers who reported being alcohol consumers but without an alcohol-related disorder, while the remaining 7% had a father with an alcohol-related disorder (Table 2).

Table 1
Descriptive statistics for the offspring.

	Number of research subjects		Alcohol-related disorders		Drug-related disorders		Substance ^a -related disorders	
	n	%	n	%	n	%	n	%
Total	64710	100	1326	2,0	788	1,2	1869	2,9
Men	33336	52	771	2,3	470	1,4	1086	3,3
Women	31374	48	555	1,8	318	1,0	783	2,5

^a Alcohol- and drug related disorders

Table 2
Distribution of substance-related disorders among offspring to fathers with and without alcohol-related disorders.

Fathers alcohol-related disorders	Offspring's substance-related disorders	
	n = 1869	%
Abstainers (ref.)	74	4
Consumer without alcohol-related disorder	1665	89
Consumer with alcohol-related disorder	130	7

3.1.1. Descriptive statistics for offspring across categories of fathers' alcohol consumption

Among all offspring, 6% had a father who reported abstinence (Table 3), 19% had a father who reported high alcohol consumption (i.e. the highest quintile), 14% had a father who reported being intoxicated quite often or often and 2% had a father who reported being apprehended for drunkenness several times. Finally, 2% had a father with an alcohol-related disorder.

SEP was measured in the offspring's childhood. Of all offspring, 20% belonged to the lowest category (out of 6 categories) (Table 3); 16% of those with fathers reporting abstinence belonged to this same category, whereas 20% of the offspring whose fathers reported high alcohol intake or high frequency of intoxication belonged to this lowest SEP group. The percentage was even higher among offspring with fathers who had been apprehended for drunkenness (24%) or had an alcohol-related disorder (22%).

Ten percent of all offspring had fathers who had received a psychiatric diagnosis at conscription and 28% had a father considered to have low emotional control at conscription. Among offspring whose fathers had been apprehended for drunkenness several times the prevalence for these risk factors were much higher.

Mental and substance-related disorders on the father's and mother's side ranged between 1% and 3% prevalence among all offspring. A higher prevalence of these risk factors was observed among offspring whose fathers reported high alcohol intake or high frequency of intoxication and especially among offspring whose fathers had been apprehended for drunkenness or had an alcohol-related disorder.

As mentioned earlier, 3% of all offspring had a substance-related disorder. Among the offspring whose fathers reported abstinence, 2% had a substance-related disorder and among offspring whose fathers reported high alcohol intake and frequent intoxication, 4% had a substance-related disorder. The highest prevalence was found among

the offspring whose fathers had been apprehended for drunkenness several times, or had an alcohol-related disorder, where 9% of the offspring had a substance-related disorder.

3.2. The association between different dimensions of father's alcohol use and risk of substance related disorders among offspring

Fathers' volume of alcohol consumption was positively and gradually associated with risk of substance-related disorders in offspring (Table 4). The risk ranged between HR= 1.11 (CI 0.84–1.45) for the lowest drinking quintile and HR=2.02 (CI 1.56–2.62) for the highest drinking quintile. Adjustments for childhood SEP and parental substance-related disorders had the strongest attenuating effects on the associations. In the fully adjusted model, those with fathers in the highest alcohol consumption quintile still had a 63% higher risk (HR=1.63 CI 1.26–2.12) compared to those whose fathers reported abstinence. Meaning, that just under 40% of the associations was explained by the included covariates.

Likewise, as the father's intoxication frequency increased, there was a gradual increase of risk for substance-related disorders in the offspring. In the fully adjusted model for those whose fathers reported frequent intoxication, the risk was 49% higher (HR=1.49 CI 1.14–1.95) compared to those whose fathers reported abstinence – corresponding to an attenuation of 40%, compared to the minimally adjusted model (Model 1).

Offspring with fathers who had been apprehended for drunkenness, also displayed a gradually increased risk for substance-related disorders: HR=2.21 (CI 1.65–2.94) for offspring of fathers who been apprehended for drunkenness once and HR=4.28 (CI 3.12–5.86) if he was apprehended for drunkenness several times. Adjustments for covariates slightly attenuated the HRs; the model including parental substance-related disorders had the strongest attenuating effects on the associations. In the fully adjusted model, there was still a more than two-fold higher risk for offspring to have a substance-related disorder if the father had been apprehended for drunkenness as compared to those whose fathers reported abstinence. Implying that the association was attenuated by almost 60% after adjustment for all covariates.

Offspring exposed to fathers with alcohol-related disorders revealed the highest risk for substance-related disorder among the offspring HR=4.47 (CI 3.31–6.03) relative to those whose fathers reported abstinence. The model including parental mental disorders had the most attenuating effect on the HRs. However, in the fully adjusted model, offspring exposed to fathers with alcohol-related disorders still had a

Table 3
Descriptive statistics for offspring across categories of fathers' alcohol consumption.

	All offspring		Offspring with abstaining fathers		Offspring with fathers in highest alcohol consumption quintile		Offspring whose fathers had been intoxicated quite often/often		Offspring whose fathers had been apprehended for drunkenness several times		Offspring whose fathers had an alcohol-related disorder	
	n	%	n	%	n	%	n	%	n	%	n	%
Number of offspring	64710	100	3664	6	12001	19	8869	14	1172	2	1452	2
Lowest SEP	11404	20	602	16	2355	20	1747	20	286	24	315	22
Measured at conscription among fathers												
Psychiatric diagnosis	6751	10	395	11	2272	19	1647	19	534	46	433	30
Low emotional control	17933	28	1007	27	4850	40	3619	41	781	67	743	51
Disorders among fathers												
Alcohol-related disorders	1470	2	18	0	609	5	376	4	226	19	1452	100
Drug-related disorders	409	1	4	0	190	2	125	1	83	7	231	16
Suicide attempts	768	1	14	0	283	2	150	2	100	9	396	27
Common mental disorders	1027	2	54	1	252	2	168	2	50	4	290	20
Disorders among mothers												
Alcohol-related disorders	356	1	11	0	99	1	67	1	23	2	62	4
Drug-related disorders	321	1	14	0	102	1	71	1	32	3	42	3
Suicide attempts	798	1	24	1	247	2	167	2	37	3	81	6
Common mental disorders	1635	3	93	3	427	4	273	3	71	6	143	10
Offspring outcome												
Substance-related disorders	1869	3	74	2	497	4	328	4	104	9	130	9

Table 4

Cox regression analysis to assess the association between father's alcohol use and substance-related disorders among offspring. All models adjusted for offspring sex and year of birth.

	Model 1, adjusted for sex and year of birth		Model 2, risk factors at conscription ^a			Model 3, childhood SEP		Model 4, parental mental disorders ^b			Model 5, parental substance-rel disorders ^c		Fully adjusted Model		
	HR ^d	95% CI		HR	95% Conf. interval		HR	95% CI		HR	95% CI		HR	95% CI	
Volume of consumption															
<i>Abstainers (ref.)</i>	1.00			1.00			1.00			1.00			1.00		
1	1.11	0.84	1.45	1.13	0.86	1.48	1.09	0.83	1.43	1.10	0.84	1.44	1.09	0.83	1.43
2	1.30	0.99	1.70	1.33	1.02	1.73	1.27	0.97	1.66	1.30	0.99	1.69	1.28	0.98	1.67
3	1.35	1.04	1.77	1.39	1.06	1.81	1.33	1.02	1.73	1.33	1.02	1.74	1.32	1.01	1.72
4	1.41	1.09	1.84	1.43	1.10	1.86	1.35	1.04	1.76	1.39	1.06	1.80	1.36	1.05	1.78
5	2.02	1.56	2.62	1.91	1.47	2.47	1.82	1.40	2.36	1.90	1.46	2.46	1.84	1.42	2.38
Freq. of intoxication															
<i>Abstainers (ref.)</i>	1.00			1.00			1.00			1.00			1.00		
<i>Consumer never intox.</i>	1.15	0.86	1.53	1.17	0.87	1.56	1.14	0.86	1.52	1.14	0.85	1.52	1.12	0.84	1.50
<i>Rarely</i>	1.41	1.10	1.81	1.43	1.11	1.83	1.35	1.06	1.74	1.38	1.08	1.77	1.36	1.06	1.74
<i>Often/quite often</i>	1.81	1.38	2.36	1.69	1.30	2.23	1.65	1.26	2.15	1.72	1.32	2.25	1.66	1.27	2.17
Appreh. For drunkenness															
<i>Abstainers (ref.)</i>	1.00			1.00			1.00			1.00			1.00		
<i>Consumer never appreh.</i>	1.33	1.03	1.70	1.34	1.05	1.72	1.29	1.00	1.65	1.31	1.02	1.68	1.30	1.01	1.66
<i>Apprehended once</i>	2.21	1.65	2.94	2.10	1.57	2.80	1.95	1.46	2.61	2.04	1.53	2.73	1.97	1.48	2.63
<i>Apprehended ≥ twice</i>	4.28	3.12	5.86	3.56	2.57	4.92	3.29	2.39	4.54	3.62	2.63	4.98	3.15	2.28	4.36
Alcohol-related disorders ^e															
<i>Abstainers (ref.)</i>	1.00			1.00			1.00			1.00			1.00		
<i>Consumer no alc-rel disorder</i>	1.36	1.06	1.75	1.37	1.07	1.76	1.32	1.03	1.69	1.36	1.06	1.74	1.36	1.06	1.74
<i>Alcohol-related disorder</i>	4.47	3.31	6.03	3.96	2.92	5.37	3.23	2.38	4.39	2.89	2.08	4.00	3.67	2.66	5.05

^a Low emotional control and psychiatric diagnosis

^b Parental suicide attempts including mortality and common mental disorders

^c Parental alcohol and drug related disorders

^d Hazard ratios

^e For this exposure, father's alcohol-related disorders are not included in model 5.

more than a two-fold increased risk for substance-related disorders, indicating that almost 70% of the association was explained by the included covariates.

4. Discussion

This study made use of a rare possibility to assess how the risk of substance-related disorders in offspring is distributed across different dimensions of father's alcohol use: from self-reported sub-clinical alcohol use, via indicators of more problematic drinking (e.g. to clinically diagnosed alcohol-related disorders).

Our results revealed that all levels of father's alcohol use were significantly associated with an increased risk of substance-related disorders in the offspring. In other words, offspring to fathers who had reported moderate alcohol use also showed an increased risk for substance-related disorders. For instance, relative to offspring with abstaining fathers, offspring to father's who reported low to moderate levels of alcohol use (quintile 1–4) had a 10–40% higher risk of being diagnosed with a substance-related disorder, whereas the risk was doubled among offspring with fathers who reported the highest alcohol consumption (quintile 5). Offspring with fathers who had been intoxicated rarely to quite often, ran a 40–80% higher risk of substance-related disorder compared to those whose fathers reported abstinence. The highest risk, more than quadruple the risk for those with abstaining fathers, was found among offspring whose fathers had an alcohol-related disorder or had been apprehended for drunkenness more than once. Our results are in line with previous studies demonstrating a link between parental alcohol use and long-term negative outcomes in offspring, such as alcohol-related disorders or morbidity and mortality (Hemmingsson et al., 2017; Holst et al., 2019; Landberg et al., 2018, 2019). However, our study adds to previous findings by demonstrating that several dimensions of father's alcohol use, also at levels below clinically diagnosed alcohol problems, is associated with substance-related disorders among offspring. It also confirms this pattern among both daughters and

sons.

To assess to what extent the associations could be attributed to a clustering of other risk factors measured in childhood, we adjusted for a number of covariates. In line with previous research, childhood SEP attenuated the associations between father's alcohol use and substance-related disorders in their offspring (Gauffin et al., 2013; Maggs et al., 2008; Probst et al., 2014). Moreover, a substantial proportion of the association between parental alcohol use and adverse outcomes for offspring has been shown to be attributed to parental comorbidity (Holst et al., 2019; Park and Schepp, 2015). In line with this, adjustment for risk factors at conscription (fathers' low emotional control and psychiatric diagnoses), mental disorders among both mother and father, and parental alcohol- and substance-related disorders resulted in attenuations of the association between father's alcohol use at all levels, and substance-related disorders in the offspring. Adjustment for all covariates accounted for about half of the associations between the indicators of father's alcohol use and offspring's substance-related disorders. Still, the finding that a substantial part of the risk for substance-related disorders in the offspring remained, implies that the studied indicators of fathers' alcohol use have an independent effect on this outcome.

In a recent study based on the same cohort, fathers' alcohol use was linked to an increased risk of suicidal behaviour among offspring (Landberg et al., 2019). In line with our study, several levels of father's alcohol use were significantly associated with offspring suicidal behaviour. In contrast to the present study, however, the increased risk of suicidal behaviour only remained among offspring to fathers with the heaviest consumption after adjustments of risk factors.

Our findings revealed that while the highest risk of substance-related disorders was found among offspring to fathers with alcohol-related disorders, the larger group of offspring whose fathers' drinking was at sub-clinical levels, still accounted for a majority of all cases of substance-related disorders among offspring. Hence the findings in this study have important implications for public health policy.

That is, in order to address the majority of substance-related

disorders in offspring attributed to parental drinking, prevention efforts should not only be aimed at offspring to parents with clinically diagnosed alcohol-related disorders but also be complemented with universal policy measures that control the level of total alcohol consumption.

4.1. Strengths and limitations

This study is based on a cohort of offspring to a full cohort of men that participated in compulsory military training in 1969/70. At the time, few men were exempted from conscription, making the risk of selection bias minimal. In addition, the prospective design means the exposure was collected long before the outcome occurred. These factors help ensure that potential systematic errors are small and potential misclassifications of outcome and exposure are non-differential, which is preferable in epidemiological research (Aschengrau, 2008). Both cohorts have now been linked with the National Cause of Death Register, and the National Hospital Discharge Register, enabling us to include several covariates measured in the offspring's childhood. This is important in view of the fact that a variety of mechanisms are believed to influence family transmission of alcohol use (Johnson and Leff, 1999), which could possibly mediate or confound the relationship between parental alcohol consumption and adverse outcome in the offspring.

One of the limitations of our study is that the father's alcohol consumption was measured in early adulthood. Seeing as alcohol use tends to fluctuate over a person's life, the variables we used do not measure the actual exposure of father's alcohol use during the offspring's childhood. However, there is evidence of associations between adolescent alcohol consumption and subsequent drinking (McBride et al., 2016; Merline et al., 2008), making the measure of the father's alcohol consumption in youth a relatively good indicator of alcohol consumption in the offspring's childhood. In addition, and in contrast to other similar studies (Hemmingsson et al., 2017), it was the fathers themselves who reported their alcohol consumption, not the offspring, increasing the accuracy of this variable.

Another limitation of this study is the lack of measures of parenting behaviour or other risk or protective factors that affect children (Mares et al., 2011; Yap et al., 2017). Also, it was not possible to perform a mediation analysis with the current data; some of the controlled-for variables (in particular childhood SEP) may partially mediate the links between the father's alcohol behaviour and offspring's substance-related disorders. It is not possible to fully determine which of the covariates are truly mediators or confounders. These circumstances may have contributed to an over-adjustment of the associations, and hence to underestimations of the true associations.

5. Conclusions

All studied dimensions of father's alcohol use were associated with increased risk of substance-related disorders among the offspring. The highest risk was found among offspring to fathers with more severe indicators of alcohol use, such as alcohol-related disorders. However, offspring whose fathers reported lower levels of alcohol use also showed an increased risk for substance-related disorders. Moreover, although the associations to a large extent were explained by other risk factors in childhood, all indicators of fathers' alcohol use were independently associated with increased risks of substance-related disorders among offspring. Despite the lower risk found among offspring whose fathers reported sub-clinical drinking when compared to those with alcohol-related disorders, the former group accounts for a much larger proportion of all cases of offspring substance-related disorders in the population, prompting universal prevention efforts targeting the level of total alcohol consumption in society.

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CRediT authorship contribution statement

Thor, S conceptualized the study, conducted the data analysis and interpreted the data, draughted the article, and approved the final version. Landberg, J conceptualized the study, interpreted the data, draughted the article, and approved the final version. Hemmingsson, T conceptualized the study, acquired the data, participated in the interpretation of data, revised the article, and approved the final version. Danielsson, AK conceptualized the study, participated in the interpretation of data, revised the article, and approved the final version.

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Conflict of interest

None.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.drugalcdep.2022.109354](https://doi.org/10.1016/j.drugalcdep.2022.109354).

References

- Adalbjarnardottir, S., Rafnsson, F.D., 2001. Perceived control in adolescent substance use: concurrent and longitudinal analyses. *Psychol. Addict. Behav.: J. Soc. Psychol. Addict. Behav.* 15 (1), 25–32.
- Alati, R., Baker, P., Betts, K.S., Connor, J.P., Little, K., Sanson, A., Olsson, C.A., 2014. The role of parental alcohol use, parental discipline and antisocial behaviour on adolescent drinking trajectories. *Drug Alcohol Depend.* 134, 178–184.
- Aschengrau, A., 2008. *Essentials of Epidemiology In Public Health*, Second Ed. Jones and Bartlett Publishers, Sudbury, Mass.
- Bailey, J.A., Hill, K.G., Oesterle, S., Hawkins, J.D., 2006. Linking substance use and problem behavior across three generations. *J. Abnorm. Child Psychol.* 34 (3), 263–292.
- Capaldi, D.M., Tiberio, S.S., Kerr, D.C., Pears, K.C., 2016. The relationships of parental alcohol versus tobacco and marijuana use with early adolescent onset of alcohol use. *J. Stud. Alcohol Drugs* 77 (1), 95–103.
- Casswell, S., You, R.Q., Huckle, T., 2011. Alcohol's harm to others: reduced wellbeing and health status for those with heavy drinkers in their lives. *Addiction* 106 (6), 1087–1094.
- Castillo-Carniglia, A., Keyes, K.M., Hasin, D.S., Cerda, M., 2019. Psychiatric comorbidities in alcohol use disorder. *Lancet Psychiatry* 6 (12), 1068–1080.
- Christoffersen, M.N., Soothill, K., 2003. The long-term consequences of parental alcohol abuse: a cohort study of children in Denmark. *J. Subst. Abuse Treat.* 25 (2), 107–116.
- Davis, L., Uezato, A., Newell, J.M., Frazier, E., 2008. Major depression and comorbid substance use disorders. *Curr. Opin. Psychiatry* 21 (1), 14–18.
- Dube, S.R., Anda, R.F., Felitti, V.J., Edwards, V.J., Croft, J.B., 2002. Adverse childhood experiences and personal alcohol abuse as an adult. *Addict. Behav.* 27 (5), 713–725.
- Duncan, S.C., Gau, J.M., Duncan, T.E., Strycker, L.A., 2011. Development and correlates of alcohol use from ages 13–20. *J. Drug Educ.* 41 (3), 235–252.
- Gauffin, K., Hemmingsson, T., Hjern, A., 2013. The effect of childhood socioeconomic position on alcohol-related disorders later in life: a Swedish national cohort study. *J. Epidemiol. Community Health* 67 (11), 932–938.
- Guttmanova, K., Hill, K.G., Bailey, J.A., Hartigan, L., Small, C.M., Hawkins, J.D., 2017. Parental alcohol use, parenting, and child on-time development. *Infant Child Dev.* 26, 5.
- Hemmingsson, T., Danielsson, A.K., Falkstedt, D., 2017. Fathers' alcohol consumption and risk of alcohol-related hospitalization in offspring before 60 years of age. *Drug Educ. Prev. Policy* 24 (1), 3–8.
- Holst, C., Tolstrup, J.S., Sorensen, H.J., Pisinger, V.S.C., Becker, U., 2019. Parental alcohol use disorder with and without other mental disorders and offspring alcohol use disorder. *Acta Psychiatr. Scand.* 139 (6), 508–517.

- Johnson, J.L., Leff, M., 1999. Children of substance abusers: overview of research findings. *Pediatrics* 103 (5 Pt 2), 1085–1099.
- Jääskeläinen, M., Holmila, M., Notkola, I.L., Raitasalo, K., 2016. Mental disorders and harmful substance use in children of substance abusing parents: a longitudinal register-based study on a complete birth cohort born in 1991. *Drug Alcohol Rev.* 35 (6), 728–740.
- Kuppens, S., Moore, S.C., Gross, V., Lowthian, E., Siddaway, A.P., 2019. The enduring effects of parental alcohol, tobacco, and drug use on child well-being: a multilevel meta-analysis. *Dev. Psychopathol.* 1–14.
- Landberg, J., Danielsson, A.K., Falkstedt, D., Hemmingsson, T., 2018. Fathers' alcohol consumption and long-term risk for mortality in offspring. *Alcohol Alcohol.* 53 (6), 753–759.
- Landberg, J., Danielsson, A.K., Hemmingsson, T., 2019. Fathers' alcohol use and suicidal behaviour in offspring during youth and young adulthood. *Acta Psychiatr. Scand.*
- Larsson, D., Hemmingsson, T., Allebeck, P., Lundberg, I., 2002. Self-rated health and mortality among young men: what is the relation and how may it be explained? *Scand. J. Public Health* 30 (4), 259–266.
- Laslett, A.M., Room, R., Ferris, J., Wilkinson, C., Livingston, M., Mugavin, J., 2011. Surveying the range and magnitude of alcohol's harm to others in Australia. *Addiction* 106 (9), 1603–1611.
- Latendresse, S.J., Rose, R.J., Viken, R.J., Pulkkinen, L., Kaprio, J., Dick, D.M., 2008. Parenting mechanisms in links between parents' and adolescents' alcohol use behaviors. *Alcohol Clin. Exp. Res.* 32 (2), 322–330.
- Lund, I.O., Bukten, A., Storrø, E.E., Moan, I.S., Skurtveit, S., Handal, M., Nordfjærn, T., Brunborg, G.S., Rossow, I., 2015. A cohort study on long-term adverse effects of parental drinking: background and study design. *Subst. Abus.: Res. Treat.* 9 (Suppl 2), 77–83.
- Maggs, J.L., Patrick, M.E., Feinstein, L., 2008. Childhood and adolescent predictors of alcohol use and problems in adolescence and adulthood in the national child development study. *Addiction* 103 (Suppl 1), 7–22.
- Makela, P., Paljarvi, T., 2008. Do consequences of a given pattern of drinking vary by socioeconomic status? A mortality and hospitalisation follow-up for alcohol-related causes of the Finnish drinking habits surveys. *J. Epidemiol. Community Health* 62 (8), 728–733.
- Mares, S.H., van der Vorst, H., Engels, R.C., Lichtwarck-Aschoff, A., 2011. Parental alcohol use, alcohol-related problems, and alcohol-specific attitudes, alcohol-specific communication, and adolescent excessive alcohol use and alcohol-related problems: an indirect path model. *Addict. Behav.* 36 (3), 209–216.
- McBride, O., Cheng, H.G., Slade, T., Lynskey, M.T., 2016. The role of specific alcohol-related problems in predicting depressive experiences in a cross-sectional national household survey. *Alcohol Alcohol.* 51 (6), 655–663.
- Merline, A., Jager, J., Schulenberg, J.E., 2008. Adolescent risk factors for adult alcohol use and abuse: stability and change of predictive value across early and middle adulthood. *Addiction* 103 (Suppl 1), 84–99.
- Park, S., Schepp, K.G., 2015. A systematic review of research on children of alcoholics: their inherent resilience and vulnerability. *J. Child Fam. Stud.* 24 (5), 1222–1231.
- Pedersen, W., von Soest, T., 2013. Socialization to binge drinking: a population-based, longitudinal study with emphasis on parental influences. *Drug Alcohol Depend.* 133 (2), 587–592.
- Pisinger, V.S.C., Holst, C.A., Bendtsen, P., Becker, U., Tolstrup, J.S., 2017. Perceived parental alcohol problems and drinking patterns in youth: a cross-sectional study of 69,030 secondary education students in Denmark. *Prev. Med.* 105, 389–396.
- Probst, C., Roerecke, M., Behrendt, S., Rehm, J., 2014. Socioeconomic differences in alcohol-attributable mortality compared with all-cause mortality: a systematic review and meta-analysis. *Int. J. Epidemiol.* 43 (4), 1314–1327.
- Ramstedt, M., Sundin, E., Moan, I.S., Storrø, E.E., Lund, I.O., Bloomfield, K., Hope, A., Kristjansson, S., Tigerstedt, C., 2015. Harm experienced from the heavy drinking of family and friends in the general population: a comparative study of six Northern European countries. *Subst. Abus.: Res. Treat.* 9 (Suppl 2), 107–118.
- Rich, S.J., Martin, P.R., 2014. Co-occurring psychiatric disorders and alcoholism. *Handb. Clin. Neurol.* 125, 573–588.
- Rossow, I., Felix, L., Keating, P., McCambridge, J., 2016a. Parental drinking and adverse outcomes in children: a scoping review of cohort studies. *Drug Alcohol Rev.* 35 (4), 397–405.
- Rossow, I., Keating, P., Felix, L., McCambridge, J., 2016b. Does parental drinking influence children's drinking? A systematic review of prospective cohort studies. *Addiction* 111 (2), 204–217.
- Stinson, F.S., Grant, B.F., Dawson, D.A., Ruan, W.J., Huang, B., Saha, T., 2005. Comorbidity between DSM-IV alcohol and specific drug use disorders in the United States: results from the national epidemiologic survey on alcohol and related conditions. *Drug Alcohol Depend.* 80 (1), 105–116.
- Yap, M.B.H., Cheong, T.W.K., Zaravinos-Tsakos, F., Lubman, D.I., Jorm, A.F., 2017. Modifiable parenting factors associated with adolescent alcohol misuse: a systematic review and meta-analysis of longitudinal studies. *Addiction* 112 (7), 1142–1162.